SEQUENCE LISTING

<110> CODEXIS, INC.

<120> ENGINEERED IMINE REDUCTASES AND METHODS FOR THE REDUCTIVE AMINATION OF KETONE AND AMINE COMPOUNDS

<130> CX2-186WO1

<140>
<141> 2020-04-23

<150> US 62/841,633
<151> 2019-05-01

<160> 802

<210> 1
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon optimized Norvaline dehydrogenase from Arthrobacter sp

<400> 1
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gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gaacgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 2
<211> 359
<212> PRT
<213> Arthrobacter sp. strain 1C

<400> 2
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly

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1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val Asn Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 3
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 3
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gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 4
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 4
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile

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                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 5
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 5
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gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatgttg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
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ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 6
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 6
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Val Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
275 280 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys

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                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 7
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 7

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gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtacggg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 8
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 8

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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
```

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Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Arg Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 9
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 9
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gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240

attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccattagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 10
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 10
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Ile Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Leu Glu
210 215 220

```
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 11
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 11
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gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatgcgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
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<210> 12
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 12
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Ala Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275   280   285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 13
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 13
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattggctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaggcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 14
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 14
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro

```
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Trp Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 15
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 15
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
```

tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 16
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 16
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn

```
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 17
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 17
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtacgtg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 18
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 18
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
```

```
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Arg Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 19
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 19
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatattg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 20
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 20
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175

```
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Ile Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 21
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 21
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatggtg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 22
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 22
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Gly Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275   280   285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335

Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 23
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 23
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattattctg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 24
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 24
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu

65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
275 280 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 25
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 25
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300

gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatgacg 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 26
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 26
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Thr
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu

```
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 27
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 27
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtactgg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 28
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 28
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Leu Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275   280   285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 29

<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 29
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
acgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 30
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 30
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125

```
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Thr Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 31
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 31
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgttagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
```

cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 32
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 32
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Val Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
275 280 285

```
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 33
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 33
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatctgg aggggatgac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 34
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 34
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
```

```
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Leu Glu
    210                 215                 220
Gly Met Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 35
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 35
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgaggcgcc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattatctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 36
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 36
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Ala Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr

```
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Tyr Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 37
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 37
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 38
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 38
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala

```
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 39
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 39
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gaaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 40
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 40
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
```

```
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 41
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 41
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360

atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 42
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 42
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240

```
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 43
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 43
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 44
<211> 359
<212> PRT
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 44
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 45
<211> 1077

<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 45
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggtgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 46
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 46
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser

```
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Val Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 47
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 47
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtatatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
```

gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 48
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 48
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Tyr Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
275 280 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro

```
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 49
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 49
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 50
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 50
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
```

```
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 51
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 51

atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 52
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 52
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190

```
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 53
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 53
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 54
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 54
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350

Gly Ile Arg Ser Ala Val Glu
        355

<210> 55
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 55
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag   1077

<210> 56
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 56
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala

```
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 57
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 57
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420

acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 58
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 58
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys

```
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 59
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 59
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 60
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 60
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 61
<211> 1077
<212> DNA

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 61
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 62
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 62
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140

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Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
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<210> 63
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 63
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
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cgcggcattg cgggacctaa gaaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 64
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 64
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
275 280 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300

Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Glu Ile Arg Ser Ala Val Glu
355

<210> 65
<211> 1078
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 65
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taaagaagtg ctgttgag 1078

<210> 66
<211> 358
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 66
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala

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        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Lys Lys Cys Cys
        355
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<210> 67
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 67
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60

gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 68
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 68
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu

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        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 69
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 69
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gaaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 70

<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 70
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Asn
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu

355

<210> 71
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 71
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 72
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 72
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95

```
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 73
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 73
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
```

tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 74
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 74
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255

```
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 75
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 75
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 76
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 76
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 77
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 77
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag   1077

<210> 78
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 78
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp

```
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 79
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 79
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gaaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
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ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 80
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 80
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp

```
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 81
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 81
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 82
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 82
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
```

```
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 83
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 83
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120

aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 84
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 84
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205

```
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 85
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 85
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttaccg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 86
<211> 359

<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 86
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Thr Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 87
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 87
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 88
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 88
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr

```
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 89
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 89
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
```

cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gaaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 90
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 90
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu

```
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 91
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 91
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 92
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 92

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 93
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 93
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg tggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 94
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 94
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160

```
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Val Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 95
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 95
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacacttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
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gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 96
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 96
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Thr Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320

```
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 97
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 97
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 98
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 98
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
```

```
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 99
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 99
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180

cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 100
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 100
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu

```
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 101
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 101
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 102
<211> 359
<212> PRT

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 102
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 103
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 103
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 104
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 104
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110

```
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 105
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 105
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
```

atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 106
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 106
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270

```
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 107
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 107
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gaaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 108
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 108
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
```

```
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Asn
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 109
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 109
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgtcag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttaccg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag   1077

<210> 110
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 110
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Val
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile

```
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Thr Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 111
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 111
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
```

ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 112
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 112
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys

```
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 113
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 113

```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 114
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 114

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
```

```
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 115
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 115
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240

attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgattacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 116
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 116
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ile Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220

```
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 117
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 117
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gaaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 118
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 118
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 119
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 119
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 120
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 120
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro

```
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 121
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 121
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
```

tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 122
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 122
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn

```
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 123
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 123
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gaaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 124
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 124
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
```

```
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 125
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 125
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgtcgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 126
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 126
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175

