

CX2-103W01_ST25
SEQUENCE LISTING

<110> Codexis, Inc.
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<120> BIOCATALYSTS FOR THE PREPARATION OF HYDROXY SUBSTITUTED
CARBAMATES

<130> CX2-103W01

<150> 61/561,665

<151> 2011-11-18

<160> 172

<170> PatentIn version 3.5

<210> 1

<211> 756

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized L. kefir ketoreductase gene

<400> 1

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gcggatgtag	gtgaaaaggg	cgccaaatca	atcggcgagg	ctgatgttat	tcgctttgtc	180
cagcacgatg	catccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattg	cagtttccaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tggttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttgagggggt	cgtaggcgat	ccgacgctgg	gggcatacaa	cgcttccaag	480
ggggcggtag	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggctat	atcaagaccc	cgctgggtcga	tgatctggaa	600
ggtgctgagg	aaatgatgtc	acagcgtagc	aaaacccta	tgggccacat	tggcgaaccg	660
aatgacatcg	catggatctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtatacc	gcacag			756

<210> 2

<211> 252

<212> PRT

<213> Lactobacillus kefir

<400> 2

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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	Thr	Thr	Glu	Glu	Ala
65				70				75					80		
Phe	Gly	Pro	Val	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		

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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> Engineered variant of Lactobacillus kefir ketoreductase

<400> 3
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 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcgggcccg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgcta atctggatgg tgttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
 ggtgctgagg aaatgatgtc acagcgtacg aaaaccctta tgggccacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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

<220>
 <223> Engineered variant of Lactobacillus 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 Val Val Asn Asn Ala Gly Ile Gly Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
 100 105 110

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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
Phe Gly Met Val Gly Asp Pro Thr Thr Gly Ala Tyr Asn Ala Ser Lys
145      150      155      160
Gly Ala Val Arg Ile Met Ser Lys Ser Ala Leu Asp Cys Ala Leu
    165      170      175
Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Pro Ile Lys
    180      185      190
Thr Pro Met Leu Asp Asp Tyr 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 Val 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 Trp Thr Ala Gln
    245      250

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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gcggatgtag gtgaaaaggg cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcagcatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggccccg ttacgaccgt cgtgaacaat gcagggattg gggttcttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
ggtgctgagg aaatgatgtc acagcgtagc aaaacccta tgggccacat tggcgaaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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<210> 6
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<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 Gly Val Leu
    85      90      95
Lys Ser Val Glu Asp Thr Thr Thr 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

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Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
 130 135 140
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Ala Leu Asp Asp Tyr 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 Val 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 Trp Thr Ala Gln
 245 250

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcac 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttccggcccg ttacgaccgt cgtgaacaat gcagggtattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtag gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggccacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcgaatttg tggctcgacg cggttggacc gcacag 756

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 10
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 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 Gly Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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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130	Phe Gly Met Val Gly Asp	135	Pro Thr Thr Gly Ala Tyr	140	Asn Ala Ser Lys
145	Gly Ala Val Arg Ile Met	150	Ser Lys Ser Ala Ala Leu	155	Asp Cys Ala Leu
	165	170	Val His Pro Gly Pro	175	Ile Lys
Lys Asp Tyr Asp Val Arg Val Asn Thr	180	185	Gly Ala Glu Glu Met	190	Phe Ser Gln
Thr Pro Met Leu Asp Asp Tyr Glu	195	200	Gly His Ile Gly Glu Pro	205	Asn Asp Ile Ala
Arg Thr Lys Thr Pro Met Gly	210	215	Ser Asp Glu Ser Lys	220	Phe Ala Thr Gly
Trp Val Cys Val Tyr Leu Ala	225	230	Asp Gly Gly Trp Thr	235	Ala Gln
Ala Glu Phe Val Val Asp	245	250			

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 11

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gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcgcca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttcttaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgta	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
ggtgctgagg	aaatgatgtc	acagcgtagc	aaaaccccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cggttgacc	gcacag			756

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 12

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 Arg 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 Gly Val 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	

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Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp Tyr 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 13
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcggcccggt ttacgaccgt cgtgaacaat gcagggattg ggggttgtaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtag gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgctgttca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 14
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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 Arg 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 Val Val Asn Asn Ala Gly Ile Gly Val Val
 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
 Phe Gly Met Val Gly Asp Pro Thr Thr Gly Ala Tyr Asn Ala Ser Lys

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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 Pro Ile Lys
      180      185      190
Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
      245      250

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc      180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca      240
ttcggcccggt ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccgctc tgggcattca gcgcataaaa aataaaaggct tgggcgctag catcatcaat      420
atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag      480
ggggcgggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat      540
gtgctgtgca acacagtaca tccgggcccc atcaagaccc cggctctcga tgattatgaa      600
ggtgctgagg aaatgatgtc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtggacc gcacag      756

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 16
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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 Arg 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 Gly Val Val
      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
Phe Gly Met Val Gly Asp Pro Thr Thr Gly Ala Tyr Asn Ala Ser Lys
145      150      155      160

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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 Pro Ile Lys
 180 185 190
 Thr Pro Ala Leu Asp Asp Tyr 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 Val 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 Trp Thr Ala Gln
 245 250

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcggccccg ttacgaccgt cgtgaacaat gcagggattc ctgttggtta aagcggtgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccggtta atctggatgg tgtttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
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 ggtgctgagg aaatgttttc acagcgtagc aaaaccctta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcattctgacg aatcgaaatt tgcgacgggt 720
 gcgaatttg tggtcgacgg cgggtggacc gcacag 756

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 18
 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 Arg 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 Pro Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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
 Phe Gly Met Val Gly Asp Pro Thr Thr 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

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				165				170					175				
Lys	Asp	Tyr	Asp	Val	Arg	Val	Asn	Thr	Val	His	Pro	Gly	Pro	Ile	Lys		
			180					185					190				
Thr	Pro	Met	Leu	Asp	Asp	Tyr	Glu	Gly	Ala	Glu	Glu	Met	Phe	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	Val	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	Trp	Thr	Ala	Gln						
				245					250								

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 19

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacact	gggtatcggt	60
ttggcaatcg	ccgataaatt	tgtagaggag	ggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattg	ggatgggttaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcgggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgttca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt	720
gcgaattttg	tggtcgacgg	cgggtggacc	gcacag			756

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 20

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	Arg	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	Gly	Met	Val		
			85					90					95				
Lys	Ser	Val	Glu	Asp	Thr	Thr	Thr	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							
Phe	Gly	Met	Val	Gly	Asp	Pro	Thr	Thr	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				

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Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 21
 atgaccgatac gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcggt 60
 ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggtcgctcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcgggcccg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcgggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 22
 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 Arg 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 Gly Val Val
 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 Val
 130 135 140
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys

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Thr	Pro	Met	180	Leu	Asp	Asp	Tyr	Glu	185	Gly	Ala	Glu	Glu	Met	190	Phe	Ser	Gln
Arg	Thr	Lys	195	Thr	Pro	Met	Gly	His	200	Ile	Gly	Glu	Pro	Asn	205	Asp	Ile	Ala
Trp	Val	Cys	210	Val	Tyr	Leu	Ala	Ser	215	Asp	Glu	Ser	Lys	Phe	220	Ala	Thr	Gly
225	Ala	Glu	Phe	Val	Val	230	Asp	Gly	Gly	Trp	Thr	Ala	Gln					240
				245						250								

<210> 23
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 23
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcggg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcggcccggt ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccggtt atctggatgg tgtttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcaactgaa ggactacgat 540
 gtgctgtgca acacagtaca tccgggcccc atcaagacct cgatgatgga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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

<220>
 <223> Engineered variant of Lactobacillus 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 Arg 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 Val Val Asn Asn Ala Gly Ile Gly Val Val
 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
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190

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Thr Pro Met Met Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 25
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact ggggtatcggt 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgctcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tgcgtttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcggcccggt ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
 gtgctgtgta acacagtaca tccgggcccc atcaagaccc cgatgctcga ttcgtatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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

<220>
 <223> Engineered variant of Lactobacillus 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 Arg 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 Val Val Asn Asn Ala Gly Ile Gly Val Val
 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
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Ser Tyr Glu Gly Ala Glu Glu Met Phe Ser Gln

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195 200 205
 Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
 210 215 220
 Trp Val 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 Trp Thr Ala Gln
 245 250

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 27
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcggg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgctcg 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcggccccg ttaccgacct agtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccggtt atctggatgg tgtttttttc 360
 ggcacccgctc tgggcattca gcgcataaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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

<220>
 <223> Engineered variant of Lactobacillus 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 Arg 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 Thr Thr Glu Glu Ala
 65 70 75 80
 Phe Gly Pro Val Thr Leu Val Asn Asn Ala Gly Ile Gly Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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
 Phe Gly Gln Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe Ser Gln
 195 200 205

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Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
 210 215 220
 Trp Val 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 Trp Thr Ala Gln
 245 250

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 29
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatcgggt 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcggcccggt ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcgggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
 gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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

<220>
 <223> Engineered variant of Lactobacillus 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 Arg 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 Thr Thr Glu Glu Ala
 65 70 75 80
 Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Gly Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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
 Phe Gly Gln Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe Ser Gln
 195 200 205
 Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala

