SEQUENCE LISTING

<110> Codexis, Inc.
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Hennemann, Joerg
Oh, Seong ho
Zha, Wenjuan

<120> KETOREDUCTASE POLYPEPTIDES FOR THE PREPARATION OF PHENYLEPHRINE

<130> CX2-015WO1

<150> 61/235,324
<151> 2009-08-19

<160> 34

<170> PatentIn version 3.5

<210> 1
<211> 756
<212> DNA
<213> Lactobacillus kefir

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ttggcaatcg ctgataagtt tgttgaagaa ggcgcaaagg ttgttattac cggccgtcac 120

gctgatgtag gtgaaaaagc tgccaaatca atcggcggca cagacgttat ccgttttgtc 180

caacacgatg cttctgatga agccggctgg actaagttgt ttgatacgac tgaagaagca 240

tttggcccag ttaccacggt tgtcaacaat gccggaattg cggtcagcaa gagtgttgaa 300

gataccacaa ctgaagaatg gcgcaagctg ctctcagtta acttggatgg tgtcttcttc 360

ggtacccgtc ttggaatcca acgtatgaag aataaaggac tcggagcatc aatcatcaat 420

atgtcatcta tcgaaggttt tgttggtgat ccaactctgg gtgcatacaa cgcttcaaaa 480

ggtgctgtca gaattatgtc taaatcagct gccttggatt gcgctttgaa ggactacgat 540

gttcgggtta acactgttca tccaggttat atcaagacac cattggttga cgatcttgaa 600

ggggcagaag aaatgatgtc acagcggacc aagacaccaa tgggtcatat cggtgaacct 660

aacgatatcg cttggatctg tgtttacctg gcatctgacg aatctaaatt tgccactggt 720

gcagaattcg ttgtcgatgg tggatacact gctcaa 756

<210> 2
<211> 252
<212> PRT
<213> Lactobacillus kefir

<400> 2

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Val Ser
85 90 95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Glu Gly Phe Val Gly Asp Pro Thr Leu Gly Ala Tyr Asn Ala Ser Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Tyr Ile Lys
180 185 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Ala Glu Glu Met Met Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Tyr Thr Ala Gln
245 250

<210> 3
<211> 756
<212> DNA
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 3
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gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg catccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg cagtttccaa aagcgttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct ggtaggcgat ccgacgctgg gggcatacaa cgcttccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggctgc atcaagaccc cgctggtcga tgatctggaa 600

ggtgctgagg aaatgatgtc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtatacc gcacag 756

<210> 4
<211> 252
<212> PRT
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 4

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Val Ser
85 90 95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Ala Gly Leu Val Gly Asp Pro Thr Leu Gly Ala Tyr Asn Ala Ser Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Cys Ile Lys
180 185 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Ala Glu Glu Met Met Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Tyr Thr Ala Gln
245 250

<210> 5
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

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ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcac 120

gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg catccgatga ggcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg caatgagtaa aagcgttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct ggtaggcgat ccgacgctgg gggcatacaa cgcttccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggctgc atcaagaccc cgctggtcga tgatctggaa 600

ggttttgagg aaatgtgttc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtatacc gcacag 756

<210> 6
<211> 252

<212> PRT
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 6

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Met Ser
85 90 95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Ala Gly Leu Val Gly Asp Pro Thr Leu Gly Ala Tyr Asn Ala Ser Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Cys Ile Lys
180 185 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Phe Glu Glu Met Cys Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Tyr Thr Ala Gln
245 250

<210> 7
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

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gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg catccgatga ggcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg caatgagtaa aagcgttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct ggtaggcgat ccgacgctgg gggcatacaa cgcttccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggcggt atcaagaccc cgctggtcga tgatctggaa 600

ggttttgagg aaatgtgttc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtatacc gcacag 756

<210> 8
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 8

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Met Ser
85 90 95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Ala Gly Leu Val Gly Asp Pro Thr Leu Gly Ala Tyr Asn Ala Ser Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Gly Ile Lys
180 185 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Phe Glu Glu Met Cys Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Tyr Thr Ala Gln
245 250

<210> 9
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

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gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg catccgatga ggcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg caatgctgaa aagcgttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct ggtaggcgat ccgacgctgg gggcatacaa cgcttccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggcggt atcaagaccc cgctggtcga tgatctggaa 600

ggttttgagg aaatgtgttc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtttacc gcacag 756

<210> 10
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 10

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Met Leu
85 90 95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Ala Gly Leu Val Gly Asp Pro Thr Leu Gly Ala Tyr Asn Ala Ser Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Gly Ile Lys
180 185 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Phe Glu Glu Met Cys Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Phe Thr Ala Gln
245 250

<210> 11
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 11
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gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg catccgatga ggcaggctgg acgaaactgt tcgacatcac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg caatgctgaa aagcgttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct gatcggcgat ccgacgctgg gggcatacaa cgcttccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggcggt atcaagaccc cgctggtcga tgatctggaa 600

ggttttgagg aaatgtgttc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtttacc gcacag 756