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Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 127
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 127
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gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
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<210> 128
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 128
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335

Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Glu Ile Arg Ser Ala Val Glu
355

<210> 129
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 129
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 130
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 130
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu

65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Glu Ile Arg Ser Ala Val Glu
355

<210> 131
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 131
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300

gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 132
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 132
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu

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225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
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<210> 133
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 133
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gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
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<210> 134
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 134
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 135

<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 135
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 136
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 136
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125

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Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 137
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 137
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720

cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 138
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 138
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285

```
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 139
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 139
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 140
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 140
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
```

```
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 141
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 141
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttaccg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gaaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 142
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 142
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr

```
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Thr Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 143
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 143
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gaaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 144
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 144
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Asn
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala

```
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 145
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 145

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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 146
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 146

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
```

```
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 147
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 147
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360

atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 148
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 148
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240

```
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 149
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 149
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
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<210> 150
<211> 359
<212> PRT
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 150
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 151
<211> 1077

<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 151
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 152
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 152
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser

```
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 153
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 153
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780

gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 154
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 154
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro

```
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 155
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 155
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 156
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 156
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
```

```
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 157
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 157

atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 158
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 158
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190

```
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 159
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 159
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 160
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 160
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275   280   285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350

Gly Ile Arg Ser Ala Val Glu
        355

<210> 161
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 161
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 162
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 162
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala

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                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 163
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 163
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420

acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 164
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 164
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys

```
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
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<210> 165
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 165
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 166
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 166
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 167
<211> 1077
<212> DNA

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 167
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gaaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 168
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 168
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140

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Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Asn
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 169
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 169
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840

cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 170
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 170
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300

Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 171
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 171
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 172
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 172
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala

```
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 173
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 173
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60

gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gttgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 174
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 174
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu

```
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Val Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 175
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 175
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 176

<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 176
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu

355

<210> 177
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 177
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 178
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 178
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95

```
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 179
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 179
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
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tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttaccg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 180
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 180
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Thr Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255

```
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 181
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 181
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gaaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 182
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 182
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
        275   280   285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 183
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 183
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 184
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 184
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp

```
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 185
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 185
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gaaccttaac acgcgctact tcttcgagga tgtaagcacc 900
```

ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 186
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 186
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Asn
275 280 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp

```
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 187
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 187
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 188
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 188
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
```

```
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 189
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 189
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120

```
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 190
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 190

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
```

```
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 191
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 191
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 192
<211> 359

<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 192
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 193
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 193
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 194
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 194
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr

```
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 195
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 195
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540

cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 196
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 196
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu

```
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 197
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 197
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttaccg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 198
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 198

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Thr Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 199
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 199
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 200
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 200
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160

```
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 201
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 201
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gaaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
```

gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 202
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 202
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Asn
275 280 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320

```
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 203
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 203
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gaaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 204
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 204
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
```

```
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 205
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 205
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180

cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gaaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 206
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 206
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu

```
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Asn
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 207
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 207
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 208
<211> 359
<212> PRT

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 208
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 209
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 209
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 210
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 210
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110

```
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 211
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 211
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600

atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 212
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 212
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270

```
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 213
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 213
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgctact tcttcgagga tgcaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 214
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 214
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
```

```
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Ala Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 215
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 215
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 216
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 216
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile

```
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 217
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 217
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
```

ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 218
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 218
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys

```
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 219
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 219
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 220
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 220
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
```

```
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 221
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 221
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240

attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagcctcaac acgcgccact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 222
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 222
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220

```
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg His Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 223
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 223
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 224
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 224
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275   280   285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 225
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 225
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 226
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 226
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro

```
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 227
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 227
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
```

tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 228
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 228
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser

```
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 229
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 229
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 230
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 230
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
```

```
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 231
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 231
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 232
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 232
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175

```
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 233
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 233
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gaaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 234
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 234
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
        275   280   285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335

```
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 235
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 235
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggcccagca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 236
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 236
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
```

65 70 75 80
Ile Val Val Pro Ala Gln His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
275 280 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 237
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 237
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300

gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 238
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 238
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu

```
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 239
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 239
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gaaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 240
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 240
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Asn
        275   280   285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 241

<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 241
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 242
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 242
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125

```
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 243
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 243
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720

cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gaaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 244
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 244
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
275 280 285

```
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 245
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 245
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 246
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 246
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
```

```
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 247
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 247
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 248
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 248
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr

```
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 249
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 249
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 250
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 250
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala

```
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 251
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 251

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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttaccg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgccact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 252
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 252

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
```

```
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Thr Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg His Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 253
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 253
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360

atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 254
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 254
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240

```
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 255
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 255
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 256
<211> 359
<212> PRT
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 256
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275   280   285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 257
<211> 1077

<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 257
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggtggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 258
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 258
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Val Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser

```
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 259
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 259
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
```

gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 260
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 260
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro

```
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 261
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 261
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 262
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 262
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
```

```
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 263
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 263

atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgccact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 264
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 264
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190

```
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg His Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 265
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 265
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
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<210> 266
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 266
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275   280   285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350

Gly Ile Arg Ser Ala Val Glu
        355

<210> 267
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 267
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 268
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 268
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala

```
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 269
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 269
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420

acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gaaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 270
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 270
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys

```
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 271
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 271
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
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<210> 272
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 272
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275   280   285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 273
<211> 1077
<212> DNA

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 273
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 274
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 274
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140