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210 215 220
 Trp Val 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 Trp Thr Ala Gln
 245 250

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 31
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcggcccggt ttacgaccgt cgtgaacaat gcagggattc cggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgatgga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcgaattttg tggctcgacg cgggtggacc gcacag 756

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

<220>
 <223> Engineered variant of Lactobacillus 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 Arg 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 Pro Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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 Val
 130 135 140
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Met Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe Ser Gln
 195 200 205
 Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
 210 215 220

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Trp Val 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 Trp Thr Ala Gln
 245 250

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

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 33
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaca aggtatcggg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgctcg 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcgcca ctgatgttat tcgctttgtc 180
 cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaagca 240
 ttccggcccg ttacgaccgt agtgaacaat gcagggattc cgatgggttaa aagcggtgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcgcccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg tgttcgggat tgtagggcag ccgactaccg gggcatactg tgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcattctgac aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtacacc gcacag 756

<210> 34
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 34
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Gln 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 Arg 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 Pro 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 Pro Met Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr Glu Trp Arg Lys Leu Leu Ser
 100 105 110
 Val Asn Leu Asp Gly Val Phe Phe Gly Ala Arg Leu Gly Ile Gln Arg
 115 120 125
 Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Val
 130 135 140
 Phe Gly Ile Val Gly Asp Pro Thr Thr Gly Ala Tyr Cys 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Met Asp Ser Tyr Glu Gly Ala Glu Glu Met Phe Ser Gln
 195 200 205
 Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
 210 215 220

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Trp Val 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> 35
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 35
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 ttggcaatcg ccgataaatt ttagaggag ggtgcaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
 ttcgggcccg ttacgaccgt agtgaacaat gcagggattc cggtggttaa aagcggtgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg tgttcgggat tgtaggcgac ccgactaccg gggcatactg tgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgctgtgca acacagtaca tccgggcccc atcaagacct cgatgatgga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcactgtacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggttcacc gcacag 756

<210> 36
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 36
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Gln 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 Arg 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 Pro 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 Pro Val Val
 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 Val
 130 135 140
 Phe Gly Ile Val Gly Asp Pro Thr Thr Gly Ala Tyr Cys 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Met Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly

225 230 CX2-103W01_ST25 240
Ala Glu Phe Val Val Asp Gly Gly Phe Thr Ala Gln
245 250

<210>	37
<211>	756
<212>	DNA
<213>	Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400>	37						
atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacaat	gggtatcggg		60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggctgcgcgt		120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc		180
cagcacgatg	tatccgatga	agcaggctgg	actaaactgt	tcgacaccac	cgaggaagca		240
ttcggcccg	ttacgacctt	agtgaacaat	gcagggattc	cggttgttaa	aagcgttgaa		300
gacactacca	cggaggaatg	gcgtaaatcg	ctgtccgtta	atctggatgg	tgtttttttc		360
ggcaccgcgc	tgggcattca	gcgatgaaa	aataaaggct	tgggcgctag	catcatcaat		420
atgagcagtg	tgttcgggat	ggtaggcgac	ccgactaccg	gggcatactg	tgcttccaag		480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat		540
gtgctgttca	acacagtaca	tccgggcccc	atcaagaccc	cgatgatgga	tagccatgaa		600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg		660
aatgacatcg	catggttcctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt		720
qcagaattttg	tgggtgcacg	cggggttcacc	gcacag				756

<210>	38
<211>	252
<212>	PRT
<213>	Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

Met 1	Thr 38	Asp	Arg	Leu 5	Lys	Gly	Lys	Val	Ala 10	Ile	Val	Thr	Gly	Gly 15	Thr
Met 20	Gly	Ile	Gly	Leu	Ala	Ile	Ala	Asp 25	Lys	Phe	Val	Glu	Glu	Gly 30	Ala
Lys 35	Val	Val	Ile	Thr	Gly	Arg	Arg	Ala	Asp	Val	Gly	Glu	Lys	Ala	Ala
Lys 50	Ser	Ile	Gly	Gly	Thr	Asp 55	Val	Ile	Arg	Phe	Val	Gln	His	Asp	Val
Ser 65	Asp	Glu	Ala	Gly	Trp 70	Thr	Lys	Leu	Phe	Asp 75	Thr	Thr	Glu	Glu	Ala
Phe 85	Gly	Pro	Val	Thr	Thr	Leu	Val	Asn	Asn 90	Ala	Gly	Ile	Pro	Val	Val
Lys 100	Ser	Val	Glu	Asp	Thr	Thr	Thr	Glu	Glu	Trp	Arg	Lys	Leu	Leu	Ser
Val 115	Asn	Leu	Asp	Gly	Val	Phe	Phe 120	Gly	Thr	Arg	Leu	Gly	Ile	Gln	Arg
Met 130	Lys	Asn	Lys	Gly	Leu	Gly 135	Ala	Ser	Ile	Ile	Asn 140	Met	Ser	Ser	Val
Phe 145	Gly	Met	Val	Gly	Asp 150	Pro	Thr	Thr	Gly	Ala 155	Tyr	Cys	Ala	Ser	Lys
Gly 165	Ala	Val	Arg	Ile	Met	Ser	Lys	Ser	Ala 170	Ala	Leu	Asp	Cys	Ala	Leu
Lys 180	Asp	Tyr	Asp	Val	Arg	Val	Asn	Thr 185	Val	His	Pro	Gly	Pro	Ile	Lys
Thr 195	Pro	Met	Met	Asp	Ser	His	Glu	Gly 200	Ala	Glu	Glu	Met	Phe	Ser	Gln
Arg 210	Thr	Lys	Thr	Pro	Met	Gly 215	His	Ile	Gly	Glu	Pro	Asn	Asp	Ile	Ala
Trp 225	Val	Cys	Val	Tyr	Leu 230	Ala	Ser	Asp	Glu	Ser 235	Lys	Phe	Ala	Thr	Gly

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

<210> 39
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 39
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cgggtatcggg 60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcacgatg tatccgatga agcaggctgg actaaactgt tcgacaccac cgaggaggca 240
ttcggcccgg ttacgacctt agtgaacaat gcagggattc cggttgttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagtg tgttcgggat tgtaggctac ccgactaccg gggcatactg tgcttccaag 480
ggagcggtag gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa 600
ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggtcgacgg cgggtggacc gcacag 756

<210> 40
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 40
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15
Arg 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 Arg 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 Thr Thr Glu Glu Ala
65 70 75 80
Phe Gly Pro Val Thr Leu Val Asn Asn Ala Gly Ile Pro Val Val
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 Val
130 135 140
Phe Gly Ile Val Gly Tyr Pro Thr Thr Gly Ala Tyr Cys 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 Pro Ile Lys
180 185 190
Thr Pro Met Met Asp Ser Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln

<210> 41
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 41
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaca aggtatcggt      60
ttggcagtcg ccgataaaatt ttagaggag ggtgcgaaag tagttattac tggtcgtcgt      120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc      180
cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca      240
ttcggccccg ttacgacctt agtgaacaat gcagggattc cgatgggtta aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccgctc tgggcattca gcgcattgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagtg ttttcgggat ttaggcgac ccgactggtg gggcatactg tgcttccaag      480
ggggcggtag gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat      540
gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa      600
ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggttcacc gcacag      756
  
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<210> 42
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 42
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1      5      10      15
Gln Gly Ile Gly Leu Ala Val Ala Asp Lys Phe Val Glu Glu Gly Ala
20     25     30
Lys Val Val Ile Thr Gly Arg Arg 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 Pro Lys Leu Phe Asp Thr Thr Glu Glu Ala
65     70     75     80
Phe Gly Pro Val Thr Leu Val Asn Asn Ala Gly Ile Pro Met Val
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 Val
130    135    140
Phe Gly Ile Val Gly Asp Pro Thr Gly Gly Ala Tyr Cys 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 Pro Ile Lys
180    185    190
Thr Pro Met Met Asp Ser Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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> 43
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 43
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggatcgggt 60
 ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggtcgctcg 120
 gcggatgtag gtgaaaaggg cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
 ttcggcccgg ttacgaccgt agtgaacaat gcagggattc cgatgggttaa aagcggtgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg tgttcgggat ggtaggctac ccgactaccg gggcatacaa tgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
 gtgctgttca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa 600
 ggtgctgagg aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

<210> 44
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 44
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Arg 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 Arg 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 Pro 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 Pro Met Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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 Val
 130 135 140
 Phe Gly Met Val Gly Tyr Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Met Asp Ser Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

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<210> 45
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 45
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact ggggtatcggg 60
 ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggtcgtcac 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcgga ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcgcccggt ttacgaccgt cgtgaacaat gcagggattg gggtttataa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaactg ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtag gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagacct cgatgctcga tgattatgaa 600
 ggtgctgagg aatgatgtc acagcgtacg aaaaccctta tgggccacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcactgtacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

<210> 46
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 46
 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 Gly Val Tyr
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp Tyr 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 Val 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 Trp Thr Ala Gln
 245 250

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<210> 47
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 47
 atgaccgatac gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcac 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttggggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtag gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
 ggtgctgagg aaatgatgtc acagcgtacg aaaaccctta tgggccacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

