

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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ttggca	atcg	ccgata	aaatt	tgtag	aggag	ggtgcg	aaag	tagtt	attac	tggtcg	tcac	120
gcggat	gtag	gtgaaa	aggc	cgccaa	atca	atcggc	ggca	ctgat	gttat	tcgctt	tgtc	180
cagcac	gatg	catccg	atga	agcagg	ctgg	acgaaa	actgt	tcgac	accac	cgagg	aggca	240
ttcggc	ccgg	ttacgc	accgt	cgtga	aaca	atgcag	ggattg	cagttt	ccaa	aagcgt	ttgaa	300
gacact	acca	cggagga	aatg	gcgtaa	actg	ctgtcc	gtta	atctgg	atgg	tgtttt	tttc	360
ggcacc	ccgtc	tgggcatt	ca	gcgc	atgaaa	aataaa	aggct	tgggcg	ctag	catcat	caat	420
atgagc	agta	ttgagg	gggtt	cgtagg	cgat	ccgacg	ctgg	gggcata	caa	cgctt	ccaag	480
ggggcg	gtac	gtatcat	gtc	gaaaag	cgca	gcgctg	gatt	gcgcact	gaa	ggacta	cgat	540
gtgcgt	gtca	acacagt	taca	tccggg	ctat	atcaag	accc	cgctgg	tcga	tgatct	ggaa	600
ggtgct	gagg	aaatgat	gtc	acagcg	tacg	aaaacc	cccta	tgggcc	acat	tggcga	accg	660
aatgac	atcg	catggat	ctg	tgtgtac	ctg	gcattc	tgacg	aatcgaa	att	tgcgac	gggt	720
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<210> 2

<211> 252

<212> PRT

<213> Lactobacillus kefir

<400> 2

Met	Thr	Asp	Arg	Leu	Lys	Gly	Lys	Val	Ala	Ile	Val	Thr	Gly	Gly	Thr
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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

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

<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
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gacactacca	cggaggaatg
ggcaccgctc	tgggcatcca
atgagcagta	ttttcgggat
ggggcggtac	gtatcatgtc
gtgcgtgtca	acacagtaca
ggtgctgagg	aaatgatgtc
aatgacatcg	catgggtctg
gcagaatttg	tggtcgacgg
	cgggtggacc
	gcacag
	atcgtaaccg
	gcgggacact
	gggtatcggt
	tagttattac
	ctgatgttat
	tcgctttgtc
	tcgacaccac
	cgaggaggca
	aagcgttgaa
	tggttttttc
	atctggatgg
	tgggctgtag
	catcatcaat
	gggcatataa
	cgcttccaag
	gcgactgaa
	ggactacgat
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	tgattatgaa
	tgggccacat
	tggcgaaccg
	aatcgaaatt
	tgcgacgggt
	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
1	5
Leu Gly Ile	Gly Leu Ala Ile Ala
	20
	25
	10
	15
	30

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Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
   35   40
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 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 gtgaaaaggc cgccaaatca atcggcgagg ctgatgttat tcgctttgtc      180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca      240
ttcgggccgg ttacgaccgt cgtgaacaat gcagggattg gggttcttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaaact ctgtccggtta atctggatgg tgtttttttc      360
ggcaccggtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag      480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcaactgaa ggactacgat      540
gtgcgtgtca 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

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

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

<400> 6

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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	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	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> 7
 <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
cagcacgatg	cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca
ttcggcccg	ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa
gacactacca	cggaggaatg gcgtaaaactg ctgtccgtta atctggatgg tgttttttc
ggcaccgctc	tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat
atgagcagta	ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag
ggggcggtac	gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat
gtgctgtca	acacagtaca tccgggcccc atcaagaccc cggtctcga tgattatgaa
ggtgctgagg	aaatgatgtc acagcgtagc aaaacccta tgggccacat tggcgaaccg
aatgacatcg	catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt
gcagaatttg	tggtcgacgg cgggtggacc gcacag
	60 120 180 240 300 360 420 480 540 600 660 720 756

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

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<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 8

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Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
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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 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 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

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<210> 9

<211> 756

<212> DNA

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 9

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gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc      180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca      240
ttcggcccggttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccctgc 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 acagcgtagc aaaacccta tgggccacat tggcgaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtggacc gcacag                                756

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<210> 10

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

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

<400> 10
Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15
Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
20 25 30
Lys Val Val Ile Thr Gly Arg His Ala Asp Val Gly Glu Lys Ala Ala
35 40 45
Lys Ser Ile Gly Gly Thr Asp Val Ile Arg Phe Val Gln His Asp Ala
50 55 60
Ser Asp Glu Ala Gly Trp Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
65 70 75 80
Phe Gly Pro Val Thr Thr Val Val Asn Asn Ala Gly Ile 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> 11
<211> 756
<212> DNA
<213> Artificial Sequence

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

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gcggatgtag gtgaaaaggc cgccaaatca atcggcgagg ctgatgttat tcgctttgtc 180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg gggttcttaa 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 gcgcaactgaa ggactacgat 540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
ggtgctgagg aaatgatgtc acagcgtagc aaaacccta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggtcgacgg cgggtggacc gcacag

756

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

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

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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 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 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
 ttcgggcccg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgta atctggatgg tgttttttc 360
 ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480

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ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcaactgaa	ggactacgat	540
gtgcgtgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
gggtgctgagg	aaatgttttc	acagcgtagc	aaaaccccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcacatctgacg	aatcgaaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

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

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

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

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

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 gcggatgtag gtgaaaaaggc cgccaaatca atcggcgaggc ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

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ttcggccccg	ttacgaccgt	cgtgaacaat	gcaggggattg	gggttggttaa	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	gcgcactgaa	ggactacgat	540
gtgcgtgtca	acacagtaca	tccggggcccc	atcaagaccc	cggctctcga	tgattatgaa	600
ggtgctgagg	aaatgatgtc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcatctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

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

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

<400> 16
 Met Thr Asp Arg Leu Lys Gly Lys Val Ala Ile Val Thr Gly Gly Thr
 1 5 10 15
 Leu Gly Ile Gly Leu Ala Ile Ala Asp Lys Phe Val Glu Glu Gly Ala
 20 25 30
 Lys Val Val Ile Thr Gly Arg 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 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

<400> 17

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atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaacccg	gcgggacact	gggtatcggt	60
ttggcaatcg	ccgataaatt	tgtagaggag	ggtgcgaaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattc	ctgttggttaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccctgc	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	aaatgttttc	acagcgtacg	aaaacccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcatctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	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
			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

CX2-103W01_ST25

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 19

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacact	gggtatcggt	60
ttggcaatcg	ccgataaaatt	tgtagaggag	ggtgcgaaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcgggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattg	ggatgggtaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccctgc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgcgtgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaaccccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaaatt	tgcgacgggt	720
gcagaatttg	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	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> 21

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

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

<400> 21
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg 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 gcgtaaaactg ctgtccgcta atctggatgg tgttttttc 360
ggcaccggtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagtg ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcgggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
gggtgctgagg aaatgttttc acagcgtagc aaaaccctta tgggtcacat tggcgaaaccg 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 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
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