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Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 275
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 275
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
```

cgcggcattg cgggacctaa gaaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacaccgatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 276
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 276
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300

```
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 277
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 277
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 278
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 278
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
```

```
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 279
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 279
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60

gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcac gcatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 280
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 280
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Arg Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu

```
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 281
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 281
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 282

<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 282
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275   280   285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu

355

<210> 283
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 283
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat caaccttaac acgcgccact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 284
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 284
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95

```
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg His Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 285
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 285
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
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tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gtcgtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 286
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 286
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255

```
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Val Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 287
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 287
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggtcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 288
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 288
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 289
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 289
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 290
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 290
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp

```
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 291
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 291
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gaaccttaac acgcgcttct tcttcgagga tgtaagcacc 900
```

ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 292
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 292
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Asn
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp

```
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 293
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 293
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat taaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 294
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 294
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
```

```
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 295
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 295
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120

aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gaaccttaac acgcgctact tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 296
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 296
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205

```
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Asn
        275                 280                 285
Leu Asn Thr Arg Tyr Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 297
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 297
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa aaatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgccaat tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 298
<211> 359

<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 298
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Gln Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 299
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 299
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacg tggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc ggggcgcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgccaat tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacgtagatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 300
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 300
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr

```
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Val Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ala Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Gln Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Val Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 301
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 301
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
```

cctcaatacc gtgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttctgg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgccaat tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gcagtgaatg tgcctacccc acttatcgat 960
gctgttcttg acttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 302
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 302
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Leu Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu

```
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Gln Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Asp Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 303
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 303
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 304
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 304

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 305
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 305
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 306
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 306
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160

```
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 307
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 307
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
```

gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 308
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 308
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320

Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 309
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 309
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 310
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 310
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu

```
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 311
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 311
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180

cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gagagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 312
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 312
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu

```
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 313
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 313
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcgttga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 314
<211> 359
<212> PRT

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 314
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Val
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 315
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 315
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 316
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 316
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110

```
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 317
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 317
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
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atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 318
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 318
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270

Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 319
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 319
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 320
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 320
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly

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1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
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<210> 321
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 321
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 322
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 322
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile

```
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 323
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 323
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
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ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 324
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 324
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Phe Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys

```
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 325
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 325
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gagagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 326
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 326
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
```

```
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 327
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 327
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240

attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 328
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 328
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220

Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Glu Ile Arg Ser Ala Val Glu
355

<210> 329
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 329
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 330
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 330
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Phe Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 331
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 331
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 332
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 332
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro

```
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 333
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 333
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
```

tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 334
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 334
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser

```
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 335
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 335
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 336
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 336
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
```

```
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 337
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 337
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 338
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 338
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175

```
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 339
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 339
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 340
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 340
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335

Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 341
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 341
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 342
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 342
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu

```
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 343
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 343
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300

gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 344
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 344
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu

225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Val Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 345
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 345
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 346
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 346
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 347

<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 347
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 348
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 348
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125

```
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 349
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 349
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
```

cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 350
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 350
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Phe Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285

```
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 351
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 351
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 352
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 352
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
```

```
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 353
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 353
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 354
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 354
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr

```
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 355
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 355
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggcaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 356
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 356
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala

```
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 357
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 357

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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 358
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 358

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
```

```
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 359
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 359
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360

atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 360
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 360
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240

```
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 361
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 361
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 362
<211> 359
<212> PRT
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 362
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Phe Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 363
<211> 1077

<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 363
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gagagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 364
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 364
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser

```
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Glu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 365
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 365
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gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
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gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 366
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 366
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Phe Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro

```
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 367
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 367
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 368
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 368
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
```

```
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 369
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 369

atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 370
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 370
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190

```
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 371
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 371
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 372
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 372
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350

Gly Ile Arg Ser Ala Val Glu
        355

<210> 373
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 373
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 374
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 374
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala

```
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 375
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 375
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420

acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gtgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 376
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 376
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys

```
                245                 250                 255
Glu Trp Phe Lys Val Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 377
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 377
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag   1077

<210> 378
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 378
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Phe Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 379
<211> 1077
<212> DNA

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 379
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 380
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 380
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140

```
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 381
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 381
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
```

cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 382
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 382
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300

Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 383
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 383
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 384
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 384
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala

```
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 385
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 385
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60

gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
cgtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 386
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 386
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu

```
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 387
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 387
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
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<210> 388

<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 388
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Phe Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu

355

<210> 389
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 389
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
cgtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 390
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 390
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95

```
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 391
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 391
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
```

tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gagagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 392
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 392
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255

```
Glu Trp Phe Lys Glu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 393
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 393
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
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<210> 394
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 394
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 395
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 395
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
agtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 396
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 396
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp

```
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Ser Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 397
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 397
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
```

ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 398
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 398
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Val Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp

```
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 399
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 399
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 400
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 400
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
```

```
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 401
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 401
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120

aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 402
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 402
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205

```
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 403
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 403
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
agtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 404
<211> 359

<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 404
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Ser Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 405
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 405
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 406
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 406
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr

```
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 407
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 407
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
```

cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 408
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 408
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Phe Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu

```
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 409
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 409
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 410
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 410

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 411
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 411
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtccttga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 412
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 412
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160

```
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 413
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 413
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
agtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
```

gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 414
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 414
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Phe Lys Ser Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320

Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 415
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 415
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 416
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 416
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu

```
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 417
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 417
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180

```
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 418
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 418

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
```

```
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 419
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 419
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 420
<211> 359
<212> PRT

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 420
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Phe Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 421
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 421
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 422
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 422
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110