<210> 48
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 48
 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 Gly Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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
 Leu Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp Tyr 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 49
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 49
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcac 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttccggcccgg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcgggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgctgtgca acacagtaca tccgggcccc atcaagaccc cggggctcga tgattatgaa 600
 ggtgctgagg aaatgatgtc acagcgtacg aaaaccctta tgggccacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggctcgacgg cgggtggacc gcacag 756

<210> 50
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 50
 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 Gly Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Gly Leu Asp Asp Tyr 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 Val 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 Trp Thr Ala Gln
 245 250

CX2-103W01_ST25

<210> 51
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 51
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatcgggt      60
ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggtcgtcac      120
gcggatgtag gtgaaaaggg cgccaaatca atcggcggca ctgatgttat tcgctttgtc      180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca      240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg ggggttgtaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag      480
ggggcggtag gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat      540
gtgctgtgta acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa      600
ggtgctgagg aaatgttgtc acagcgtagc aaaacccta tgggccacat tggcgaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcactctgac aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtggacc gcacag                                756
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<210> 52
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

```
<400> 52
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 Gly Val Val
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
Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
180    185    190
Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Leu 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 Val 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 Trp Thr Ala Gln
245    250
```

<210> 53

CX2-103W01_ST25

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

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 53
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg 60
ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggctcgtcac 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tgcctttgtc 180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tgcacaccac cgaggaggca 240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaaactg ctgtccggtta atctggatgg tgttttttc 360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcatgaa 600
ggtgctgagg aatgatgtc acagcgtacg aaaaccctta tgggccacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggctcgacg cggttgacc gcacag 756
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<210> 54
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

```
<400> 54
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 Val Val Asn Asn Ala Gly Ile Gly Val Val
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
Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
180 185 190
Thr Pro Met Leu Asp Asp His 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 Val 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 Trp Thr Ala Gln
245 250
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<210> 55
<211> 756

CX2-103W01_ST25

<212> DNA

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 55

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacaca	gggtatcggt	60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggtta	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgTTTTTtc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	TTTTcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtag	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 56

<211> 252

<212> PRT

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 56

Met	Thr	Asp	Arg	Leu	Lys	Gly	Lys	Val	Ala	Ile	Val	Thr	Gly	Gly	Thr	
1				5					10					15		
Gln	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	Arg	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	Val	Val	Asn	Asn	Ala	Gly	Ile	Gly	Val	Val		
			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						
Phe	Gly	Met	Val	Gly	Asp	Pro	Thr	Thr	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	Pro	Ile	Lys	
			180				185					190				
Thr	Pro	Met	Leu	Asp	Asp	Tyr	Glu	Gly	Ala	Glu	Glu	Met	Phe	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	Val	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	Trp	Thr	Ala	Gln					
			245				250									

<210> 57

<211> 756

<212> DNA

<213> Artificial Sequence

<220>

<223> Engineered variant of *Lactobacillus kefir* ketoreductase

<400> 57

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacacg	gggtatcggg	60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggg	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccg	ttacgaccgt	cgtgaacaat	gcagggattg	gggtttgttaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tggttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtag	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
ggtgctgagg	aatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcgaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 58

<211> 252

<212> PRT

<213> Artificial Sequence

<220>

<223> Engineered variant of *Lactobacillus kefir* ketoreductase

<400> 58

Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr	1	5	10	15
Arg 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 Arg 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 Gly Val Val	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	
Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys	180	185	190	
Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln	245	250		

<210> 59

<211> 756

<212> DNA

<213> Artificial Sequence

CX2-103W01_ST25

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 59

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacact	gggtatcggt	60
ttggcaatcg	ccgataaatt	tgtaggggag	ggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	cctaaactgt	tcgacaccac	cgaggaggca	240
ttcggccccg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggtta	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tggttcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 60

<211> 252

<212> PRT

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 60

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	Gly	Glu	Gly	Ala	
			20					25					30			
Lys	Val	Val	Ile	Thr	Gly	Arg	Arg	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	Pro	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	Gly	Val	Val	
				85				90						95		
Lys	Ser	Val	Glu	Asp	Thr	Thr	Thr	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					
Phe	Gly	Met	Val	Gly	Asp	Pro	Thr	Thr	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	Pro	Ile	Lys	
		180						185					190			
Thr	Pro	Met	Leu	Asp	Asp	Tyr	Glu	Gly	Ala	Glu	Glu	Met	Phe	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	Val	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	Trp	Thr	Ala	Gln					
			245					250								

<210> 61

<211> 756

<212> DNA

<213> Artificial Sequence

CX2-103W01_ST25

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 61

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacact	gggtatcggt	60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccg	ttacgaccgt	cgtgaacaat	gcagggattg	ctgttggtta	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccgctc	tgggcattca	gcgcattgaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	ggtagggcat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcgggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgtca	acacagtaca	tccggggccc	atcaagaccc	cgatgctcga	tgattatgaa	600
gggtctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 62

<211> 252

<212> PRT

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 62

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	Arg	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	Val	
				85				90						95		
Lys	Ser	Val	Glu	Asp	Thr	Thr	Thr	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					
Phe	Gly	Met	Val	Gly	Asp	Pro	Thr	Thr	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	Pro	Ile	Lys	
			180					185					190			
Thr	Pro	Met	Leu	Asp	Asp	Tyr	Glu	Gly	Ala	Glu	Glu	Met	Phe	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	Val	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	Trp	Thr	Ala	Gln					
				245					250							

<210> 63

<211> 756

<212> DNA

<213> Artificial Sequence

<220>

<223> Engineered variant of *Lactobacillus kefir* ketoreductase

<400> 63

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacact	gggtatcggg	60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccg	ttacgaccgt	cgtgaacaat	gcagggatta	gtgttggtta	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tggttttttc	360
ggcaccgcgc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgtctga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactgtgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 64

<211> 252

<212> PRT

<213> Artificial Sequence

<220>

<223> Engineered variant of *Lactobacillus kefir* ketoreductase

<400> 64

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 Arg 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 Val Val Asn Asn Ala Gly Ile Ser Val Val	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	
Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys	180	185	190	
Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln	245	250		

<210> 65

<211> 756

<212> DNA

<213> Artificial Sequence

<220>

<223> Engineered variant of *Lactobacillus kefir* ketoreductase

CX2-103W01_ST25

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<400> 65
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatcgggt 60
ttggcaatcg ccgataaatt ttagagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaaactg ctgtccgtta atctggatgg tgtttttttc 360
ggcaccctgc tgggcattca gcgcatgaaa agtaaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtag gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
gtgctgtgta acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
gggtgctgagg aaatgttttc acagcgtagc aaaaccctta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggctgcacgg cgggtggacc gcacag 756

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<210> 66
<211> 252
<212> PRT
<213> Artificial Sequence

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<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 66
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 Arg 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 Gly Val Val
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 Ser Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
130 135 140
Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
180 185 190
Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
245 250