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

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

<400> 23
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg 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 gcagggatg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgctc tgggcatcga gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcgggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgctgtgta acacagtaca tccgggcccc atcaagaccc cgatgatgga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcactctgacg 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 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 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

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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
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 gggatatcggg	60
ttggcaatcg ccgataaaatt ttagaggag 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 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
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga ttcgtatgaa	600
ggtgctgagg aaatgttttc acagcgtagc aaaacccta 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 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	

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Thr	Pro	Met	180	Leu	Asp	Ser	Tyr	Glu	185	Gly	Ala	Glu	Glu	Met	190	Phe	Ser	Gln
Arg	Thr	Lys	195	Thr	Pro	Met	Gly	200	His	Ile	Gly	Glu	Pro	205	Asn	Asp	Ile	Ala
Trp	Val	Cys	210	Val	Tyr	Leu	215	Ala	Ser	Asp	Glu	Ser	220	Lys	Phe	Ala	Thr	Gly
225	Ala	Glu	Phe	Val	Val	230	Asp	Gly	Gly	Trp	Thr	235	Ala	Gln				240
				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	gggtatcggg		60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt		120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcgggca	ctgatgttat	tcgctttgtc		180
cagcacgatg	tttccgatga	agcaggcttg	acgaaactgt	tcgacaccac	cgaggaggca		240
ttcggcccg	ttacgacctt	agtgaacaat	gcagggtatg	gggttggttaa	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
gtgctgtgca	acacagtaca	tccggggccc	atcaagaccc	cgatgctcga	tgatcatgaa		600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg		660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt		720
gcagaatttg	tggctgcacg	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	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	

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145	Gly	Ala	Val	Arg	Ile	Met	Ser	Lys	Ser	Ala	Ala	Leu	Asp	Cys	Ala	Leu
				165	Arg	Val	Asn	Thr	Val	His	Pro	Gly	Pro	Ile	Lys	
			180	Thr	Pro	Met	Leu	Asp	Asp	His	Glu	Gly	Ala	Glu	Glu	Met
		195	Arg	Thr	Lys	Thr	Pro	Met	Gly	His	Ile	Gly	Glu	Pro	Asn	Asp
		210	Trp	Val	Cys	Val	Tyr	Leu	Ala	Ser	Asp	Glu	Ser	Lys	Phe	Ala
225	Ala	Glu	Phe	Val	Val	Asp	Gly	Gly	Trp	Thr	Ala	Gln				
				245												

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

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

<400>	29																
	atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacact	gggtatcggg											60
	ttggcaatcg	ccgataaatt	tgtagaggag	ggtgcgaaag	tagttattac	tggtcgtcgt											120
	gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc											180
	cagcacgatg	tttccgatga	agcaggctgg	acgaaaactgt	tcgacaccac	cgaggaggca											240
	ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggtta	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	gcgctggatt	gcgcactgaa	ggactacgat											540
	gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgatcatgaa											600
	ggtgctgagg	aaatgttttc	acagcgtacg	aaaacccccta	tgggtcacat	tggcgaaccg											660
	aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	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	

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

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

<400> 31
 atgaccgattc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgggt 60
 ttggcaaatcg ccgataaatt ttagaggag ggtgcgaaaag tagttattac tggtcgctcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttccggcccgg ttacgaccgt cgtgaacaat gcagggattc cggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg tgttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcaactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg 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

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

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

<400> 35
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaca aggtatcggt 60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaaag tagttattac tggtcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
ttcggcccgg ttacgaccgt agtgaacaat gcagggattc cgggtggttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaaactg ctgtccggtta atctggatgg tgtttttttc 360
ggcaccgctc tgggcattca gcgcatgaaa aataaaaggct tgggcgctag catcatcaat 420
atgagcagtg tgttcgggat tgtaggcgac ccgactaccg gggcatactg tgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
gtgctgtgta acacagtaca tccgggcccc atcaagaccc cgatgatgga tgattatgaa 600
ggtgctgagg aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg 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

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Gln	Gly	Ile	Gly	Leu	Ala	Ile	Ala	Asp	Lys	Phe	Val	Glu	Gly	Ala
			20					25				30		
Lys	Val	Val	Ile	Thr	Gly	Arg	Arg	Ala	Asp	Val	Gly	Glu	Lys	Ala
		35					40				45			
Lys	Ser	Ile	Gly	Gly	Thr	Asp	Val	Ile	Arg	Phe	Val	Gln	His	Asp
	50					55				60				
Ser	Asp	Glu	Ala	Gly	Trp	Pro	Lys	Leu	Phe	Asp	Thr	Thr	Glu	Glu
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
			100					105				110		
Val	Asn	Leu	Asp	Gly	Val	Phe	Phe	Gly	Thr	Arg	Leu	Gly	Ile	Gln
		115					120					125		
Met	Lys	Asn	Lys	Gly	Leu	Gly	Ala	Ser	Ile	Ile	Asn	Met	Ser	Ser
	130					135					140			
Phe	Gly	Ile	Val	Gly	Asp	Pro	Thr	Thr	Gly	Ala	Tyr	Cys	Ala	Ser
145					150					155				160
Gly	Ala	Val	Arg	Ile	Met	Ser	Lys	Ser	Ala	Ala	Leu	Asp	Cys	Ala
				165					170					175
Lys	Asp	Tyr	Asp	Val	Arg	Val	Asn	Thr	Val	His	Pro	Gly	Pro	Ile
			180					185				190		
Thr	Pro	Met	Met	Asp	Asp	Tyr	Glu	Gly	Ala	Glu	Glu	Met	Phe	Ser
		195					200					205		
Arg	Thr	Lys	Thr	Pro	Met	Gly	His	Ile	Gly	Glu	Pro	Asn	Asp	Ile
	210					215					220			
Trp	Val	Cys	Val	Tyr	Leu	Ala	Ser	Asp	Glu	Ser	Lys	Phe	Ala	Thr
225					230					235				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 atcgtaacgg gcgggacaat gggatatcggg 60
ttggcaatcg	ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
gcggatgtag	gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcacgatg	tatccgatga agcaggctgg actaaactgt tcgacaccac cgaggaagca 240
ttcggcccgg	ttacgacctt agtgaacaat gcagggattc cggttgttaa aagcgttgaa 300
gacactacca	cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
ggcaccgctc	tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagtg	tggtcgggat ggtaggcgac cgcactaccg gggcatactg tgcttccaag 480
ggggcggtac	gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
gtgctgtgca	acacagtaca tccgggcccc atcaagaccc cgatgatgga tagccatgaa 600
ggtgctgagg	aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
aatgacatcg	catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg	tggtcgacgg cgggttcacc gcacag 756

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

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

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<400> 38
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 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
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

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

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

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<400> 39
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggatatcgg 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 gcgtaaaactg ctgtccgtta atctggatgg tgtttttttc 360
ggcaccctgc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagtg tgttcgggat tgtaggttac ccgactaccg gggcactactg tgcttccaag 480
ggagcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcaactgaa ggactacgat 540
gtgcgtgtca 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