```
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 423
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 423
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
```

atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 424
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 424
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270

Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 425
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 425
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 426
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 426
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly

```
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 427
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 427
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag   1077

<210> 428
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 428
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile

```
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 429
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 429
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
```

ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 430
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 430
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys

```
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 431
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 431

```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gtgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 432
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 432

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50                  55                  60
```

```
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Val Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 433
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 433
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240

attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gtgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 434
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 434
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220

```
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Val Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 435
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 435
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 436
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 436
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 437
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 437
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
agtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 438
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 438
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro

```
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Ser Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 439
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 439
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
```

tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 440
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 440
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Phe Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser

```
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 441
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 441
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 442
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 442
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
```

```
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 443
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 443
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 444
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 444
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175

```
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 445
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 445
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gagagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 446
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 446
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Phe Lys Glu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335

Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 447
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 447
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg agtttattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 448
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 448
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu

65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Phe Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 449
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 449
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300

gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 450
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 450
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu

225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 451
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 451
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 452
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 452
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Phe Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 453

<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 453
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 454
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 454
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125

```
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 455
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 455
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
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cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 456
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 456
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285

```
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 457
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 457
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
agtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 458
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 458
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
```

```
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Ser Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 459
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 459
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 460
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 460
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr

```
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 461
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 461
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgcctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 462
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 462
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala

```
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 463
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 463

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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 464
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 464

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
```

```
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 465
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 465
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360

atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 466
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 466
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240

```
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 467
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 467
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 468
<211> 359
<212> PRT
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 468
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Phe Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 469
<211> 1077

<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 469
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 470
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 470
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser

```
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 471
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 471
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
```

gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 472
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 472
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro

```
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 473
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 473
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 474
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 474
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
```

```
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 475
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 475

atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 476
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 476
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190

```
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 477
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 477
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgcctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 478
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 478
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350

Glu Ile Arg Ser Ala Val Glu
        355

<210> 479
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 479
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag   1077

<210> 480
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 480
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala

```
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 481
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 481
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420

acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gagagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 482
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 482
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys

```
                245                 250                 255
Glu Trp Phe Lys Glu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 483
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 483
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
cgtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 484
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 484
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Arg Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 485
<211> 1077
<212> DNA

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 485
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagttc tgttgag   1077

<210> 486
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 486
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140

```
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ser Val Glu
        355
```

<210> 487
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 487
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840

cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 488
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 488
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300

Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 489
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 489
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 490
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 490
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala

```
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 491
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 491
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60

gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 492
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 492
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu

```
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 493
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 493
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
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<210> 494

<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 494
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Phe Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu

355

<210> 495
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 495
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 496
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 496
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95

```
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
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<210> 497
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 497
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
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tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gagagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 498
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 498
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255

```
Glu Trp Phe Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 499
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 499
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gagagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
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<210> 500
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 500
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 501
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 501
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 502
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 502
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp

```
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 503
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 503
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgactacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
```

ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 504
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 504
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Thr Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp

305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 505
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 505
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
cgtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 506
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 506
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45

```
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 507
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 507
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120

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aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 508
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 508

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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
```

```
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 509
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 509
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agctatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 510
<211> 359

<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 510
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 511
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 511
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 512
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 512
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr

```
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 513
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 513
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
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cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 514
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 514
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Phe Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu

```
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 515
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 515
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg cgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 516
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 516

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Ala Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 517
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 517
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgcctacact gttaaacgct gctcgctgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 518
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 518
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145 150 155 160

```
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 519
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 519
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
```

gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 520
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 520
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320

```
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 521
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 521
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 522
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 522
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
```

```
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 523
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 523
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180

```
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gagagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 524
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 524

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
```

```
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 525
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 525
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
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<210> 526
<211> 359
<212> PRT

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 526
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 527
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 527
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gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 528
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 528
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110

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Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 529
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 529
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
```

atgcacccgc tgcctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 530
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 530
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270

```
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 531
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 531
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gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
agtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 532
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 532
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
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1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Ser Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 533
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 533
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gtgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag   1077

<210> 534
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 534
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile

```
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Val Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 535
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 535
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gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
agtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
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ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 536
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 536
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Phe Lys Ser Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys

```
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 537
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 537
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 538
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 538
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50                  55                  60
```

```
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 539
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 539
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240

attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 540
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 540
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220

```
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 541
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 541
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 542
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 542
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 543
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 543
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtactgg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gagagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 544
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 544
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro

```
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Leu Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 545
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 545
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtactgg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660

tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 546
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 546
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Leu Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser

```
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 547
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 547
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 548
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 548
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
```

```
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 549
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 549
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 550
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 550
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175

```
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ser Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 551
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 551
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 552
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 552
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335

```
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 553
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 553
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 554
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 554
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
```

```
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 555
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 555
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300

gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 556
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 556
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu

```
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 557
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 557
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 558
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 558
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Phe Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 559

<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 559
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 560
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 560
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125

```
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 561
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 561
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
```

cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gagagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 562
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 562
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285

```
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 563
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 563
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gagagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 564
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 564
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
```

```
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 565
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 565
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 566
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 566
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr

```
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 567
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 567
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaattgtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 568
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 568
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Cys Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Phe Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala

```
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 569
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 569

```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 570
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 570

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
```

```
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 571
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 571
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360

atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 572
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 572
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240