```

```

<210> 67
<211> 756
<212> DNA
<213> Artificial Sequence

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<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 67
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg 60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcgcca ctgatgttat tgcctttgtc 180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tgcgaccac cgaggaggca 240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggat ggtaggctat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
gtgctgttca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
gggtctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcacttgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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<210> 68
<211> 252
<212> PRT
<213> Artificial Sequence

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<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 68
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 Arg 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 Val Val Asn Asn Ala Gly Ile Gly Val Val
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
Phe Gly Met Val Gly Tyr Pro Thr Thr 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 Pro Ile Lys
180    185    190
Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
245    250

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<210> 69
<211> 756
<212> DNA
<213> Artificial Sequence

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<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 69

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atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacact	gggtatcgg	60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggttaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaaactg	ctgtccggtta	atctggatgg	tggttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	ggtaggcgat	ccggggaccg	gggcatacaa	cgcttccaag	480
ggggcgggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
gggtgtgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 70
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 70
 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 Arg 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 Gly Val Val
 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
 Phe Gly Met Val Gly Asp Pro Gly Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 71
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 71
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggtatcgg

60

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ttggcaatcg	ccgataaatt	tgtagaggag	ggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccg	ttacgaccgt	cgtgaacaat	gcaggggattg	gggttggttaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatactg	tgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 72
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 72

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	Arg	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	Gly	Val	Val
			85					90						95	
Lys	Ser	Val	Glu	Asp	Thr	Thr	Thr	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				
Phe	Gly	Met	Val	Gly	Asp	Pro	Thr	Thr	Gly	Ala	Tyr	Cys	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	Pro	Ile	Lys
			180					185					190		
Thr	Pro	Met	Leu	Asp	Asp	Tyr	Glu	Gly	Ala	Glu	Glu	Met	Phe	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	Val	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	Trp	Thr	Ala	Gln				
			245					250							

<210> 73
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 73

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacact	gggtatcggt	60
ttggcaatcg	ccgataaatt	tgtagaggag	ggtgcgaaag	tagttattac	tggtcgtcgt	120

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gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgctccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggccccg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggtta	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tggttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgtc	acacagtaca	tccgggcccc	atcaagaccc	cgggtctcga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 74
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 74
 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 Arg 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 Gly Val Val
 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
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Gly Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 75
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 75
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgggt 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

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cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggttaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccatta	atctggatgg	tgtttttttc	360
ggcaccggtc	tgggcattca	gcgcataaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgcgtgtca	acacagtaca	tccggggccc	atcaagaccc	cgatgcttga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaacccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggctgcacg	cgggtggacc	gcacag			756

<210> 76
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 76
 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 Arg 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 Val Val Asn Asn Ala Gly Ile Gly Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser
 100 105 110
 Ile 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
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 77
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 77
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcggg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

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ttcggcccg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggttaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tggttttttc	360
ggcaccgcgtc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcgggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcaactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgatgga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 78
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 78
 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 Arg 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 Val Val Asn Asn Ala Gly Ile Gly Val Val
 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
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Met Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 79
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacact	gggtatcggt	60
ttggcaatcg	ccgataaatt	tgtagaggag	ggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcgcca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggttaa	aagcgttgaa	300

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gacactacca	cggaggaatg	gcgtaaactg	ctgtccggtta	atctggatgg	tgTTTTTTTtc	360
ggcaccgcgc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	TTTTcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcgggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgcgtgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
gggtgtgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggggtacc	gcacag			756

<210> 80
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 80
 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 Arg 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 Gly Val Val
 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
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Gly Thr Ala Gln
 245 250

<210> 81
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 81
 atgaccgatc gtctgaaggc caaagtagcc atcgtaaccg gcgggacaat gggatatcggg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
 gcggatgtag gtgaaaaggc cgcaaatca atcgcgcgca ctgatgttat tcgctttgtc 180
 cagcacgatg tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcggcccggt ttacgacctt agtgaacaat gcagggtattg gggtttataa aagcgttgaa 300

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gacactacca	cggaggaatg	gcgtaaactg	ctgtccggtta	atctggatgg	tgtttttttc	360
ggcaccgcgc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggct	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcgggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgatcatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaacccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	aggggtggacc	gcacag			756

<210> 82
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 82

Met	Thr	Asp	Arg	Leu	Lys	Gly	Lys	Val	Ala	Ile	Val	Thr	Gly	Gly	Thr
1				5					10					15	
Met	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	Arg	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	Thr	Thr	Glu	Glu	Ala
65					70				75					80	
Phe	Gly	Pro	Val	Thr	Thr	Leu	Val	Asn	Asn	Ala	Gly	Ile	Gly	Val	Tyr
			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				
Phe	Gly	Leu	Val	Gly	Asp	Pro	Thr	Thr	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	Pro	Ile	Lys
		180						185					190		
Thr	Pro	Met	Leu	Asp	Asp	His	Glu	Gly	Ala	Glu	Glu	Met	Phe	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	Val	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	Trp	Thr	Ala	Gln				
			245					250							

<210> 83
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 83

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacaat	gggtatcggg	60
ttggcaatcg	ccgataaatt	tgtagaggag	ggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgacctt	agtgaacaat	gcagggatgg	gggttggtta	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccggtta	atctggatgg	tgtttttttc	360

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ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggct	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctgttat	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgatcatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 84
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 84
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Met 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 Arg 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 Leu Val Asn Asn Ala Gly Ile Gly Val Val
 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
 Phe Gly Leu Val Gly Asp Pro Thr Thr Gly Ala Tyr Asn Ala Ser Lys
 145 150 155 160
 Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Leu Cys Ala Leu
 165 170 175
 Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 85
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 85	
atgaccgctc	gtctgaaggg
ttggcaatcg	ccgataaatt
gcggatgtag	gtgaaaaggc
cagcacgatg	tttccgatga
ttcggcccgg	ttaccgactt
gacactacca	cggaggaatg
ggcaccgctc	tgggcattca
	gcgcatgaaa
	aataaaggct
	tgggcgctag
	catcatcaat
	60
	120
	180
	240
	300
	360
	420

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atgagcagta	ttttcgggca	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctgttat	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccggggccc	atcaagaccc	cgatgctcga	tgatcatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcctctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 86
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 86
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Met 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 Arg 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 Thr Thr Glu Glu Ala
 65 70 75 80
 Phe Gly Pro Val Thr Thr Leu Val Asn Asn Ala Gly Ile Gly Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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
 Phe Gly Gln Val Gly Asp Pro Thr Thr Gly Ala Tyr Asn Ala Ser Lys
 145 150 155 160
 Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Leu Cys Ala Leu
 165 170 175
 Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 87
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 87
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgggt 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttccggcccg ttacgacctt agtgaacaat gcagggattg gggttctgaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

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atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtag	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgatcatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 88
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 88
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Met 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 Arg 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 Leu Val Asn Asn Ala Gly Ile Gly Val Leu
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 89
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 89
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgggt 60
 ttggcaatcg ccgataaatt ttagtagagg ggtgcgaaag tagttattac tggctcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcgggc ctgatgttat tcgctttgtc 180
 cagcacgatg cgtctgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcgggcccg ttacgaccgt cgtgaacaat gcagggattg gggttctgaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggctgtag catcatcaat 420
 atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480

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ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccggggccc	atcaagaccc	cgatgctcga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cggttgacc	gcacag			756

<210> 90
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 90
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Met 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 Arg 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 Gly Val 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
 Phe Gly Gln Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 91
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 91
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatcgggt 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcgagg ctgatgttat tcgctttgtc 180
 cagcacgatg ttcccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttccggcccg ttacgacctt agtgaacaat gcagggattg gggtttacia aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaaact ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540

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gtgctgtgtca	acacagtaca	tccggggcccc	atcaagaccc	cgatgctcga	tgatcatgaa	600
gggtgctgagg	aaatgttttc	acagcgtacg	aaaaccccca	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 92
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 92
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Met 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 Arg 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 Thr Thr Glu Glu Ala
 65 70 75 80
 Phe Gly Pro Val Thr Thr Leu Val Asn Asn Ala Gly Ile Gly Val Tyr
 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
 Phe Gly Gln Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 93
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 93
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcaaaag tagttattac tggctgctcg 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcggcccggt ttacgacctt agtgaacaat gcagggatgg gggttctgaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcgggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
 gtgctgtgtca acacagtaca tccggggcccc atcaagaccc cgatgctcga tgatcatgaa 600

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ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacatg gcatctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggtcgacgg cgggtggacc gcacag 756

<210> 94