<210> 12
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 12

Met Ser Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

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Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
            20                  25                  30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
        35                  40                  45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
    50                  55                  60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Ile Thr Glu Glu Ala
65                  70                  75                  80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Met Leu
                85                  90                  95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
            100                 105                 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
        115                 120                 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
    130                 135                 140

Ala Gly Leu Ile Gly Asp Pro Thr Leu Gly Ala Tyr Asn Ala Ser Lys
145                 150                 155                 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
                165                 170                 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Gly Ile Lys
            180                 185                 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Phe Glu Glu Met Cys Ser Gln
        195                 200                 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
    210                 215                 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225                 230                 235                 240

Ala Glu Phe Val Val Asp Gly Gly Phe Thr Ala Gln
                245                 250
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<210> 13
<211> 756
<212> DNA
<213> Artificial Sequence

<220>

<223> variant of L. kefir ketoreductase

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gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg catccgatga ggcaggctgg acgaaactgt tcgacatcac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg caatgctgaa aagcgttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct gatcggcgat ccggcaatgg gggcatacaa cgcttccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggcggt atcaagaccc cgctggtcga tgatctggaa 600

ggttttgagg aaatgtgttc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtttacc gcacag 756

<210> 14
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 14

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Ile Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Met Leu
85 90 95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Ala Gly Leu Ile Gly Asp Pro Ala Met Gly Ala Tyr Asn Ala Ser Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Gly Ile Lys
180 185 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Phe Glu Glu Met Cys Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Phe Thr Ala Gln
245 250

<210> 15
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

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gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg tatccgatga ggcaggctgg acgaaactgt tcgacatcac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg caatgctgaa aagccttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct gatcggcgat ccggcaatgg gggcatacaa cgctaccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggcggt atcaagaccc cgctggtcgc agatctgccg 600

ggttttgagg aaatgtgttc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtttacc gcacag 756

<210> 16
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 16

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Val
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Ile Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Met Leu
85 90 95

Lys Ser Leu Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Ala Gly Leu Ile Gly Asp Pro Ala Met Gly Ala Tyr Asn Ala Thr Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Gly Ile Lys
180 185 190

Thr Pro Leu Val Ala Asp Leu Pro Gly Phe Glu Glu Met Cys Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Phe Thr Ala Gln
245 250

<210> 17
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 17
atgactgatc gtctgaaggg caaagtagcc ctggtaaccg gcgggacgct gggtatcggt 60

ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcac 120

gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg tatccgatga ggcaggctgg acgaaactgt tcgacatcac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg caatgctgaa aagccttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct gatcggcgat ccggcaatgg gggcatacaa cgctaccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggcggt atcaagaccc cgctggtcgc agatctgccg 600

ggttttgagg aaatgtgttc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtttacc gcacag 756

<210> 18
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 18

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Leu Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Val
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Ile Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Met Leu
85 90 95

Lys Ser Leu Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Ala Gly Leu Ile Gly Asp Pro Ala Met Gly Ala Tyr Asn Ala Thr Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Gly Ile Lys
180 185 190

Thr Pro Leu Val Ala Asp Leu Pro Gly Phe Glu Glu Met Cys Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Phe Thr Ala Gln
245 250

<210> 19
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 19
atgactgatc gtctgaaggg caaagtagcc ctggtaaccg gcgggacgct gggtatcggt 60

ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcac 120

gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg tatccgatga ggcaggctgg acgaaactgt tcgacatcac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg caatgctgaa aagccttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggat catcggcgat ccggcaatgg gggcatacaa cgctaccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggcggt atcaagaccc cgctggtcgc agatctgccg 600

ggttttgagg aaatgtgttc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtttacc gcacag 756

<210> 20
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 20

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Leu Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Val
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Ile Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Met Leu
85 90 95

Lys Ser Leu Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Ala Gly Ile Ile Gly Asp Pro Ala Met Gly Ala Tyr Asn Ala Thr Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Gly Ile Lys
180 185 190

Thr Pro Leu Val Ala Asp Leu Pro Gly Phe Glu Glu Met Cys Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Phe Thr Ala Gln
245 250

<210> 21
<211> 756
<212> DNA
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 21
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggactct gggtatcggt 60

ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcac 120

gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg catccgatga ggcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg caatgagtaa aagcgttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct ggtaggcgat ccgacgctgg gggcatacaa cgcttccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggctgc atcaagaccc cgctggtcga tgatctggaa 600

ggtgctgagg aaatgatgtc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtatacc gcacag 756

<210> 22
<211> 252
<212> PRT
<213> Artificial sequence

<220>

<223> variant of L. kefir ketoreductase

<400> 22

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Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1               5                  10                  15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
            20                  25                  30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
        35                  40                  45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
    50                  55                  60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
65                  70                  75                  80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Met Ser
                85                  90                  95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
            100                 105                 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
        115                 120                 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
    130                 135                 140

Ala Gly Leu Val Gly Asp Pro Thr Leu Gly Ala Tyr Asn Ala Ser Lys
145                 150                 155                 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
                165                 170                 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Cys Ile Lys
            180                 185                 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Ala Glu Glu Met Met Ser Gln
        195                 200                 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
    210                 215                 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225                 230                 235                 240