```
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 573
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 573
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
agtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag    1077
```

<210> 574
<211> 359
<212> PRT
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 574
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Ser Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 575
<211> 1077

<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 575
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 576
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 576
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser

```
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 577
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 577
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780

agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 578
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 578
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Phe Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro

```
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 579
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 579
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gagagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 580
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 580
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
```

```
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Glu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 581
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 581

atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gagagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 582
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 582
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190

```
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 583
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 583
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtactgg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gagagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 584
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 584
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Leu Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350

Gly Ile Arg Ser Ala Val Glu
        355

<210> 585
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 585
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 586
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 586
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala

```
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
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<210> 587
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 587
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420

acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 588
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 588
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys

```
                245                 250                 255
Glu Trp Phe Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 589
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 589
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 590
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 590
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Phe Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 591
<211> 1077
<212> DNA

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 591
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 592
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 592
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140

```
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 593
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 593
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
```

cgcggcattg cgggacctat cagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 594
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 594
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300

```
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 595
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 595
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtactgg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 596
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 596
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
```

```
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Leu Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 597
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 597
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60

gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 598
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 598
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu

```
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 599
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 599
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgctgccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 600

<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 600
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met Leu Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu

355

<210> 601
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 601
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 602
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 602
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95

```
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 603
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 603
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
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tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcctgg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 604
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 604
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255

```
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Leu Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 605
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 605
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
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<210> 606
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 606
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 607
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 607
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtgt acctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 608
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 608
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp

```
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Val Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 609
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 609
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtactgg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
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ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 610
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 610
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Leu Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Phe Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp

305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Glu Ile Arg Ser Ala Val Glu
355

<210> 611
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 611
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtactcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 612
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 612
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45

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Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Leu Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 613
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 613
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120

aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gagagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 614
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 614
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205

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Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
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<210> 615
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 615
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
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<210> 616
<211> 359

<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 616
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Phe Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 617
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 617
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 618
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 618
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr

```
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 619
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 619
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtactgg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
```

cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 620
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 620
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Leu Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu

```
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 621
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 621
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 622
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 622

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 623
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 623
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 624
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 624
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145 150 155 160

```
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 625
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 625
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggactagc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtactgg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
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gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 626
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 626
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Leu Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320

Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 627
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 627
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa acatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
cgtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 628
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 628
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu

```
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Arg Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 629
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 629
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180

```
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttgggg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 630
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 630

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Gly Glu
```

```
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 631
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 631
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag    1077
```

<210> 632
<211> 359
<212> PRT

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 632
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Glu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Gly Ile Arg Ser Ala Val Glu
        355

<210> 633
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 633
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat cagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag   1077

<210> 634
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 634
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110

```
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 635
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 635
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600

atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggca taagaagtgc tgttgag 1077

<210> 636
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 636
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Phe Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270

```
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Gly Ile Arg Ser Ala Val Glu
        355
```

<210> 637
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 637
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
agtagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 638
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 638
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
```

```
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Phe Lys Ser Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 639
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 639
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
ctgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 640
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 640
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile

```
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Leu Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 641
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 641
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgccaacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtacaag 780
gaaagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
```

ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 642
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 642
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Pro Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Glu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys

```
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 643
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 643

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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgg ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa atatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaatg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aggctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
agtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctat tagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 644
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 644

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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Gly Gly Thr Ala His Pro Asp Leu
    50                  55                  60
```

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Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Asn Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Ser Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Ile Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 645
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 645
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagagcgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc ggggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240

attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtattcg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc aagctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtgtacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtttaag 780
ctgagttacg gccagtcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctaa gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcgggga taagaagtgc tgttgag 1077

<210> 646
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 646
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Ser Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Phe Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Gln Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Cys Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220

Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Phe Lys Leu Ser Tyr Gly Gln Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Lys Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Gly Ile Arg Ser Ala Val Glu
355

<210> 647
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 647
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 648
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 648
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210   215   220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245   250   255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 649
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 649
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatac ctcggctgta 600
ctgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tatttcagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atgggtaaag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 650
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 650
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro

```
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Thr Ser Ala Val Leu His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Val Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 651
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 651
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660

tcgttcagcg agtttattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcaccga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 652
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 652
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Phe Ser Glu
210 215 220
Phe Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Thr
245 250 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser

```
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 653
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 653
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgttcggcg agggtattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 654
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 654
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
```

```
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Phe Gly Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 655
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 655
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tatttcagcg agtttattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcaccga atggtataag 780
acgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 656
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 656
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175

```
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Phe Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Thr
                245                 250                 255
Glu Trp Tyr Lys Thr Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 657
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 657
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
catttcggcg agctgattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgtga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 658
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 658
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln His Phe Gly Glu
    210   215   220
Leu Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335

Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 659
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 659
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgttcggcg agctgattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgtga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 660
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 660
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu

65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Phe Gly Glu
210 215 220
Leu Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Glu Ile Arg Ser Ala Val Glu
355

<210> 661
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 661
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300

gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgctgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
catttcggcg agtttattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgtga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcatgg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 662
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 662
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met Leu Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln His Phe Gly Glu
210 215 220
Phe Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu

```
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Met Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 663
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 663
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgttcggcg agctgattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgtga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcatcg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 664
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 664
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Phe Gly Glu
    210   215   220
Leu Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 665

<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 665
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
ctgttcagcg agtttattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcgtgga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 666
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 666
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125

```
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Leu Phe Ser Glu
    210                 215                 220
Phe Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Val
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 667
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 667
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattgcaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
```

cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 668
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 668
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Leu Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285