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 94
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15
Met 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 Arg 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 Leu Val Asn Asn Ala Gly Ile Gly Val 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
Phe Gly Gln Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
180 185 190
Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
245 250

<210> 95
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 95
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg 60
ttggcaatcg ccgataaatt ttagaggag ggtgcaaaag tagttattac tggtcgctcg 120
gcggatgtag gtgaaaaggc cgccaaatca atcgggcgga ctgatgttat tcgctttgtc 180
cagcagcatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg gggttctgaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccggtt atctggatgg tgtttttttc 360
ggcaccgcgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggca agtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctgttat gcgactgaa ggactacgat 540
gtgctgttca acacagtaca tccgggcccc atcaagacc cgaatgctga tgattatgaa 600
ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660

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aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt
gcagaatttg tggtcgacgg cgggtggacc gcacag

720
756

<210> 96
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 96
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 Arg 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 Gly Val Leu
85 90 95
Lys Ser Val Glu Asp Thr Thr Thr 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
Phe Gly Gln Val Gly Asp Pro Thr Thr Gly Ala Tyr Asn Ala Ser Lys
145 150 155 160
Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Leu Cys Ala Leu
165 170 175
Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Pro Ile Lys
180 185 190
Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
245 250

<210> 97
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 97
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgggt 60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcgga ctgatgttat tcgctttgtc 180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
gtgctgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcacgaa 600
ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggctcgacgg cgggtggacc gcacag

756

<210> 98
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 98
 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 Arg 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 Gly Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 99
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 99
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcgcca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcgggcccg ttacgacctt agtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgta atctggatgg tgttttttc 360
 ggcaccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctgttat gcgactgaa ggactacgat 540
 gtgctgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcactcgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggctcgacgg cgggtggacc gcacag 756

<210> 100
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 100
 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 Arg 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 Leu Val Asn Asn Ala Gly Ile Gly Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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
 Phe Gly Gln Val Gly Asp Pro Thr Thr Gly Ala Tyr Asn Ala Ser Lys
 145 150 155 160
 Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Leu Cys Ala Leu
 165 170 175
 Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 101
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 101
 atgaccgatac gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcggg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcgggc ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttccggcccgg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
 gtgctgtca acacagtaca tccgggcccc atcaagaccc cgatgtctga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctca tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcacttgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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<210> 102
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 102
 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 Arg 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 Gly Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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
 Phe Gly Gln Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 103
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 103
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgctcg 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttccggcccg ttacgacctt agtgaacaat gcagggattg gggtttaca aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgcta atctggatgg tgtttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctgttat gcgactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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<210> 104
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 104
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Met 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 Arg 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 Leu Val Asn Asn Ala Gly Ile Gly Val Tyr
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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
 Phe Gly Met Val Gly Asp Pro Thr Thr Gly Ala Tyr Asn Ala Ser Lys
 145 150 155 160
 Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Leu Cys Ala Leu
 165 170 175
 Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 105
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 105
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcggcccggt ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgtc tgggcattca gcgcataaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
 agtgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

<210> 106

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

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 106
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15
Met 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 Arg 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 Thr Thr Glu Glu Ala
65 70 75 80
Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Gly Val Val
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
Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
180 185 190
Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe Ser Gln
195 200 205
Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Ser Asp Ile Ala
210 215 220
Trp Val 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 Trp Thr Ala Gln
245 250

<210> 107
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 107
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgggt 60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcgcca ctgatgttat tcgctttgtc 180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccggt ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaaactg ctgtccgtta atctggatgg tgtttttttc 360
ggcaccggtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
gcgaattttg tggtcgacgg cgggtggacc gcacag 756

<210> 108
<211> 252

CX2-103W01_ST25

<212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 108
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Met 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 Arg 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 Gly Val Val
 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
 Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 109
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 109
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgggt 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcggccccg ttacgaccgt cgtgaacaat gcagggattg gggtttaca aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat tgtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctgttat gcgcactgaa ggactacgat 540
 gtgctgtgta acacagtaca tccgggcccc atcaagacct cgatgctcga tgatcatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcattctgacg aatcgaaatt tgcgacgggt 720
 gcgaatttg tggctcgacgg cgggtggacc gcacag 756

<210> 110
 <211> 252
 <212> PRT

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 110

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Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1      5      10      15
Met 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 Arg 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 Thr Thr Glu Glu Ala
65     70     75     80
Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Gly Val Tyr
85     90     95
Lys Ser Val Glu Asp Thr Thr Thr 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
Phe Gly Ile Val Gly Asp Pro Thr Thr Gly Ala Tyr Asn Ala Ser Lys
145    150    155    160
Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Leu Cys Ala Leu
165    170    175
Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Pro Ile Lys
180    185    190
Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
245    250

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<210> 111

<211> 756

<212> DNA

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 111

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atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgggt      60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt      120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc      180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca      240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg gggttctgaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag      480
ggggcggtag gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat      540
gtgcgtgtca acacagtaca tccgggcccc atcaagacct cgatgctcga tgattatgaa      600
ggtgctgagg aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtacacc gcacag      756

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<210> 112

<211> 252

<212> PRT

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 112

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Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1      5      10      15
Met 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 Arg 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 Gly Val Leu
85     90     95
Lys Ser Val Glu Asp Thr Thr Thr 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
Phe Gly Gln Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
180    185    190
Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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> 113

<211> 756

<212> DNA

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 113

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atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgg      60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt      120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc      180
cagcagcatg tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca      240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag      480
ggggcgggtac gtatcatgtc gaaaagcgca gcgctgttat gcgcactgaa ggactacgat      540
gtgctgtgta acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcatgaa      600
ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtggacc gcacag                                756

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<210> 114

<211> 252

<212> PRT

<213> Artificial Sequence

CX2-103W01_ST25

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 114

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Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1      5      10      15
Met 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 Arg 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 Thr Thr Glu Glu Ala
65     70     75     80
Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Gly Val Val
85     90     95
Lys Ser Val Glu Asp Thr Thr Thr 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
Phe Gly Gln Val Gly Asp Pro Thr Thr Gly Ala Tyr Asn Ala Ser Lys
145    150    155    160
Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Leu Cys Ala Leu
165    170    175
Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Pro Ile Lys
180    185    190
Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
245    250

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<210> 115

<211> 756

<212> DNA

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 115

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atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgg      60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt      120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc      180
cagcacgatg tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca      240
ttcggccccg ttacgacctt agtgaacaat gcagggattg gggtttaca aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagta ttttcgggat tgtaggcgat ccgactaccg gggcatacaa cgcttccaag      480
ggggcggtac gtatcatgtc gaaaagcgca gcgctgttat gcgactgaa ggactacgat      540
gtgctgttca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa      600
ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcactgtacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtggacc gcacag                                756

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<210> 116

<211> 252

<212> PRT

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 116

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Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1      5      10      15
Met 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 Arg 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 Thr Thr Glu Glu Ala
65     70     75     80
Phe Gly Pro Val Thr Thr Leu Val Asn Asn Ala Gly Ile Gly Val Tyr
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
Phe Gly Ile Val Gly Asp Pro Thr Thr Gly Ala Tyr Asn Ala Ser Lys
145    150    155    160
Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Leu Cys Ala Leu
165    170    175
Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Pro Ile Lys
180    185    190
Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
245    250

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<210> 117

<211> 756

<212> DNA

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 117

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atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg      60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt      120
gcggatgtag gtgaaaaggg cgccaaatca atcggcgcca ctgatgttat tcgctttgtc      180
cagcacgatg tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca      240
ttcggcccgg ttacgacctt agtgaacaat gcagggattg gggtttaca aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag      480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat      540
gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcatgaa      600
ggtgctgagg aaatgttttc acagcgtagc aaaaccctta tgggtcacat tggcgaaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt      720
gcgaatttg tggtcgacgg cgggtacacc gcacag      756

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<210> 118

<211> 252

<212> PRT

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

CX2-103W01_ST25

<400> 118
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 Arg 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 Thr Thr Glu Glu Ala