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<210> 40
<211> 252
<212> PRT

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<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 40

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Met Thr Asp Arg 5 Leu Lys Gly Lys Val 10 Ala Ile Val Thr Gly Gly Thr
1 Arg Gly Ile Gly 20 Leu Ala Ile Ala 25 Lys Phe Val Glu Glu Gly Ala
Lys Val Val Ile Thr Gly Arg Arg Ala Asp Val Gly Glu Lys Ala Ala
35 Lys Ser Ile Gly Gly Thr 40 Asp Val Ile Arg Phe Val Gln His Asp Val
50 Ser Asp Glu Ala Gly Trp 55 Thr Lys Leu Phe Asp Thr Thr Glu Glu Ala
65 Phe Gly Pro Val Thr 70 Thr Leu Val Asn Asn Ala Gly Ile Pro Val Val
85 Lys Ser Val Glu Asp Thr Thr Thr 90 Glu Glu Trp Arg Lys Leu Leu Ser
100 Val Asn Leu Asp Gly Val Phe Phe 105 Gly Thr Arg Leu Gly Ile Gln Arg
115 Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Val
130 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 Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Pro Ile Lys
180 Thr Pro Met Met Asp Ser Tyr Glu 185 Gly Ala Glu Glu Met Phe Ser Gln
195 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 230 Asp Gly Gly Trp Thr Ala Gln
245

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<210> 41

<211> 756

<212> DNA

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 41

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atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaca aggtatcggt 60
ttggcagtcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
ttcggcccggt ttacgacctt agtgaacaat gcagggattc cgatgggttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccggtta atctggatgg tgtttttttc 360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagtg tgttcgggat tgtaggcgac ccgactggtg gggcactactg tgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa 600
ggtgctgagg aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg 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

<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 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

<210> 43
 <211> 756
 <212> DNA
 <213> Artificial Sequence

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

<400> 43
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggtatcggt 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
 ttcggcccgg ttacgaccgt agtgaacaat gcagggattc cgatgggttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg tggtcgggat ggtaggctac ccgactaccg gggcatacaa tgcttccaag 480
 ggggcgggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa 600

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ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	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 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

<210> 45
 <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	tggtcgtcac	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattg	gggtttataa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360

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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	aaatgatgtc	acagcgtagc	aaaacccta	tgggccacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	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

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

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

<400> 47
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgggt 60

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ttggcaatcg	ccgataaatt	tgtagaggag	ggtgCGaaaag	tagttattac	tggtcgtcac	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgTccgatga	agcaggctgg	acgaaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccg	ttacgaccgt	cgTgaacaat	gcagggattg	gggttgTtaa	aagcgTtgaa	300
gacactacca	cggaggaatg	gcgTaaactg	ctgtccgTta	atctggatgg	Tgtttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttggggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgcgtgtca	acacagtaca	tccggggcccc	atcaagaccc	cgatgctcga	Tgattatgaa	600
ggtgctgagg	aaatgatgtc	acagcgTacg	aaaaccctta	Tgggccacat	Tggcgaaaccg	660
aatgacatcg	catgggtctg	Tgtgtacctg	gcTctgacg	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 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

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<400> 49
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg 60
ttggcaatcg ccgataaaatt tgtagaggag ggtgcgaaaag tagttattac tggtcgtcac 120
gcggatgtag gtgaaaaggg cgccaaatca atcggcgggca ctgatgttat tcgctttgtc 180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
gacactacca cggagggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
ggcaccctgc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcaactgaa ggactacgat 540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cggggctcga tgattatgaa 600
ggtgctgagg aaatgatgtc acagcgtagc aaaaccccta tgggccacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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<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 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

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<210> 51

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<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 gggatatcgg      60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcac      120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc      180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca      240
ttcggcccggt ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaaactg ctgtccggtta atctggatgg tgtttttttc      360
ggcaccggtc 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
gggtgctgagg aaatgtttgtc acagcgtagc aaaaccctta tgggccacat tggcgaaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg 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 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

```

<210> 53
 <211> 756
 <212> DNA
 <213> Artificial Sequence

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

<400> 53
 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
 ttcggcccgg ttacgaccgt cgtgaacaat gcaggggattg 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
 gtgctgtgta acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcatgaa 600
 ggtgctgagg aaatgatgtc acagcgtacg aaaacccta tgggccacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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

<210> 55
 <211> 756
 <212> DNA
 <213> Artificial Sequence

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

<400> 55	
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaca gggatatcggg	60
ttggcaatcg ccgataaaatt ttagaggag ggtgcgaaag tagttattac tggtcgtcgt	120
gcggatgtag gtgaaaaggc cgccaaatca atcggcgcca ctgatgttat tcgctttgtc	180
cagcacgatg cgtccgatga 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 ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag	480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat	540
gtgcgtgtca 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> 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 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	

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		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 gggatatcggt 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 gcgtaaaactg ctgtccgcta atctggatgg tgttttttc 360
 ggcacccgctc 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 tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtagc aaaaccctta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg 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 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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Met	Lys	115	Asn	Lys	Gly	Leu	Gly	120	Ala	Ser	Ile	Ile	Asn	125	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

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

<400>	61																	
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ttggc	aat	ccg	ata	aat	tgt	ag	agg	gag	gg	g	cg	aaa	ag	tag	tt	att	ac	tg
gcggat	gtag	gtg	aaa	agg	c	gcc	aaa	tca	atc	gg	cgg	gca	ctg	at	gtt	at	t	tc
cagcac	gat	g	gtc	ccg	atg	ag	cag	gct	gg	acg	aaa	act	gt	tcg	ac	acc	ac	cg
ttcgg	ccc	gg	tt	acg	acc	gt	cg	tga	aca	at	gc	agg	gat	tg	ctg	ttg	tta	aag
gacact	acca	cgg	agga	aat	g	gcg	t	aaa	act	g	ctg	tcc	g	tta	at	ctg	gat	gg
ggcacc	cgt	tc	ggg	catt	ca	gcg	cat	gaaa	aata	aa	agg	ct	tg	ggc	g	ctag	cat	cat
atgag	cag	ta	tttt	cggg	at	gg	tag	g	c	g	at	acc	g	ggg	ca	taca	cg	ctt
ggggc	ggt	ac	gtat	cat	gtc	gaaa	ag	cg	ca	gcg	ctg	gat	g	gcg	ca	ctg	aa	gg
gtg	cgt	gt	tca	acac	agt	taca	tcc	ggg	cccc	at	ca	ag	acc	cg	at	g	ctc	ga
ggtg	ctg	agg	aaat	gttt	tc	acag	cg	tac	g	aaa	acc	cc	ta	tg	gg	t	cac	at
aatg	ac	at	cg	cat	ggg	t	ctg	tgt	gt	ac	ct	g	acg	aat	tg	cg	ac	ggg
gcaga	att	ttg	tg	gt	c	g	ac	gg	t	g	g	ac	gc					

<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			

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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	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

<400> 65																				
atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacact	gggtatcggt															60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt															120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc															180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaaactgt	tcgacaccac	cgaggaggca															240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggtta	aagcgttgaa															300
gacactacca	cggaggaatg	gcgtaaaactg	ctgtccgtta	atctggatgg	tgtttttttc															360
ggcaccctgc	tgggcattca	gcgcatgaaa	agtaaaaggct	tgggcgctag	catcatcaat															420
atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag															480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat															540
gtgcgtgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa															600
gggtgctgagg	aaatgttttc	acagcgtacg	aaaacccta	tgggtcacat	tggcgaaccg															660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt															720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag																	756

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

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

<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					

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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	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	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

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

<400> 67

atgaccg	atc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacact	gggtatcgg	60
ttggcaatc	g	ccgataaatt	tgtagaggag	ggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	g	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	g	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	g	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggtta	aagcgttgaa	300
gacactacca	g	cggaggaatg	gcgtaaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccgcgt	c	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	g	ttttcgggat	ggtaggctat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	g	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgcgtgtca	g	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
ggtgctgagg	g	aaatgttttc	acagcgtagc	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	g	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	g	tggtcgacgg	cgggtggacc	gcacag			756

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

<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 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 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
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 ctgtccgta atctggatgg tgttttttc      360
ggcaccctgc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagta ttttcgggat ggtaggcgat ccggggaccg gggcatacaa cgcttccaag      480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat      540
gtgctgtcga acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa      600
ggtgctgagg aaatgttttc acagcgtagc aaaaccctta tgggtcacat tggcgaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtggacc gcacag                                756

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

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<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

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<210> 71

<211> 756

<212> DNA

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 71

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atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg      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 gggttgttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccctgc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatactg tgcttccaag      480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat      540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa      600
ggtgctgagg aaatgttttc acagcgtacg aaaaccctca tgggtcacat tggcgaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtggacc gcacag                                756

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<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 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 gggatatcggg 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaaactgt tcgacaccac cgaggaggca 240
 ttcggcccggt ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccggtta atctggatgg tgttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cggttctcga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaccg 660

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aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaaatt tgcgacgggt
gcagaatttg tggtcgacgg cgggtggacc gcacag

720
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 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 gggatatcggt 60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcgggca ctgatgttat tcgctttgtc 180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccggt ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccatta atctggatgg tgttttttc 360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

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atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgtca	acacagtaca	tccggggcccc	atcaagaccc	cgatgcttga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaaccccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcatctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	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 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 gggtatcggt 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcgagg ctgatgttat tcgctttgtc 180

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cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggtta	aagcggtgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccgcgtc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgatgga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tgggtcgacgg	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 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

CX2-103W01_ST25

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<400> 79
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg 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 gcgtaaaactg 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
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
ggtgctgagg aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggtcgacgg cgggggtacc gcacag 756

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

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