```
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 669
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 669
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tgacgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
ctgttcggcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgtga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 670
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 670
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
```

```
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Thr Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Leu Phe Gly Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 671
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 671
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
ctgttcggcg agctgattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcaccga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 672
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 672
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr

```
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Leu Phe Gly Glu
    210                 215                 220
Leu Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Thr
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 673
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 673
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttgg 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 674
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 674
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Trp Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala

```
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 675
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 675

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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgctgat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 676
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 676

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
```

```
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Asp Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 677
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 677
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360

atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgctgtt 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 678
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 678
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240

```
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Val Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 679
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 679
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgctatt 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 680
<211> 359
<212> PRT
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 680
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210   215   220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245   250   255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Ile Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 681
<211> 1077

<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 681
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgctgag 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 682
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 682
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser

```
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Glu Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 683
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 683
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
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gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgctgtg 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttattcga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 684
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 684
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
245 250 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Val Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro

```
    290                 295                 300
Leu Phe Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 685
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 685
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgacgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
catatcagcg agggtattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgtga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 686
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 686
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
```

```
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Thr Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln His Ile Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 687
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 687

atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
catttcagcg agtttattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 688
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 688
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190

```
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln His Phe Ser Glu
    210                 215                 220
Phe Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 689
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 689
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgttcggcg agctgattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 690
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 690
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Phe Gly Glu
    210   215   220
Leu Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245   250   255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350

Glu Ile Arg Ser Ala Val Glu
        355

<210> 691
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 691
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgctgccgc tgtcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgttcggcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgtga atggtataag 780
tacagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 692
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 692
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala

```
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Leu Pro Leu Ser Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Phe Gly Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Tyr Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 693
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 693
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420

acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tgtcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
catttcggcg agggtattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgtga atggtataag 780
tacagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcatcg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 694
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 694
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ser Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln His Phe Gly Glu
210 215 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys

```
                245                 250                 255
Glu Trp Tyr Lys Tyr Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 695
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 695
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgttcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcaccga atggtataag 780
tacagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcatgg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
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<210> 696
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 696
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Phe Ser Glu
    210   215   220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Thr
                245   250   255
Glu Trp Tyr Lys Tyr Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Met Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 697
<211> 1077
<212> DNA

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 697
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tgtcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgttcggcg agtttattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
acgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcatgg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 698
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 698
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140

```
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ser Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Phe Gly Glu
    210                 215                 220
Phe Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Tyr Lys Thr Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Met Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 699
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 699
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tatttcggcg agctgattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcgtgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840

cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 700
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 700
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Gly Glu
210 215 220
Leu Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Val
245 250 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300

Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Glu Ile Arg Ser Ala Val Glu
355

<210> 701
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 701
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgcacccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
catatcggcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atggtataag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 702
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 702
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala

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        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met His Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln His Ile Gly Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Tyr Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 703
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 703
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60

gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt tgcggctgta 600
ctgcacccgc tggctacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tattttagcg aggggattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtctgcga atgggtaaag 780
gtgagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa ccctgctctg 840
cgcggcattg cgggacctac gagccttaac acgcgcttct tcttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 704
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 704
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val Ala Ala Val Leu His Pro Leu Ala Thr Leu Leu

```
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Tyr Phe Ser Glu
    210                 215                 220
Gly Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Cys
                245                 250                 255
Glu Trp Val Lys Val Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Leu Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Phe Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 705
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 705
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagtgagg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 706

<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 706
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210   215   220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245   250   255
Glu Trp Tyr Lys Arg Ser Glu Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu

355

<210> 707
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 707
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtac tcctgctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 708
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 708
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95

```
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Thr Pro Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 709
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 709
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
```

tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagtgatg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 710
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 710
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
210 215 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
245 250 255

```
Glu Trp Tyr Lys Arg Ser Asp Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 711
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 711
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc gtcgacaatt tatgaagcgg tgcagggtac tcctgctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 712
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 712
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210   215   220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245   250   255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ser Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Thr Pro Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 713
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 713
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatct gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcggtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 714
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 714
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp

```
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Leu Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Gly Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 715
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 715
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagtgttg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
```

ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 716
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 716
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
210 215 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
245 250 255
Glu Trp Tyr Lys Arg Ser Val Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp

```
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 717
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 717
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagtcagg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 718
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 718
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
```

```
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Gln Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 719
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 719
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120

aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagtatgg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 720
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 720
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205

```
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Met Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 721
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 721
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagtaatg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 722
<211> 359

<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 722
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210   215   220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245   250   255
Glu Trp Tyr Lys Arg Ser Asn Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 723
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 723
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagtgggg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 724
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 724
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr

```
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Gly Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 725
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 725
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
```

cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atattataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 726
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 726
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
210 215 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
245 250 255
Glu Tyr Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu

```
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 727
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 727
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagtctgg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 728
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 728

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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Leu Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 729
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 729
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatct gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 730
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 730
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160

```
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Leu His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 731
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 731
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcggtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggttg gcctgctggg 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
```

gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 732
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 732
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Gly Glu
210 215 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
245 250 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Trp Pro Ala Gly Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320

```
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 733
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 733
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggttt ccctgctggg 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 734
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 734
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
```

```
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Phe Pro Ala Gly Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 735
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 735
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180

```
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttttg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 736
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 736

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
```

```
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Phe Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 737
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 737
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagtaggg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgtagag    1077
```

<210> 738
<211> 359
<212> PRT

<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 738
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210   215   220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245   250   255
Glu Trp Tyr Lys Arg Ser Arg Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 739
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 739
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatct gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 740
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 740
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110