65 70 75 80
Phe Gly Pro Val Thr Thr Leu Val Asn Asn Ala Gly Ile Gly Val Tyr
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
Phe Gly Gln Val Gly Asp Pro Thr Thr Gly Ala Tyr Asn Ala Ser Lys
145 150 155 160
Gly Ala Val Arg Ile Met Ser Lys Ser Ala Leu Asp Cys Ala Leu
165 170 175
Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Pro Ile Lys
180 185 190
Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe 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 Val 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> 119
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 119
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgg 60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcgga ctgatgttat tgcgtttgtc 180
cagcacgatg tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccggt ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaactg ctgtccggtta atctggatgg tgtttttttc 360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcatgaa 600
ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggctcgacgg cgggttcacc gcacag 756

<210> 120
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

CX2-103W01_ST25

<400> 120
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15
Met 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 Arg 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 Thr Thr Glu Glu Ala
65 70 75 80
Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Gly Val Val
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
Phe Gly Gln Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
180 185 190
Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe 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 Val 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> 121
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 121
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ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcgga ctgatgttat tcgctttgtc 180
cagcacgatg tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccggt ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctgttat gcgcactgaa ggactacgat 540
gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcattctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggtcgacgg cgggtggacc gcacag 756

<210> 122
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 122

CX2-103W01_ST25

Met	Thr	Asp	Arg	Leu	Lys	Gly	Lys	Val	Ala	Ile	Val	Thr	Gly	Gly	Thr
1				5					10					15	
Met	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	Arg	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	Thr	Thr	Glu	Glu	Ala
65					70				75					80	
Phe	Gly	Pro	Val	Thr	Val	Val	Asn	Asn	Ala	Gly	Ile	Gly	Val	Val	
				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				
Phe	Gly	Gln	Val	Gly	Asp	Pro	Thr	Thr	Gly	Ala	Tyr	Asn	Ala	Ser	Lys
145					150				155						160
Gly	Ala	Val	Arg	Ile	Met	Ser	Lys	Ser	Ala	Ala	Leu	Leu	Cys	Ala	Leu
				165					170					175	
Lys	Asp	Tyr	Asp	Val	Arg	Val	Asn	Thr	Val	His	Pro	Gly	Pro	Ile	Lys
			180				185						190		
Thr	Pro	Met	Leu	Asp	Asp	Tyr	Glu	Gly	Ala	Glu	Glu	Met	Phe	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	Val	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	Trp	Thr	Ala	Gln				
				245					250						

<210> 123
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 123	
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgggt	60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgctcgt	120
gcggatgtag gtgaaaaggg cgccaaatca atcgggcgga ctgatgttat tcgctttgtc	180
cagcacgatg ttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca	240
ttcggcccg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa	300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc	360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat	420
atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag	480
ggggcggtac gtatcatgtc gaaaagcgca gcgctgttat gcgactgaa ggactacgat	540
gtgctgtgta acacagtaca tccgggcccc atcaagacct cgatgctcga tgatcatgaa	600
ggtgctgagg aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaaccg	660
aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt	720
gcagaatttg tggctgacgg cgggtggacc gcacag	756

<210> 124
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 124	
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr	

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

<210> 125
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 125

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacaat	gggtatcggt	60
ttggcaatcg	ccgataaatt	tgtagaggag	ggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	tttccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggccccg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggtta	aagcgttgaa	300
gacactacca	cggagggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tggttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggct	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 126
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 126

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

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Met 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 Arg 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 Thr Thr Glu Glu Ala
 65 70 75 80
 Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Gly Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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
 Phe Gly Leu Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 127
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 127
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcgga ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttccggcccg ttacgacctt agtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaatct ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgtc tgggcattca gcgcattgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcactgtacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

<210> 128
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 128
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Met Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala

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	20		25		30										
Lys	Val	Val	Ile	Thr	Gly	Arg	Arg	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	Leu	Val	Asn	Asn	Ala	Gly	Ile	Gly	Val	Val
	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										
Phe	Gly	Gln	Val	Gly	Asp	Pro	Thr	Thr	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	Pro	Ile	Lys
	180		185		190										
Thr	Pro	Met	Leu	Asp	Asp	His	Glu	Gly	Ala	Glu	Glu	Met	Phe	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	Val	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	Trp	Thr	Ala	Gln				
	245		250												

<210> 129
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 129

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacaat	gggtatcggt	60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	tttccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttctgaa	aagcggtgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccgctc	tgggcattca	gcgcataaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	tgtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgcctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgatcatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 130
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 130

Met	Thr	Asp	Arg	Leu	Lys	Gly	Lys	Val	Ala	Ile	Val	Thr	Gly	Gly	Thr
1		5		10		15		20		25		30			
Met	Gly	Ile	Gly	Leu	Ala	Ile	Ala	Asp	Lys	Phe	Val	Glu	Glu	Gly	Ala
	20		25		30										

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Lys Val Val Ile Thr Gly Arg Arg 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 Thr Thr Glu Glu Ala
 65 70 75 80
 Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Gly Val 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
 Phe Gly Ile Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Leu Asp Asp His Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 131
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 131
 atgaccgatc gtctgaagag caaagtagcc atcgtaaccg gcgggacact gggatatcggg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcgga ctgatgttat tcgctttatc 180
 cagcacgatg tgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttccgcccgg ttacgaccgt cgtgaacaat gcagggatgg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgtc tgggcattcg ccgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgtctga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcgtat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tgatcgacgg cgggtggacc gcacag 756

<210> 132
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 132
 Met Thr Asp Arg Leu Lys Ser 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 Arg Ala Asp Val Gly Glu Lys Ala Ala

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      35              40              45
Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Ile Gln His Asp Val
      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 Gly Val Val
      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 Arg Arg
      115              120              125
Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
      130              135              140
Phe Gly Met Val Gly Asp Pro Thr Thr 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 Pro Ile Lys
      180              185              190
Thr Pro Met Leu Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe Ser Gln
      195              200              205
Arg Thr Lys Thr Pro Met Gly Arg Ile Gly Glu Pro Asn Asp Ile Ala
      210              215              220
Trp Val Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
      225              230              235              240
Ala Glu Phe Val Ile Asp Gly Gly Trp Thr Ala Gln
      245              250

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<210> 133
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 133
atgaccgattc gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggatatcgg 60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
ttcggcccggt ttacgaccgt agtgaacaat gcagggattc cggtggttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccgcta atctggatgg tgtttttttc 360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagtg tgttcgggat tgtaggcgac ccgactaccg gggcatactg tgcttccaag 480
ggggcggtag gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa 600
ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
gcagaatctg tggtcgacgg cgggtggacc gcacag 756

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<210> 134
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 134
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1      5      10      15
Arg 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 Arg Ala Asp Val Gly Glu Lys Ala Ala
35     40     45

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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 Pro 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 Pro Val Val
85 90 95
Lys Ser Val Glu Asp Thr Thr Thr 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 Val
130 135 140
Phe Gly Ile Val Gly Asp Pro Thr Thr Gly Ala Tyr Cys 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 Pro Ile Lys
180 185 190
Thr Pro Met Met Asp Ser Tyr Glu Gly Ala Glu Glu Met Phe 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 Val Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 230 235 240
Ala Glu Ser Val Val Asp Gly Gly Trp Thr Ala Gln
245 250

<210> 135
<211> 756
<212> DNA
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 135
atgaccgatac gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggatcgggt 60
ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
ttcggcccgg ttacgacctt agtgaacaat gcagggattc cggtggttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaaactg ctgtccgtta atctggatgg tgttttttc 360
ggcaccgcgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagtg tgttcgggat ttaggctac ccgactaccg gggcatactg tgcttccaag 480
ggagcggtag gtatcatgtc gaaaagcgca gcgctggatt gcgcaactgaa ggactacgat 540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa 600
ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggctcgacgg cgggtggacc gcacag 756

<210> 136
<211> 252
<212> PRT
<213> Artificial Sequence

<220>
<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 136
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15
Arg 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 Arg 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

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      50                      55                      60
Ser Asp Glu Ala Gly Trp Pro Lys Leu Phe Asp Thr Thr Glu Glu Ala
65 Phe Gly Pro Val Thr Thr Leu Val Asn Asn Ala Gly Ile Pro Val Val
      85                      90                      95
Lys Ser Val Glu Asp Thr Thr Thr 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 Val
      130                     135                     140
Phe Gly Ile Val Gly Tyr Pro Thr Thr Gly Ala Tyr Cys Ala Ser Lys
145 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 Pro Ile Lys
      180                     185                     190
Thr Pro Met Met Asp Ser Tyr Glu Gly Ala Glu Glu Met Phe Ser Gln
      195                     200                     205
Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
210 Trp Val Cys Val Tyr Leu Ala Ser Asp Glu Ser Lys Phe Ala Thr Gly
225 Ala Glu Phe Val Val Asp Gly Gly Trp Thr Ala Gln
      245                     250

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<210> 137
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 137
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaca aggtatcggg      60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt      120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc      180
cagcacgatg tatccgatga agcaggctgg actaaactgt tcgacaccac cgaggaggga      240
ttcggccccg ttacgacctt agtgaacaat gcagggaattc cgatgggttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc      360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagtg tgttcgggat tgtaggctac ccgactaccg gggcactactg tgcttccaag      480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat      540
gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa      600
ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtggacc gcacag                                756

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<210> 138
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 138
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15
Gln 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 Arg 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

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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 Leu Val Asn Asn Ala Gly Ile Pro Met Val
      85      90      95
Lys Ser Val Glu Asp Thr Thr Thr 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 Val
      130      135      140
Phe Gly Ile Val Gly Tyr Pro Thr Thr Gly Ala Tyr Cys 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 Pro Ile Lys
      180      185      190
Thr Pro Met Met Asp Ser Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
      245      250

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<210> 139
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 139
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggatcgggt      60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt      120