```

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<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 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

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```

<210> 81
<211> 756
<212> DNA

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<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 81

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacaat	gggtatcggg	60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	tttccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgacctt	agtgaacaat	gcagggattg	gggtttacaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccctgc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggct	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcgggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgcgtgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgatcatgaa	600
gggtgctgagg	aaatgttttc	acagcgtacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	agggtggacc	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	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								

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

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

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<400> 83
atgaccgatc gtctgaaggg caaagtagcc atcgtaacg gcgggacaat gggatatcgg 60
ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggtcgctcg 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcgagg ctgatgttat tcgctttgtc 180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccgg ttacgacctt agtgaacaat gcagggatg gggttgttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
ggcaccctgc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggct ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctgttat gcgactgaa ggactacgat 540
gtgctgtgta acacagtaca tccgggcccc atcaagacct cgatgctcga tgatcatgaa 600
ggtgctgagg aaatgttttc acagcgtagc aaaaccccta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggtcgacgg cgggtggacc gcacag 756
    
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<210> 84
 <211> 252
 <212> PRT
 <213> Artificial Sequence

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

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<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
    
```

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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

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	ttacgacctt	agtgaacaat	gcagggattg	gggttggtta	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaaactg	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
gtgcgtgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgatcatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaacccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tcgcacgggt	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	35
Lys Val Val Ile	Thr Gly Arg Arg	Ala Asp Val Gly	Glu Lys Ala Ala
40	45	50	55
Lys Ser Ile Gly	Gly Thr Asp Val	Ile Arg Phe Val	Gln His Asp Val
60	65	70	75
Ser Asp Glu Ala	Gly Trp Thr Lys	Leu Phe Asp Thr	Thr Thr Glu Glu Ala
80	85	90	95
Phe Gly Pro Val	Thr Thr Leu Val	Asn Asn Ala Gly	Ile Gly Val Val
100	105	110	115
Lys Ser Val Glu	Asp Thr Thr Thr	Glu Glu Trp Arg	Lys Leu Leu Ser
120	125	130	135
Val Asn Leu Asp	Gly Val Phe Phe	Gly Thr Arg Leu	Gly Ile Gln Arg
140	145	150	155
Met Lys Asn Lys	Gly Leu Gly Ala	Ser Ile Ile Asn	Met Ser Ser Ile
160	165	170	175
Phe Gly Gln Val	Gly Asp Pro Thr	Thr Gly Ala Tyr	Asn Ala Ser Lys
180	185	190	195
Gly Ala Val Arg	Ile Met Ser Lys	Ser Ala Ala Leu	Leu Cys Ala Leu
200	205	210	215
Lys Asp Tyr Asp	Val Arg Val Asn	Thr Val His Pro	Gly Pro Ile Lys
220	225	230	235

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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	atcgtaacgc	gcgggacaat	gggtatcggg												60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt												120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcgagg	ctgatgttat	tcgctttgtc												180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca												240
ttcggccccg	ttacgacctt	agtgaacaat	gcagggattg	gggttctgaa	aagcgttgaa												300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc												360
ggcaccgcgt	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat												420
atgagcagta	ttttcgggat	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag												480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat												540
gtgcgtgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgatcatgaa												600
gggtgctgagg	aaatgttttc	acagcgtacg	aaaacccta	tgggtcacat	tggcgaaccg												660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	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	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		

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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	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	gggtatcggt	60
ttggcaatcg	ccgataaatt	tgtagaggag	ggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtctgatga	agcaggctgg	acgaaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttctgaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccgcgtc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggca	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcgggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgcgtgtca	acacagtaca	tccggggccc	atcaagaccc	cgatgctcga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaacccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tcgcacgggt	720
gcagaatttg	tggtcgacgg	cggttgagacc	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			

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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 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 gggatatcggg 60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
gcggatgtag gtgaaaaggg cgccaaatca atcggcgagg ctgatgttat tcgctttgtc 180
cagcacgatg tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccggt ttacgacctt agtgaacaat gcaggggattg gggtttaca aagcgttgaa 300
gacactacca cggaggaatg gcgtaaaactg ctgtccgtta atctggatgg tgtttttttc 360
ggcaccgctc tgggcatcga gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcaactgaa ggactacgat 540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcatgaa 600
ggtgctgagg aaatgttttc acagcgtacg aaaaccccca tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg 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
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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 Leu Val Asn Asn Ala Gly Ile Gly Val Tyr
85 90 95

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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	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

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ttggcaatcg	ccgataaatt	tgtagaggag	ggtagcgaaa	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgacctt	agtgaacaat	gcagggattg	gggttctgaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaaactg	ctgtccggtta	atctggatgg	tgtttttttc	360
ggcaccgcgt	tgggcattca	gcgcatgaaa	aataaaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcgggca	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgatcatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaacccta	tgggtcacat	tggcgaaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaaatt	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						

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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 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
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ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcacgatg cgtccgatga agcaggctgg acgaaaactgt tcgacaccac cgaggaggca 240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattg gggttctgaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
ggcaccctgc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggca agtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcgggtac gtatcatgtc gaaaagcgca gcgctgttat gcgcactgaa ggactacgat 540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggctcgaccg cgggtggacc gcacag 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

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

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

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

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ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt      120
gcggatgtag gtgaaaaggc cgccaaatca atcggcgagg ctgatgttat tcgctttgtc      180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca      240
ttcgggccgg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccctgc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag      480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcaactgaa ggactacgat      540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcacgaa      600