```
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Leu Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 741
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 741
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatct gcatgcggta 600
```

atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcggtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggcgacaatt tatgaagcgg tgcagggtac tcctgctaaa 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 742
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 742
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Leu His Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Gly Glu
210 215 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
245 250 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270

Ala Val Gln Gly Thr Pro Ala Lys Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 743
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 743
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgctgat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 744
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 744
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly

```
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Asp Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 745
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 745
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcggtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggcgacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 746
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 746
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile

```
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Gly Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 747
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 747
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtcc tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggcgacaatt tatgaagcgg tgcagggtaa tcctgcttgg 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
```

ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 748
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 748
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
Pro Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
210 215 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
245 250 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Trp Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys

```
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 749
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 749

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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 750
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 750

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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
```

```
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 751
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 751
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240

attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggttt ccctgctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 752
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 752
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
210 215 220

Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
245 250 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Phe Pro Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Glu Ile Arg Ser Ala Val Glu
355

<210> 753
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 753
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcggtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 754
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 754
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Gly Glu
    210   215   220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245   250   255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 755
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 755
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttgg 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 756
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 756
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro

```
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Trp Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 757
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 757
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
```

tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttggg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 758
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 758
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
210 215 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
245 250 255
Glu Trp Tyr Lys Arg Ser Trp Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser

```
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 759
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 759
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtcc tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atgggtaaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 760
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 760
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Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
```

```
Pro Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Val Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 761
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 761
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggttg gcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 762
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 762
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175

```
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Trp Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 763
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 763
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatct gcatgcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggcgacaatt tatgaagcgg tgcagggttt ccctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
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<210> 764
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 764
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Leu His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210   215   220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245   250   255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Phe Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335

Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 765
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 765
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtgg gcctgcttgg 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 766
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 766
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu

65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
210 215 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
245 250 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Gly Pro Ala Trp Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
290 295 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305 310 315 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
325 330 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
340 345 350
Glu Ile Arg Ser Ala Val Glu
355

<210> 767
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 767
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300

gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atgggtaaag 780
cgtagttacg gcatttcacc ggcgacaatt tatgaagcgg tgcagggtac tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 768
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 768
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
210 215 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu

```
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Val Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Thr Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 769
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 769
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atgggtaaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 770
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 770
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210   215   220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245   250   255
Glu Trp Val Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 771

<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 771
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gagtgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 772
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 772
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125

```
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
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<210> 773
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 773
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaattt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
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cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 774
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 774
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Leu His Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
210 215 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
245 250 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285

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Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 775
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 775
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggcgacaatt tatgaagcgg tgcagggtaa tcctgctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 776
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 776
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
```

```
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 777
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 777
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcggtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atgggtaaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttgg 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 778
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 778
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr

```
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Gly Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Val Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Trp Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 779
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 779
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt ggctgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 780
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 780
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val Ala Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210   215   220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245   250   255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Asn Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala

```
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 781
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 781

```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggaataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtaa tcctgcttgg 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 782
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 782

```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                  10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
```

```
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Asn Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Asn Pro Ala Trp Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 783
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 783
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360

atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtcc tcctgctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 784
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 784
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
210 215 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240

```
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Pro Pro Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 785
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 785
```
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca cgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gcatgctgta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagtg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtataag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggttg gcctgcttat 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 786
<211> 359
<212> PRT
<213> Artificial Sequence

<220>

<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 786
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Val His Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210   215   220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245   250   255
Glu Trp Tyr Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Trp Pro Ala Tyr Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355

<210> 787
<211> 1077

<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 787
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
gattgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtac tcctgctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 788
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 788
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Asp Cys Arg Ser

```
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Thr Pro Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 789
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 789
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg ggataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
```

cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtac tcctgctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 790
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 790
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Gly Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
210 215 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
245 250 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
260 265 270
Ala Val Gln Gly Thr Pro Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
275 280 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro

```
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 791
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 791
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacc atataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtac tcctgctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 792
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 792
```
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1               5                   10                  15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20                  25                  30
```

```
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35                  40                  45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50                  55                  60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65                  70                  75                  80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn His Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Thr Pro Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 793
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 793

atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtac tgttgctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 794
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 794
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190

```
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Thr Val Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 795
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 795
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgc gagcgcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtac tcctgctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 796
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 796
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Ala Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210   215   220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245   250   255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Thr Pro Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350

Glu Ile Arg Ser Ala Val Glu
        355

<210> 797
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 797
atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgt gtcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtac tgaggctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag   1077

<210> 798
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 798
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala

```
                85                  90                  95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100                 105                 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115                 120                 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130                 135                 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145                 150                 155                 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165                 170                 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180                 185                 190
Ser Leu Thr Asn Val Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195                 200                 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210                 215                 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225                 230                 235                 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245                 250                 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Thr Glu Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 799
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 799
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
```

acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatgc ttcggcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtac tcctgctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag 1077

<210> 800
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 800
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1 5 10 15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
20 25 30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
35 40 45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
50 55 60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65 70 75 80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
85 90 95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
100 105 110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
115 120 125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
130 135 140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145 150 155 160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
165 170 175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
180 185 190
Ser Leu Thr Asn Ala Ser Ala Val Met Met Pro Leu Ala Thr Leu Leu
195 200 205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
210 215 220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225 230 235 240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu

```
                245                 250                 255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260                 265                 270
Ala Val Gln Gly Thr Pro Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
        275                 280                 285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290                 295                 300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305                 310                 315                 320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325                 330                 335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340                 345                 350
Glu Ile Arg Ser Ala Val Glu
        355
```