gcggatgtag gtgaaaaggg ccgcaaatac atcggcgagg ctgatgttat tcgctttgtc      180
cagcacgatg tatccgatga agcaggctgg actaaactgt tcgacaccac cgaggaggca      240
ttcggcccggt ttacgacctt agtgaacaat gcagggattc cggttgttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccggtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagtg tgttcgggat tgtaggctac ccgactaccg gggcactactg tgcttccaag      480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat      540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa      600
ggtgctgagg aaatgttttc acggcgtagc aaaaccctta tgggtcacat tggcggaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtggacc gcacag

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<210> 140
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 140
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1      5      10      15
Arg 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 Arg 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 Thr Thr Glu Glu Ala

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65	Phe	Gly	Pro	Val	Thr	70	Thr	Leu	Val	Asn	75	Asn	Ala	Gly	Ile	Pro	80	Val
					85		Thr	Thr	Thr	90	Glu	Glu	Trp	Arg	Lys	95	Leu	Ser
	Lys	Ser	Val	Glu	Asp	100				105						110		
	Val	Asn	Leu	Asp	Gly	115	Val	Phe	Phe	120	Gly	Thr	Arg	Leu	Gly	125	Ile	Gln
	Met	Lys	Asn	Lys	Gly	130	Leu	Gly	Ala	135	Ser	Ile	Ile	Asn	Met	140	Ser	Ser
	Phe	Gly	Ile	Val	Gly	145	Tyr	Pro	Thr	150	Thr	Thr	Gly	Ala	Tyr	155	Cys	Ala
	Gly	Ala	Val	Arg	Ile	165	Met	Ser	Lys	170	Ser	Ala	Ala	Leu	Asp	175	Cys	Ala
	Lys	Asp	Tyr	Asp	Val	180	Arg	Val	Asn	185	Thr	Val	His	Pro	Gly	190	Pro	Ile
	Thr	Pro	Met	Met	Asp	195	Ser	Tyr	Glu	200	Gly	Ala	Glu	Glu	Met	205	Phe	Ser
	Arg	Thr	Lys	Thr	Pro	210	Met	Gly	His	215	Ile	Gly	Glu	Pro	Asn	220	Asp	Ile
	Trp	Val	Cys	Val	Tyr	225	Leu	Ala	Ser	230	Asp	Glu	Ser	Lys	Phe	235	Ala	Thr
	Ala	Glu	Phe	Val	Val	245	Asp	Gly	Gly	250	Trp	Thr	Ala	Gln				

<210> 141
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 141																		
atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacaca	aggtatcggt													60
ttggcaatcg	ccgataaatt	tgtagaggag	ggtgcgaaag	tagttattac	tggtcgtcgt													120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc													180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca													240
ttcggcccg	ttacgaccgt	agtgaacaat	gcagggattc	cggtgggtta	aagcgttgaa													300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc													360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat													420
atgagcagtg	tggttcgggat	tgtaggcgac	ccgactaccg	gggcatactg	tgcttccaag													480
ggggcgggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat													540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgatgga	tagctatgaa													600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg													660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt													720
gcagaatttg	tggtcgacgg	cgggtacacc	gcacag															756

<210> 142
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 142																		
Met	Thr	Asp	Arg	Leu	Lys	Gly	Lys	Val	Ala	Ile	Val	Thr	Gly	Gly	Thr			
1				5				10					15					
Gln	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	Arg	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			

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Phe	Gly	Pro	Val	Thr	Thr	Val	Val	Asn	Asn	Ala	Gly	Ile	Pro	Val	Val
				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	Val
	130					135					140				
Phe	Gly	Ile	Val	Gly	Asp	Pro	Thr	Thr	Gly	Ala	Tyr	Cys	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	Pro	Ile	Lys
			180					185					190		
Thr	Pro	Met	Met	Asp	Ser	Tyr	Glu	Gly	Ala	Glu	Glu	Met	Phe	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	Val	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> 143
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 143															
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ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt										120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc										180
cagcacgatg	tatccgatga	agcaggctgg	cctaaactgt	tcgacaccac	cgaggaggca										240
ttcggcccg	ttacgaccgt	agtgaacaat	gcagggattc	cggtgggtta	aagcgttgaa										300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tggttttttc										360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat										420
atgagcagtg	tggttcgggat	tgtaggcgac	ccgactaccg	gggcatactg	tgcttccaag										480
ggggcgggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat										540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgatgga	tagctatgaa										600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg										660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt										720
gcagaatttg	tggtcgacgg	cgggtacacc	gcacag												756

<210> 144
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 144															
Met	Thr	Asp	Arg	Leu	Lys	Gly	Lys	Val	Ala	Ile	Val	Thr	Gly	Gly	Thr
1				5					10				15		
Met	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	Arg	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	Pro	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	Pro	Val	Val

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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 Val
 130 135 140
 Phe Gly Ile Val Gly Asp Pro Thr Thr Gly Ala Tyr Cys 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Met Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 147
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 147
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggatatcgg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcg 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg tatccgatga agcaggctgg actaaactgt tcgacaccac cgaggaggca 240
 ttccggcccg ttacgaccgt cgtgaacaat gcagggattc cgggtggttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccggtta atctggatgg tgttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg tgttcgggca agtaggctac ccgactaccg gggcactactg tgcttccaag 480
 ggggcggtag gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tgactatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctca tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

<210> 148
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 148
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Arg 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 Arg 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 Thr Thr Glu Glu Ala
 65 70 75 80
 Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Pro Val Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr Glu Glu Trp Arg Lys Leu Leu Ser

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Val	Asn	Leu	Asp	Gly	Val	Phe	Phe	Gly	Thr	Arg	Leu	Gly	Ile	Gln	Arg
		100						105					110		
Met	Lys	Asn	Lys	Gly	Leu	Gly	Ala	Ser	Ile	Ile	Asn	Met	Ser	Ser	Val
	115						120					125			
Phe	Gly	Gln	Val	Gly	Tyr	Pro	Thr	Thr	Gly	Ala	Tyr	Cys	Ala	Ser	Lys
	130				135						140				
Gly	Ala	Val	Arg	Ile	Met	Ser	Lys	Ser	Ala	Ala	Leu	Asp	Cys	Ala	Leu
			145		150				155						160
Lys	Asp	Tyr	Asp	Val	Arg	Val	Asn	Thr	Val	His	Pro	Gly	Pro	Ile	Lys
			165					170						175	
Thr	Pro	Met	Met	Asp	Asp	Tyr	Glu	Gly	Ala	Glu	Glu	Met	Phe	Ser	Gln
		180					185					190			
Arg	Thr	Lys	Thr	Pro	Met	Gly	His	Ile	Gly	Glu	Pro	Asn	Asp	Ile	Ala
	195					200						205			
Trp	Val	Cys	Val	Tyr	Leu	Ala	Ser	Asp	Glu	Ser	Lys	Phe	Ala	Thr	Gly
	210				215						220				240
Ala	Glu	Phe	Val	Val	Asp	Gly	Gly	Trp	Thr	Ala	Gln				
			225		230				235						
			245					250							

<210> 149
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 149

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccc	gcgggacaat	gggtatcggt	60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcgagg	ctgatgttat	tcgctttgtc	180
cagcacgatg	tatccgatga	agcaggctgg	cctaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	agtgaacaat	gcagggattc	cggtgggtta	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tggttttttc	360
ggcaccgcgc	tgggcattca	gcgcattgaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagtg	tggttcgggt	tgtaggcgac	ccgactaccg	gggcatactg	tgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgtc	acacagtaca	tccgggcccc	atcaagaccc	cgatgatgga	tagctatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctca	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 150
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 150

Met	Thr	Asp	Arg	Leu	Lys	Gly	Lys	Val	Ala	Ile	Val	Thr	Gly	Gly	Thr
1				5					10				15		
Met	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	Arg	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	Pro	Lys	Leu	Phe	Asp	Thr	Thr	Glu	Glu	Ala
65				70				75					80		
Phe	Gly	Pro	Val	Thr	Val	Val	Asn	Asn	Ala	Gly	Ile	Pro	Val	Val	
			85				90					95			
Lys	Ser	Val	Glu	Asp	Thr	Thr	Thr	Glu	Glu	Trp	Arg	Lys	Leu	Leu	Ser
			100				105					110			

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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 Val
    130      135      140
Phe Gly Ile Val Gly Asp Pro Thr Thr Gly Ala Tyr Cys 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 Pro Ile Lys
    180      185      190
Thr Pro Met Met Asp Ser Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
    245      250

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<210> 151
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 151
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggatcgggt      60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt      120
gcggatgtag gtgaaaaggg cgccaaatca atcggcgggc ctgatgttat tcgctttgtc      180
cagcacgatg catccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca      240
ttcggcccggt ttacgacctt agtgaacaat gcagggattc cggttgttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccggtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagtg tgttcgggat tgtaggctac ccgactaccg gggcatactg tgcttccaag      480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat      540
gtgctgtgca acacagtaca tccgggccct atcaagaccc cgatgatgga tgactatgaa      600
ggtgctgagg aaatgttttc acagcgtagc aaaaccctta tgggtcacat tggcgaaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtggacc gcacag      756

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<210> 152
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 152
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1      5      10      15
Arg 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 Arg 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 Pro Lys Leu Phe Asp Thr Thr Glu Glu Ala
    65      70      75      80
Phe Gly Pro Val Thr Leu Val Asn Asn Ala Gly Ile Pro Val Val
    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

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Met	Lys	Asn	Lys	Gly	Leu	Gly	Ala	Ser	Ile	Ile	Asn	Met	Ser	Ser	Val
	130					135					140				
Phe	Gly	Ile	Val	Gly	Tyr	Pro	Thr	Thr	Gly	Ala	Tyr	Cys	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	Pro	Ile	Lys
			180					185					190		
Thr	Pro	Met	Met	Asp	Asp	Tyr	Glu	Gly	Ala	Glu	Glu	Met	Phe	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	Val	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	Trp	Thr	Ala	Gln				
				245					250						

<210> 153
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 153

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacaat	gggtatcggg	60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	tatccgatga	agcaggctgg	cctaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccg	ttacgaccgt	agtgaacaat	gcggggattc	cggtgggtta	aagcgttgaa	300
gacactacca	cgggggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagt	tggttcgggat	tgtaggctac	ccgactaccg	gggcatactg	tgcttccaag	480
ggggcggtag	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgatgga	tgaccatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 154
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 154

Met	Thr	Asp	Arg	Leu	Lys	Gly	Lys	Val	Ala	Ile	Val	Thr	Gly	Gly	Thr
1				5					10					15	
Met	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	Arg	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	Pro	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	Pro	Val	Val
				85				90					95		
Lys	Ser	Val	Glu	Asp	Thr	Thr	Thr	Gly	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			

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Met	Lys	Asn	Lys	Gly	Leu	Gly	Ala	Ser	Ile	Ile	Asn	Met	Ser	Ser	Val
	130					135					140				
Phe	Gly	Ile	Val	Gly	Tyr	Pro	Thr	Thr	Gly	Ala	Tyr	Cys	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	Pro	Ile	Lys
			180					185					190		
Thr	Pro	Met	Met	Asp	Asp	His	Glu	Gly	Ala	Glu	Glu	Met	Phe	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	Val	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	Trp	Thr	Ala	Gln				
				245					250						

<210> 155
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 155	
atgaccgatac	gtctgaaggg
ttggcaatcg	ccgataaatt
gcggatgtag	gtgaaaaggc
cagcagcatg	cgtccgatga
ttcggcccg	ttacgaccgt
gacactacca	cggaggaatg
ggcaccggtt	tgggcattca
atgagcagtg	tggttcgggat
ggggcgggtac	gtatcatgtc
gtgcgtgtca	acacagtaca
ggtgctgagg	aaatgttttc
aatgacatcg	catgggtctg
gcagaatttg	tggtcgacgg
	caaagtagcc
	tgtagaggag
	cgccaaatca
	agcaggctgg
	cgtgaacaat
	gcagggattc
	gcgtaaactg
	gcgcatgaaa
	tgtaggcgac
	gaaaagcgca
	tccgggcccc
	acagcgtacg
	tgtgtacctg
	cggggtggacc
	atcgtaaccg
	ggtgcgaaag
	atcggcggca
	actaaactgt
	gcagggattc
	ctgtccgtta
	aataaaggct
	gcgctggatt
	gcgactgaa
	gcgactgaa
	gagcactgaa
	atcaagaccc
	aaaaccctta
	gcacag
	gcgacacacg
	cggtatcggt
	tagttattac
	ctgatgttat
	tcgacaccac
	cgaggaggca
	aagcgttgaa
	tggttttttc
	catcatcaat
	tgcttccaag
	ggactacgat
	tagccatgaa
	tggtcgaaccg
	tgcgacgggt
	60
	120
	180
	240
	300
	360
	420
	480
	540
	600
	660
	720
	756

<210> 156
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 156															
Met	Thr	Asp	Arg	Leu	Lys	Gly	Lys	Val	Ala	Ile	Val	Thr	Gly	Gly	Thr
1				5					10					15	
Arg	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	Arg	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	Pro	Val	Val
				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	Val

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      130      135      140
Phe Gly Ile Val Gly Asp Pro Thr Thr Gly Ala Tyr Cys 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 Pro Ile Lys
      180      185      190
Thr Pro Met Met Asp Ser His Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
      245      250

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<210> 157
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

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<400> 157
atgaccgatac gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggatcgggt      60
ttggcaatcgc ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgctcgt      120
gcggatgtagc gtgaaaaggg cgccaaatca atcggcgagg ctgatgttat tcgctttgtc      180
cagcacgatgc tatccgatga agcaggctgg actaaactgt tcgacaccac cgaggaggca      240
ttcggccccgg ttacgaccgt cgtgaacaat gcagggtatt cgatgggttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccggtta atctggatgg tgttttttc      360
ggcaccgcgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagtg tgttcgggat ggtaggctac ccgactaccg gggcatacaa tgcttccaag      480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat      540
gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgatgga tgattatgaa      600
ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcactctgac aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtacacc gcacag      756

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<210> 158
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