ggtgctgagg aaatgttttc acagcgtacg aaaaccccta tgggtcacat tggcgaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtggacc gcacag                                756

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

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

<400> 98

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Met	Thr	Asp	Arg	Leu	Lys	Gly	Lys	Val	Ala	Ile	Val	Thr	Gly	Gly	Thr
1				5					10				15		
Leu	Gly	Ile	Gly	Leu	Ala	Ile	Ala	Asp	Lys	Phe	Val	Glu	Glu	Gly	Ala
			20					25				30			
Lys	Val	Val	Ile	Thr	Gly	Arg	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	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	
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ttggcaatcg	ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt
gcggatgtag	gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc
cagcacgatg	cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca
ttcggcccg	ttacgacctt agtgaacaat gcagggattg gggttgttaa aagcgttgaa
gacactacca	cggaggaatg gcgtaaaactg ctgtccggtta atctggatgg tgttttttc
ggcaccgctc	tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat
atgagcagta	ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag
ggggcggtac	gtatcatgtc gaaaagcgca gcgctgttat gcgcactgaa ggactacgat
gtgctgtca	acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa
ggtgctgagg	aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaccg
aatgacatcg	catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt
gcagaatttg	tggtcgacgg cgggtggacc gcacag
	60 120 180 240 300 360 420 480 540 600 660 720 756

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

CX2-103W01_ST25

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 100

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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 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 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> 101

<211> 756

<212> DNA

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 101

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gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc      180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca      240
ttcggcccggtttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccctgc 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 tgattatgaa      600
ggtgctgagg aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtggacc gcacag      756

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<210> 102

CX2-103W01_ST25

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

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

<400> 102
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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 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

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gcggatgtag gtgaaaaggc cgccaaatca atcggcgagg ctgatgttat tcgctttgtc 180
cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccgg ttacgacctt agtgaacaat gcagggattg gggtttaca aagcgttgaa 300
gacactacca cggaggaatg gcgtaaaactg ctgtccgtta atctggatgg tgttttttc 360
ggcaccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctgttat gcgcaactgaa ggactacgat 540
gtgctgtgca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
ggtgctgagg aaatgttttc acagcgtagc aaaaccccta tgggtcacat tggcgaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720

gcagaatttg tggctcgacgg cgggtggacc gcacag

756

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

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

<400> 104
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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 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 gggatatcggt 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg ttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcgggcccg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgta atctggatgg tgttttttc 360
 ggacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480

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ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcaactgaa	ggactacgat	540
gtgcgtgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgatcatgaa	600
gggtgctgagg	aaatgttttc	acagcgtagc	aaaaccccta	tgggtcacat	tggcgaaccg	660
agtgacatcg	catgggtctg	tgtgtacctg	gcacatctgacg	aatcgaaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 106
 <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 gggatatcggg 60
 ttggcaatcg ccgataaatt ttagagaggag ggtgcgaaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaaggc cgccaaatca atcggcgggca ctgatgttat tcgctttgtc 180
 cagcacgatg cgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240

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ttcggccccg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggttaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaaactg	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
gtgcgtgtca	acacagtaca	tccggggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcatctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 108
 <211> 252
 <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	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

CX2-103W01_ST25

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacaat	gggtatcggt	60
ttggcaatcg	ccgataaatt	tgtagaggag	ggtgcgaaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	tttccgatga	agcaggctgg	acgaaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattg	gggtttacaa	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	gcgcactgaa	ggactacgat	540
gtgctgttca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgatcatgaa	600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaacccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 110
 <211> 252
 <212> PRT
 <213> Artificial Sequence

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

<400> 110
 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

<210> 111
 <211> 756
 <212> DNA
 <213> Artificial Sequence

CX2-103W01_ST25

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 111

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacaat	gggtatcggt	60
ttggcaatcg	ccgataaaatt	tgtagaggag	ggtgcgaaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcgggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttctgaa	aagcgttgaa	300
gacactacca	cggagggaatg	gcgtaaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccctgc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagta	ttttcggggca	ggtagggcgat	ccgactaccg	gggcatacaa	cgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgta	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaaccccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtacacc	gcacag			756

<210> 112

<211> 252

<212> PRT

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 112

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	Tyr	Thr	Ala	Gln				
			245					250							

<210> 113

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

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

<400> 113
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgg 60
ttggcaatcg cccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgctcg 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcacgatg tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccggt ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaaactg ctgtccggtta atctggatgg tgtttttttc 360
ggcaccggtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctgttat gcgactgaa ggactacgat 540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcatgaa 600
ggtgctgagg aaatgttttc acagcgtagc aaaaccctta tgggtcacat tggcgaaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg tggtcgacgg cgggtggacc gcacag 756

<210> 114
<211> 252
<212> PRT
<213> Artificial Sequence

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

<400> 114
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 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

<210> 115
 <211> 756
 <212> DNA
 <213> Artificial Sequence

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

<400> 115
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcgg 60
 ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggtcgctcg 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcggcccgg ttacgacctt agtgaacaat gcagggattg gggtttaca aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggat ttagggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcgggtac gtatcatgtc gaaaagcgca gcgctgttat gcgcactgaa ggactacgat 540
 gtgctgtgta acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcactctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggctcgacgg cgggtggacc gcacag 756

<210> 116
 <211> 252
 <212> PRT
 <213> Artificial Sequence

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

<400> 116
 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 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

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

<210> 117
 <211> 756
 <212> DNA
 <213> Artificial Sequence

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

<400> 117	
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcgg	60
ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggtcgctcg	120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc	180
cagcacgatg ttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca	240
ttcggcccgg ttacgacctt agtgaacaat gcagggattg gggtttaca 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 gcgctggatt gcgactgaa ggactacgat	540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcatgaa	600
ggtgctgagg aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaccg	660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt	720
gcagaatttg tggtcgacgg cgggtacacc gcacag	756

<210> 118
 <211> 252
 <212> PRT
 <213> Artificial Sequence

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

<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 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

								CX2-103W01_ST25							
			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	atcgtaaccc	gcgggacaat	gggtatcggg		60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgtcgt		120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcgcca	ctgatgttat	tcgctttgtc		180
cagcacgatg	tttccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca		240
ttcggcccg	ttacgaccgt	cgtgaacaat	gcagggtatg	gggttggttaa	aagcgttgaa		300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc		360
ggcaccgcgc	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	acagcgtatg	aaaaccctta	tgggtcacat	tggcgaaccg		660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaatt	tgcgacgggt		720
gcagaatttg	tggctgcacg	cgqggttcacc	gcacag				756

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

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

<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	

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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	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						
atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaacccg	gcgggacaat	gggtatcggg		60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggctgcctg		120
gcggatgtag	gtgaaaaggc	gcgcaaatca	atcggcggca	ctgatgttat	tcgctttgtc		180
cagcacgatt	ttttccgatga	agcaggctgg	acgaaactgt	tcgcacaccac	cgaggaggca		240
ttcggcccg	ttacgaccgt	cgtgaacaat	gcagggattg	gggttggttaa	aagcgttgaa		300
gacactacca	cggaggaatg	gcgtaaaactg	ctgtcccgta	atctggatgg	tgtttttttc		360
ggcaccgcgtc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat		420
atgagcagta	ttttcgggca	ggtaggcgat	ccgactaccg	gggcatacaa	cgcttccaag		480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctgttat	gcgcactgaa	ggactacgat		540
gtgctgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgctcga	tgattatgaa		600
ggtgctgagg	aaatgttttc	acagcgtacg	aaaaccccta	tgggtcacat	tggcgaaccg		660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt		720
qcagaatttg	tggctcgacgg	cgggttgacc	gcacag				756

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

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

<400>	122															
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	

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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
 atgaccgatac gtctgaaggg caaagtagcc atcgtaaccg gcgggacact gggatatcggt 60
 ttggcaaatcg ccgataaatt thtagaggag ggtgcgaaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg ttcccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
 ttcgggcccg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaaactg ctgtccggtta atctggatgg tgtttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagta ttttcgggca ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctgttat gcgcaactgaa ggactacgat 540
 gtgctgttca acacagtaca tccgggcccc atcaagacct cgatgctcga tgatcatgaa 600
 ggtgctgagg aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg 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
 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

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50	Ser	Asp	Glu	Ala	Gly	Trp	Thr	Lys	Leu	Phe	Asp	Thr	Thr	Glu	Glu	Ala
65	Phe	Gly	Pro	Val	Thr	Thr	Val	Val	Asn	Asn	Ala	Gly	Ile	Gly	Val	Val
				85	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	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	gggtatcggg														60
ttggcaatcg	ccgataaatt	tgtagaggag	gggtgcgaaag	tagttattac	tggtcgctcg														120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc														180
cagcacgatg	cgtccgatga	agcaggctgg	acgaaactgt	tcgacaccac	cgaggaggca														240
ttcggcccgg	ttacgacctt	agtgaacaat	gcagggattg	gggttggtta	aagcgttgaa														300
gacactacca	cggaggaatg	gcgtaaaactg	ctgtccgtta	atctggatgg	tgtttttttc														360
ggcaccgctc	tgggcattca	gcgcatgaaa	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
gggtgctgagg	aaatgttttc	acagcgtacg	aaaacccta	tgggtcacat	tggcgaaccg														660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	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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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	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	
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ttggcaatcgc	ccgataaatt ttagaggag ggtgcgaaa tagttattac tggtcgtcgt 120
gcggatgtag	gtgaaaaggc cgcaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcacgatg	tttccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccgcg	ttacgaccgt cgtgaacaat gcagggattg gggttctgaa aagcgttgaa 300
gacactacca	cggaggaatg gcgtaaaactg ctgtccggtta atctggatgg tgtttttttc 360
ggcaccgcgtc	tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta	ttttcgggat ttagggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac	gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
gtgcgtgtca	acacagtaca tccgggcccc atcaagaccc cgatgctcga tgatcatgaa 600
ggtgctgagg	aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660
aatgacatcg	catgggtctg tgtgtacctg gcatctgacg 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

CX2-103W01_ST25

<400> 130
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 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 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
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gcggatgtag gtgaaaaggc cgccaaatca atcggcgga ctgatgttat tcgctttatc 180
cagcacgatg tgtccgatga agcaggctgg acgaaactgt tcgacaccac cgaggaggca 240
ttcggcccg ttacgaccgt cgtgaacaat gcagggattg gggttgttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccgta atctggatgg tgttttttc 360
ggcaccctgc tgggcattcg ccgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagta ttttcgggat ggtaggcgat ccgactaccg gggcatacaa cgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
gtgctgtca acacagtaca tccgggcccc atcaagaccc cgatgctcga tgattatgaa 600
ggtgctgagg aaatgttttc acagcgtagc 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

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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
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

<400> 133

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gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
ttcggcccggt tacgaccgt agtgaacaat gcagggattc cggtggttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccggtta atctggatgg tgtttttttc 360
ggcaccctgc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagtg tgttcgggat tgtaggcgac ccgactaccg gggcatactg tgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa 600
ggtgctgagg aaatgttttc acagcgtacg aaaaccctca 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

<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
 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 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
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggatatcgggt 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
 ttcggcccggt ttacgacctt agtgaacaat gcagggattc cggtggttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccggtta atctggatgg tgttttttc 360
 ggcacccgctc 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 aaaacccta tgggtcacat tggcgaaccg 660

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aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaaatt tgcgacgggt
gcagaatttg tggtcgacgg cgggtggacc gcacag

720
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
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 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

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

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

<400> 137
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaca aggtatcggt 60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
gcggatgtag gtgaaaaggc cgccaaatca atcggcgggca ctgatgttat tcgctttgtc 180
cagcacgatg tatccgatga agcaggctgg actaaactgt tcgacaccac cgaggaggca 240
ttcggcccggt ttacgacctt agtgaacaat gcagggattc cgatgggttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccggtta atctggatgg tgttttttc 360
ggcaccgcgtc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420