<210> 801
<211> 1077
<212> DNA
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 801
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atgatcgagt caaaaacata cgccgttttg ggattaggaa acgggggtca tgcatttgcc 60
gcctatttag cattgaaggg ccagcgtgta ctggcttggg acatcgatgc tcagagaatc 120
aaagagattc aggaccgtgg agccatcata gcggaaggac caggacttgc tgggactgct 180
cacccggatc ttctgacctc agatataggt ttggcggtta aagacgctga tgtgatactg 240
attgtagtgc cggccatcca ccacgcttcc attgcagcaa agatcgccag ttacatttcc 300
gagggtcagt tgattatcct taaccctggg gcaacgggtg gagcgctgga attccggaaa 360
atcctgcgtg aaaatggtgc gccggaggta acgatcgggg aaacctcaag tatgctcttt 420
acatgccgct ccgagagacc aggacaggtt acggtaaacg cgataaaagg cgccatggac 480
tttgcatgtc tcccagcggc aaaagctgga tgggccctgg aacagatagg gtcggttctt 540
cctcaatacc gcgctgtcga aaacgtgttg catacttcgc tgactaatcc ggcagcggta 600
atgatgccgc tggcgacact gttaaacgct gctcgttgtg agtctggtac cccattccaa 660
tcgatcagcg agtatattac gccatcagtc gggagtcttg cggagaaagt ggacgctgaa 720
cgcatagcaa tcgcaaaggc tttcgattta aacgttccgt cggtcctgga atggtggaag 780
cgtagttacg gcatttcacc ggccacaatt tatgaagcgg tgcagggtac tcctgctttt 840
cgcggcattg cgggacctac gagccttaac acgcgcttca ttttcgagga tgtaagcacc 900
ggactggtac cgttatccga actgggtcgg gccgtgaatg tgcctacccc acttatcgat 960
gctgttcttc tgttgatcag ttcgctgata gacacggatt tcagaaagga aggtcgtacc 1020
ttggaaaaat taggtctgag cggacttacc gccgcggaga taagaagtgc tgttgag    1077
```

<210> 802
<211> 359
<212> PRT
<213> Artificial Sequence

<220>
<223> Variant of Norvaline dehydrogenase from Arthrobacter sp

<400> 802
Met Ile Glu Ser Lys Thr Tyr Ala Val Leu Gly Leu Gly Asn Gly Gly
1   5   10   15
His Ala Phe Ala Ala Tyr Leu Ala Leu Lys Gly Gln Arg Val Leu Ala
            20   25   30
Trp Asp Ile Asp Ala Gln Arg Ile Lys Glu Ile Gln Asp Arg Gly Ala
        35   40   45
Ile Ile Ala Glu Gly Pro Gly Leu Ala Gly Thr Ala His Pro Asp Leu
    50   55   60
Leu Thr Ser Asp Ile Gly Leu Ala Val Lys Asp Ala Asp Val Ile Leu
65   70   75   80
Ile Val Val Pro Ala Ile His His Ala Ser Ile Ala Ala Lys Ile Ala
                85   90   95
Ser Tyr Ile Ser Glu Gly Gln Leu Ile Ile Leu Asn Pro Gly Ala Thr
            100   105   110
Gly Gly Ala Leu Glu Phe Arg Lys Ile Leu Arg Glu Asn Gly Ala Pro
        115   120   125
Glu Val Thr Ile Gly Glu Thr Ser Ser Met Leu Phe Thr Cys Arg Ser
    130   135   140
Glu Arg Pro Gly Gln Val Thr Val Asn Ala Ile Lys Gly Ala Met Asp
145   150   155   160
Phe Ala Cys Leu Pro Ala Ala Lys Ala Gly Trp Ala Leu Glu Gln Ile
                165   170   175
Gly Ser Val Leu Pro Gln Tyr Arg Ala Val Glu Asn Val Leu His Thr
            180   185   190
Ser Leu Thr Asn Pro Ala Ala Val Met Met Pro Leu Ala Thr Leu Leu
        195   200   205
Asn Ala Ala Arg Cys Glu Ser Gly Thr Pro Phe Gln Ser Ile Ser Glu
    210   215   220
Tyr Ile Thr Pro Ser Val Gly Ser Leu Ala Glu Lys Val Asp Ala Glu
225   230   235   240
Arg Ile Ala Ile Ala Lys Ala Phe Asp Leu Asn Val Pro Ser Val Leu
                245   250   255
Glu Trp Trp Lys Arg Ser Tyr Gly Ile Ser Pro Ala Thr Ile Tyr Glu
            260   265   270
Ala Val Gln Gly Thr Pro Ala Phe Arg Gly Ile Ala Gly Pro Thr Ser
        275   280   285
Leu Asn Thr Arg Phe Ile Phe Glu Asp Val Ser Thr Gly Leu Val Pro
    290   295   300
Leu Ser Glu Leu Gly Arg Ala Val Asn Val Pro Thr Pro Leu Ile Asp
305   310   315   320
Ala Val Leu Leu Leu Ile Ser Ser Leu Ile Asp Thr Asp Phe Arg Lys
                325   330   335
Glu Gly Arg Thr Leu Glu Lys Leu Gly Leu Ser Gly Leu Thr Ala Ala
            340   345   350
Glu Ile Arg Ser Ala Val Glu
        355