```

<400> 158
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1      5      10      15
Arg 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 Arg 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 Thr Thr Glu Glu Ala
65      70      75      80
Phe Gly Pro Val Thr Val Val Asn Asn Ala Gly Ile Pro Met Val
      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 Val
130      135      140

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Phe Gly Met Val Gly Tyr Pro Thr Thr 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Met Asp Asp Tyr Glu Ala Glu Glu Met Phe 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 Val 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> 159
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 159
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaca aggtatcggg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg catccgatga agcaggctgg actaaactgt tcgacaccac cgaggaggca 240
 ttcggcccggt ttacgaccgt agtgaacaat gcagggattc cgatgggttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg tgttcgggca agtaggcgac ccgactaccg gggcatacaa tgcttccaag 480
 ggggcgggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagccatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggttcacc gcacag 756

<210> 160
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 160
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Gln 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 Arg 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 Val Val Asn Asn Ala Gly Ile Pro Met Val
 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 Val
 130 135 140
 Phe Gly Gln Val Gly Asp Pro Thr Thr Gly Ala Tyr Asn Ala Ser Lys

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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	Pro	Ile	Lys
		180		185		190									
Thr	Pro	Met	Met	Asp	Ser	His	Glu	Gly	Ala	Glu	Glu	Met	Phe	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	Val	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> 161
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 161

atgaccg	gtctga	aggagg	caaagtag	cc	atcgta	accg	gcgggac	acaca	agg	tatcg	gt	60
ttggca	atcg	ccgata	aaatt	tgtagagg	agg	gcgaa	ag	tagttatt	ac	tggtc	gtcgt	120
gcggat	gtag	gtgaaa	aggc	cgccaa	atca	atcggc	ggca	ctgatgtt	at	tcgctt	tgtc	180
cagcac	gatg	tatccg	atga	agcagg	ctgg	actaa	actgt	tcgacacc	ac	cgaggag	ggca	240
ttcggc	ccgg	ttacgac	ctt	agtgaaca	at	gcaggga	ttc	cggttg	ttaa	aagcg	ttgaa	300
gacact	acca	cggagga	aatg	gcgtaaa	ctg	tccgtta	at	cttggat	gg	tg	tttttt	360
ggcacc	cg	tc	gattca	gcgcat	gaaa	aataaa	aggct	tgggcg	ctag	catcat	caat	420
atgagc	agtg	tg	tcggg	at	tgtagg	cgac	ccgact	accg	gggcata	ctg	tgcttcca	480
ggggcg	gtac	gtatcat	gtc	gaaaag	cgca	gcgctg	gatt	gcgcact	gaa	ggactac	gat	540
gtg	cg	gtg	tca	acacagt	taca	tccggg	cccc	atcaag	accc	cgatgat	gga	600
ggtg	ctg	agg	aaatg	ttttc	acagc	gtacg	aaaaccc	cta	tgggtc	acat	tg	660
aatg	acat	cg	catggg	tctg	tgtgtac	ctg	gc	atctg	acg	aatcgaa	att	720
gcaga	attt	g	tggtc	gacgg	cg	gggtg	gacc	gcacag				756

<210> 162
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 162

Met	Thr	Asp	Arg	Leu	Lys	Gly	Lys	Val	Ala	Ile	Val	Thr	Gly	Gly	Thr
1				5					10					15	
Gln	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	Arg	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	Thr	Thr	Glu	Glu	Ala
65					70				75					80	
Phe	Gly	Pro	Val	Thr	Leu	Val	Asn	Asn	Ala	Gly	Ile	Pro	Val	Val	
				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	Val
			130			135					140				
Phe	Gly	Ile	Val	Gly	Asp	Pro	Thr	Thr	Gly	Ala	Tyr	Cys	Ala	Ser	Lys
145					150					155					160

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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 Pro Ile Lys
 180 185 190
 Thr Pro Met Met Asp Ser His Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 163
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 163
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaca aggtatcggt 60
 ttggcaatcg ccgataaact tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcgagg ctgatgttat tcgctttgtc 180
 cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
 ttcggccccg ttaccaccgt cgtgaacaat gcagggattc cgatgggttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg tgttcgggat tgtaggcgac ccgactaccg gggcatacaa tgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
 gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtacacc gcacag 756

<210> 164
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 164
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Gln Gly Ile Gly Leu Ala Ile Ala Asp Lys Leu Val Glu Glu Gly Ala
 20 25 30
 Lys Val Val Ile Thr Gly Arg Arg 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 Pro 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 Pro Met Val
 85 90 95
 Lys Ser Val Glu Asp Thr Thr Thr 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 Val
 130 135 140
 Phe Gly Ile Val Gly Asp Pro Thr Thr 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

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Lys	Asp	Tyr	Asp	Val	Arg	Val	Asn	Thr	Val	His	Pro	Gly	Pro	Ile	Lys
			180					185					190		
Thr	Pro	Met	Met	Asp	Ser	Tyr	Glu	Gly	Ala	Glu	Glu	Met	Phe	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	Val	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> 165
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 165	
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaca aggtatcggt	60
ttggcaatcg ccgataaatt ttagagaggag ggtgcgaaag tagttattac tggctcgtcgt	120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc	180
cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca	240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattc cggttgttaa aagcgttgaa	300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc	360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat	420
atgagcagtg tgttcgggat ggtaggcgat ccgactaccg gggcatactg tgcttccaag	480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat	540
gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgatgga tgactatgaa	600
ggtgctgagg aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg	660
aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt	720
gcagaatttg tggctcgacgg cgggtacacc gcacag	756

<210> 166
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 166	
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr	
1 5 10 15	
Gln 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 Arg 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 Pro 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 Pro Val Val	
85 90 95	
Lys Ser Val Glu Asp Thr Thr Thr 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 Val	
130 135 140	
Phe Gly Met Val Gly Asp Pro Thr Thr Gly Ala Tyr Cys 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	

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Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Pro Ile Lys
 180 185 190
 Thr Pro Met Met Asp Asp Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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> 167
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 167
 atgaccgatac gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggatcgggt 60
 ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcagcatg catccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
 ttcggcccg ttacgacctt agtgaacaat gcagggattc cggtggttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaaactg ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg tgttcgggat ttagggcgac ccgactaccg gggcactactg tgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgctgtgta acacagtaca tccgggcccc atcaagaccc cgatgatgga tgactatgaa 600
 ggtgctgagg aaatgttttc acagcgtagc aaaaccccta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggttcacc gcacag 756

<210> 168
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 168
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Arg 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 Arg 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 Pro Lys Leu Phe Asp Thr Thr Glu Glu Ala
 65 70 75 80
 Phe Gly Pro Val Thr Thr Leu Val Asn Asn Ala Gly Ile Pro Val Val
 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 Val
 130 135 140
 Phe Gly Ile Val Gly Asp Pro Thr Thr Gly Ala Tyr Cys 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 Pro Ile Lys

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Thr Pro Met Met Asp Ser Tyr Glu Gly Ala Glu Glu Met Phe 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 Val 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 Trp Thr Ala Gln
 245 250

<210> 171
 <211> 756
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 171
 atgaccgatac gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggatcgggt 60
 ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcgcca ctgatgttat tcgctttgtc 180
 cagcagcatg tatccgatga agcaggctgg actaaactgt tcgacaccac cgaggaggca 240
 ttcggcccgg ttacgaccgt cgtgaacaat gcagggattc cgatgggtta aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg tgttcgggat ggtaggcgac ccgactaccg gggcatactg tgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
 gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgatgga tgaccatgaa 600
 ggtgctgagg aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggttcacc gcacag 756

<210> 172
 <211> 252
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 172
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Arg 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 Arg 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 Thr Thr Glu Glu Ala
 65 70 75 80
 Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile Pro Met Val
 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 Val
 130 135 140
 Phe Gly Met Val Gly Asp Pro Thr Thr Gly Ala Tyr Cys 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 Pro Ile Lys
 180 185 190
 Thr Pro Met Met Asp Asp His Glu Gly Ala Glu Glu Met Phe Ser Gln

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		195				200					205				
Arg	Thr	Lys	Thr	Pro	Met	Gly	His	Ile	Gly	Glu	Pro	Asn	Asp	Ile	Ala
	210					215					220				
Trp	Val	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						