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atgagcagtg	tgttcgggat	tgtaggctac	ccgactaccg	gggcatactg	tgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgtca	acacagtaca	tccggggcccc	atcaagaccc	cgatgatgga	tagctatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaaccccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcacatctgac	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cggttgacc	gcacag			756

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

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

<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
 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 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

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

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

<400> 139
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggtatcggt 60
 ttggcaatcg ccgataaatt thtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180

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cagcacgatg	tatccgatga	agcaggctgg	actaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccg	ttacgacctt	agtgaacaat	gcagggattc	cggttggtta	aagcggtgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagtg	tggtcgggat	tgtaggctac	ccgactaccg	gggcatactg	tgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgatgga	tagctatgaa	600
ggtgctgagg	aaatgttttc	acggcgctacg	aaaaccctta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

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

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

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

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

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<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
ttcggccccg ttacgaccgt agtgaacaat gcagggattc cggtggttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccctgc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagtg tgttcgggat tgtaggcgac ccgactaccg gggcatactg tgcttccaag      480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat      540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa      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> 142
<211> 252
<212> PRT
<213> Artificial Sequence

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

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

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<210> 143
<211> 756
<212> DNA
<213> Artificial Sequence

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<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 143

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacaat	gggtatcggg	60
ttggcaatcg	ccgataaatt	tgtagaggag	ggtgCGaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	tatccgatga	agcaggctgg	cctaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccg	ttacgaccgt	agtgaacaat	gcagggattc	cggtgggttaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagtg	tgttcgggat	tgtaggcgac	ccgactaccg	gggcatactg	tgcttccaag	480
ggggcggtag	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgcgtgtca	acacagtaca	tccggggcccc	atcaagaccc	cgatgatgga	tagctatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaacccta	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	
			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								

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<210> 145
 <211> 756
 <212> DNA
 <213> Artificial Sequence

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

<400> 145
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 ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
 ttcggcccggt ttacgaccgt cgtgaacaat gcagggattc cgatgggttaa aagcgttgaa 300
 gacactacca cggagggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg tgttcgggat ttagggcgac ccgactaccg gggcatactg tgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tgactatgaa 600
 ggtgctgagg aaatgttttc acagcgtagc aaaaccctca tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

<210> 146
 <211> 252
 <212> PRT
 <213> Artificial Sequence

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

<400> 146
 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 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

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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 atcgtaacgc gcgggacacg cggatcgggt 60
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gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcacgatg tatccgatga agcaggctgg actaaactgt tcgacaccac cgaggaggca 240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattc cggtggttaa aagcgttgaa 300
gacactacca cggaggaatg gcgtaaactg ctgtccgcta atctggatgg tgtttttttc 360
ggcaccgcgt tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagtg tgttcgggca agtaggctac ccgactaccg gggcatactg tgcttccaag 480
ggggcgggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tgactatgaa 600
ggtgctgagg aaatgttttc acagcgtagc aaaacccta 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
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 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

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

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

<400> 149
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaat gggatatcggt 60
 ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
 ttcggcccggt ttacgaccgt agtgaacaat gcagggattc cgggtggttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgtttttttc 360
 ggcacccgctc tgggcatctca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg tgttcgggat ttagggcgac ccgactaccg gggcatactg tgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccggggcccc atcaagaccc cgatgatgga tagctatgaa 600
 ggtgctgagg aaatgttttc acagcgtagc aaaaccccta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg 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 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

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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 Trp Thr Ala Gln
 245 250

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

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

<400> 151
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggatatcggg 60
 ttggcaatcg ccgataaatt ttagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
 cagcacgatg catccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
 ttcggcccgg ttacgacctt agtgaacaat gcagggattc cggttgttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaaactg ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgctc tggggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg ttttcgggat ttaggctac ccgactaccg gggcactactg tgcttccaag 480
 ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggccct atcaagaccc cgatgatgga tgactatgaa 600
 ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660
 aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
 gcagaatttg tggtcgacgg cgggtggacc gcacag 756

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

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

<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
 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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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	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	
atgaccgatc	gtctgaaggg caaagtagcc atcgtaacccg gcgggacacg cggatatcggg 60
ttggcaatcg	ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
gcggatgtag	gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc 180
cagcacgatg	cggtccgatga agcaggctgg actaaactgt tgcacaccac cgaggaggca 240
ttcggcccgg	ttacgaccgt cgtgaacaat gcagggattc cggtggttaa aagcgttgaa 300
gacactacca	cggaggaatg gcgtaaactg ctgtccggtta atctggatgg tgtttttttc 360
ggcaccctgt	tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagtg	tgttcgggat tgtaggcgac ccgactaccg gggcatactg tgcttccaag 480
ggggcgggtac	gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
gtgcgtgtca	acacagtaca tccggggccc atcaagaccc cgatgatgga tagccatgaa 600
ggtgctgagg	aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaccg 660
aatgacatcg	catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg	tgggtcgaccg cgggtggacc gcacag 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

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

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

<400> 157

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacacg	cggtatcggt	60
ttggcaatcg	ccgataaatt	tgtagaggag	ggtagcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcgagg	ctgatgttat	tgcgtttgtc	180
cagcacgatg	tatccgatga	agcaggctgg	actaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattc	cgatgggtta	aagcgttgaa	300
gacactacca	cgagggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccctgc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagtg	tggtcgggat	ggtaggctac	ccgactaccg	gggcatacaa	tgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcaactgaa	ggactacgat	540
gtgcgtgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgatgga	tgattatgaa	600
ggtagctgag	aaatgttttc	acagcgtagc	aaaacccta	tggttcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcatctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtacacc	gcacag			756