Ala Glu Phe Val Val Asp Gly Gly Tyr Thr Ala Gln
                245                 250
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<210> 23
<211> 756
<212> DNA
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 23
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggactct gggtatcggt 60

ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcac 120

gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg catccgatga ggcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg cagtttccaa aagcgttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct ggtaggcgat ccgacgctgg gggcatacaa cgcttccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggctgc atcaagaccc cgctggtcga tgatctggaa 600

ggtgctgagg aaatgtgttc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtatacc gcacag 756

<210> 24
<211> 252
<212> PRT
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 24

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Val Ser
85 90 95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Ala Gly Leu Val Gly Asp Pro Thr Leu Gly Ala Tyr Asn Ala Ser Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Cys Ile Lys
180 185 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Ala Glu Glu Met Cys Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Tyr Thr Ala Gln
245 250

<210> 25
<211> 756
<212> DNA
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 25
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggactct gggtatcggt 60

ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcac 120

gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg catccgatga ggcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg cagtttccaa aagcgttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct ggtaggcgat ccgacgctgg gggcatacaa cgcttccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggctgc atcaagaccc cgctggtcga tgatctggaa 600

ggttttgagg aaatgatgtc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtatacc gcacag 756

<210> 26
<211> 252
<212> PRT
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 26

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Val Ser
85 90 95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Ala Gly Leu Val Gly Asp Pro Thr Leu Gly Ala Tyr Asn Ala Ser Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Cys Ile Lys
180 185 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Phe Glu Glu Met Met Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Tyr Thr Ala Gln
245 250

<210> 27
<211> 756
<212> DNA
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 27
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggactct gggtatcggt 60

ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcac 120

gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg catccgatga ggcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg caatgagtaa aagcgttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct ggtaggcgat ccgacgctgg gggcatacaa cgcttccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggctgc atcaagaccc cgctggtcga tgatctggaa 600

ggttttgagg aaatgatgtc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtatacc gcacag 756

<210> 28
<211> 252
<212> PRT
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 28

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Met Ser
85 90 95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Ala Gly Leu Val Gly Asp Pro Thr Leu Gly Ala Tyr Asn Ala Ser Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Cys Ile Lys
180 185 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Phe Glu Glu Met Met Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Tyr Thr Ala Gln
245 250

<210> 29
<211> 756
<212> DNA
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 29
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggactct gggtatcggt 60

ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcac 120

gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg catccgatga ggcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg caatgagtaa aagcgttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct ggtaggcgat ccgacgctgg gggcatacaa cgcttccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggctgc atcaagaccc cgctggtcga tgatctggaa 600

ggttttgagg aaatgtgttc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtttacc gcacag 756

<210> 30
<211> 252
<212> PRT
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 30

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Met Ser
85 90 95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Ala Gly Leu Val Gly Asp Pro Thr Leu Gly Ala Tyr Asn Ala Ser Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Cys Ile Lys
180 185 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Phe Glu Glu Met Cys Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Phe Thr Ala Gln
245 250

<210> 31
<211> 756
<212> DNA
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 31
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggactct gggtatcggt 60

ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcac 120

gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg catccgatga ggcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg caatgagtaa aagcgttgaa 300

gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360

ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

atgagcagta ttgcggggct ggtaggcgat ccgacgctgg gggcatacaa cgcttccaag 480

ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

gtgcgtgtca acacagtaca tccgggcggt atcaagaccc cgctggtcga tgatctggaa 600

ggttttgagg aaatgtgttc acagcgtacg aaaaccccta tgggccacat tggcgaaccg 660

aatgacatcg catggatctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtttacc gcacag 756

<210> 32
<211> 252
<212> PRT
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 32

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
50 55 60

Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
65 70 75 80

Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Met Ser
85 90 95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140

Ala Gly Leu Val Gly Asp Pro Thr Leu Gly Ala Tyr Asn Ala Ser Lys
145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Gly Ile Lys
180 185 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Phe Glu Glu Met Cys Ser Gln
195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 215 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240

Ala Glu Phe Val Val Asp Gly Gly Phe Thr Ala Gln
245 250

<210> 33
<211> 756
<212> DNA
<213> Artificial sequence

<220>
<223> variant of L. kefir ketoreductase

<400> 33
atgtcagatc gtctgaaggg caaagtagcc atcgtaaccg gcgggactct gggtatcggt 60

ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcac 120

gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

cagcacgatg catccgatga ggcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg caatgagtaa aagcgttgaa 300

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Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
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Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45

Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
50 55 60

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Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
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Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Ala Met Ser
                85                  90                  95

Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
            100                 105                 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
        115                 120                 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
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Ala Gly Leu Val Gly Asp Pro Thr Leu Gly Ala Tyr Asn Ala Ser Lys
145                 150                 155                 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
                165                 170                 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Gly Ile Lys
            180                 185                 190

Thr Pro Leu Val Asp Asp Leu Glu Gly Phe Glu Glu Met Cys Ser Gln
        195                 200                 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
    210                 215                 220

Trp Ile Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225                 230                 235                 240

Ala Glu Phe Val Val Asp Gly Gly Tyr Thr Ala Gln
                245                 250
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