<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			

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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 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 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 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> 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 ggtgcgaaaag 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 gcgtaaaactg ctgtccggtta atctggatgg tgtttttttc 360
ggcaccgctc tgggcattca gcgcatgaaa aataaaaggct tgggcgctag catcatcaat 420
atgagcagtg tgttcgggca agtaggcgac ccgactaccg gggcatacaa tgcttccaag 480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
gtgctgtgta acacagtaca tccgggcccc atcaagaccc cgatgatgga tagccatgaa 600
ggtgctgagg aaatgttttc acagcgtagc aaaacccta tgggtcacat tggcgaaaccg 660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg 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

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Gln	Gly	Ile	Gly	Leu	Ala	Ile	Ala	Asp	Lys	Phe	Val	Glu	Gly	Ala
			20					25				30		
Lys	Val	Val	Ile	Thr	Gly	Arg	Arg	Ala	Asp	Val	Gly	Glu	Lys	Ala
		35					40				45			
Lys	Ser	Ile	Gly	Gly	Thr	Asp	Val	Ile	Arg	Phe	Val	Gln	His	Asp
	50				55					60				
Ser	Asp	Glu	Ala	Gly	Trp	Thr	Lys	Leu	Phe	Asp	Thr	Thr	Glu	Glu
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
		100						105					110	
Val	Asn	Leu	Asp	Gly	Val	Phe	Phe	Gly	Thr	Arg	Leu	Gly	Ile	Gln
		115					120					125		
Met	Lys	Asn	Lys	Gly	Leu	Gly	Ala	Ser	Ile	Ile	Asn	Met	Ser	Ser
	130				135						140			
Phe	Gly	Gln	Val	Gly	Asp	Pro	Thr	Thr	Gly	Ala	Tyr	Asn	Ala	Ser
145					150					155				160
Gly	Ala	Val	Arg	Ile	Met	Ser	Lys	Ser	Ala	Ala	Leu	Asp	Cys	Ala
			165						170					175
Lys	Asp	Tyr	Asp	Val	Arg	Val	Asn	Thr	Val	His	Pro	Gly	Pro	Ile
		180						185					190	
Thr	Pro	Met	Met	Asp	Ser	His	Glu	Gly	Ala	Glu	Glu	Met	Phe	Ser
		195					200					205		
Arg	Thr	Lys	Thr	Pro	Met	Gly	His	Ile	Gly	Glu	Pro	Asn	Asp	Ile
	210					215					220			
Trp	Val	Cys	Val	Tyr	Leu	Ala	Ser	Asp	Glu	Ser	Lys	Phe	Ala	Thr
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	
atgaccgatc	gtctgaaggg caaagtagcc atcgtaacgg gcgggacaca aggtatcggg 60
ttggcaatcg	ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggctcgtcg 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 tgtttttttc 360
ggcaccgctc	tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
atgagcagtg	tgttcgggat tgtaggcgac cgcactaccg gggcatactg tgcttccaag 480
ggggcggtac	gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
gtgctgtgca	acacagtaca tccgggcccc atcaagaccc cgatgatgga tagccatgaa 600
ggtgctgagg	aaatgttttc acagcgtacg aaaaccctta tgggtcacat tggcgaaccg 660
aatgacatcg	catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt 720
gcagaatttg	tggctcgacgg cgggtggacc gcacag 756

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

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

CX2-103W01_ST25

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

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

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<400> 163
atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaca aggtatcggt      60
ttggcaatcg ccgataaaact tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt      120
gcggatgtag gtgaaaaggc cgccaaaatca atcggcgggca ctgatgttat tcgctttgtc      180
cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca      240
ttcggcccgg ttacgaccgt cgtgaacaat gcagggattc cgatgggttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaaactg ctgtccgtta atctggatgg tgtttttttc      360
ggcaccctgc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat      420
atgagcagtg tgttcgggat tgtaggcgac ccgactaccg gggcatacaa tgcttccaag      480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcaactgaa ggactacgat      540
gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tagctatgaa      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> 164
<211> 252
<212> PRT

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<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 164

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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 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
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

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<210> 165

<211> 756

<212> DNA

<213> Artificial Sequence

<220>

<223> Engineered variant of Lactobacillus kefir ketoreductase

<400> 165

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atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacaca aggtatcggt      60
ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt      120
gcggatgtag gtgaaaaggc cgccaaatca atcggcggca ctgatgttat tcgctttgtc      180
cagcacgatg tatccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca      240
ttcggcccggt ttacgaccgt cgtgaacaat gcagggattc cggttgttaa aagcgttgaa      300
gacactacca cggaggaatg gcgtaaaactg ctgtccggtta atctggatgg tgtttttttc      360
ggcaccgctc tgggcattca gcgcatgaaa aataaaaggct tgggcgctag catcatcaat      420
atgagcagtg tgttcgggat ggtaggcgat ccgactaccg gggcactactg tgcttccaag      480
ggggcggtac gtatcatgtc gaaaagcgca gcgctggatt gcgactgaa ggactacgat      540
gtgctgttca acacagtaca tccgggcccc atcaagaccc cgatgatgga tgactatgaa      600
ggtgctgagg aaatgttttc acagcgtacg aaaacccta tgggtcacat tggcgaaaccg      660
aatgacatcg catgggtctg tgtgtacctg gcatctgacg aatcgaaatt tgcgacgggt      720
gcagaatttg tggtcgacgg cgggtacacc gcacag      756

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CX2-103W01_ST25

<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 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 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
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggtatcggt 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120
 gcggatgtag gtgaaaaggc cgccaaatca atcggcgga ctgatgttat tcgctttgtc 180
 cagcacgatg catccgatga agcaggctgg cctaaactgt tcgacaccac cgaggaggca 240
 ttcggcccgg ttacgacctt agtgaacaat gcagggattc cggtgggttaa aagcgttgaa 300
 gacactacca cggaggaatg gcgtaaactg ctgtccgtta atctggatgg tgttttttc 360
 ggcacccgctc tgggcattca gcgcatgaaa aataaaggct tgggcgctag catcatcaat 420
 atgagcagtg tggtcgggat tgtaggcgac ccgactaccg gggcatactg tgcttccaag 480
 ggggcgggtac gtatcatgtc gaaaagcgca gcgctggatt gcgcactgaa ggactacgat 540
 gtgcgtgtca acacagtaca tccgggcccc atcaagaccc cgatgatgga tgactatgaa 600

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ggtgctgagg	aaatgttttc	acagcgtacg	aaaacccta	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
 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 Phe Thr Ala Gln
 245 250

<210> 169
 <211> 756
 <212> DNA
 <213> Artificial Sequence

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

atgaccgatc	gtctgaaggg	caaagtagcc	atcgtaaccg	gcgggacaca	aggtatcggt	60
ttggcaatcg	ccgataaatt	tgtagaggag	ggtgcgaaag	tagttattac	tggtcgtcgt	120
gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	tatccgatga	agcaggctgg	cctaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattc	cggttgtaa	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360

CX2-103W01_ST25

ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagtg	tggtcgggat	tgtaggcgac	ccgactaccg	gggcatataa	tgcttccaag	480
ggggcggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgctgtgca	acacagtaca	tccgggcccc	atcaagaccc	cgatgatgga	tagctatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaacccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcattctgacg	aatcgaaatt	tgcgacgggt	720
gcagaatttg	tggtcgacgg	cgggtggacc	gcacag			756

<210> 170
 <211> 252
 <212> PRT
 <213> Artificial Sequence

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

<400> 170
 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 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 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
 atgaccgatc gtctgaaggg caaagtagcc atcgtaaccg gcgggacacg cggtatcggt 60
 ttggcaatcg ccgataaatt tgtagaggag ggtgcgaaag tagttattac tggtcgtcgt 120

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gcggatgtag	gtgaaaaggc	cgccaaatca	atcggcggca	ctgatgttat	tcgctttgtc	180
cagcacgatg	tatccgatga	agcaggctgg	actaaactgt	tcgacaccac	cgaggaggca	240
ttcggcccgg	ttacgaccgt	cgtgaacaat	gcagggattc	cgatgggtta	aagcgttgaa	300
gacactacca	cggaggaatg	gcgtaaactg	ctgtccgtta	atctggatgg	tgtttttttc	360
ggcaccgctc	tgggcattca	gcgcatgaaa	aataaaggct	tgggcgctag	catcatcaat	420
atgagcagtg	tggtcgggat	ggtagggcgac	ccgactaccg	gggcatactg	tgcttccaag	480
ggggcgggtac	gtatcatgtc	gaaaagcgca	gcgctggatt	gcgcactgaa	ggactacgat	540
gtgcgtgtca	acacagtaca	tccgggcccc	atcaagaccc	cgatgatgga	tgaccatgaa	600
ggtgctgagg	aaatgttttc	acagcgtagc	aaaacccccta	tgggtcacat	tggcgaaccg	660
aatgacatcg	catgggtctg	tgtgtacctg	gcactctgacg	aatcgaaaatt	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
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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
		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						