SEQUENCE LISTING

<110> Jennewein Biotechnologie GmbH

<120> Novel fucosyltransferases and their application in producing fucosylated human milk oligosaccharides

<130> P 1702 WO

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<170> PatentIn version 3.5

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gattttaacg ttgactcgtt cgtcaatgcc catgattttg acagcctgga acgcctggtt 720

gaatatatta tcgaactgga tagttccaaa gacaaatacc tggaaatgct ggaaaaaccg 780

tggctgctgg ataaaaccta tctggactgg aaacagctgc tgctgaactt catcaacaac 840

atcatgatga aaagttacaa agatgcgaaa tacctggtta actacggcca cgccggtaaa 900

taccgtaatg aacaacgctt ctggggccgt tgcgaacgta aattcaaact gcaacgcatt 960

atcgaatact actcccaact gtttgatcgt aaataa 996

<210> 15
<211> 550
<212> DNA
<213> Escherichia coli

<400> 15
atgagcatta ttcgtctgca gggtggtctg ggtaatcagc tgtttcagtt tagctttggt 60

tatgccctga gcaaaattaa tggtacaccg ctgtatttcg acattagcca ttatgccgaa 120

aacgatgatc atggtggtta tcgtctgaat aatctgcaga ttccggaaga atatctgcag 180

tattataccc cgaaaattaa taatatttat aaactgctgg tgcgtggcag ccgtctgtat 240

ccggatattt ttctgtttct gggcttttgc aacgaatttc atgcctatgg ctacgatttt 300

gaatatattg cccagaaatg gaaaagcaaa aaatacattg gctactggca gagcgaacac 360

tttttttcata aacatattct ggacctgaaa gaatttttta ttccgaaaaa tgtgagcgaa 420

caggcaaatc tgctggcagc aaaaattctg gaaagccaga gcagcctgag cattcatatt 480

cgtcgtggcg attatattaa aaacaaaacc gcaaccctga cacatggtgt ttgtagcctg 540

gaatattata 550

<210> 16
<211> 320
<212> PRT
<213> Helicobacter hepaticus

<400> 16

Met Lys Asp Asp Leu Val Ile Leu His Pro Asp Gly Gly Ile Ala Ser
1 5 10 15

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

Lys Val Lys Tyr Asp Leu Ser Trp Phe Ala Glu Gly Ala Lys Gly Phe
35 40 45

Trp Asn Pro Ser Asn Gly Tyr Asp Lys Val Tyr Asp Ile Thr Trp Asp
50 55 60

Ile Ser Lys Ala Phe Pro Ala Leu His Ile Glu Ile Ala Asn Glu Glu
65 70 75 80

Glu Ile Glu Arg Tyr Lys Ser Lys Tyr Leu Ile Asp Asn Asp Arg Val
85 90 95

Ile Asp Tyr Ala Pro Pro Leu Tyr Cys Tyr Gly Tyr Lys Gly Arg Ile
100 105 110

Phe His Tyr Leu Tyr Ala Pro Phe Phe Ala Gln Ser Phe Ala Pro Lys
115 120 125

Glu Ala Gln Asp Ser His Thr Pro Phe Ala Ala Leu Leu Gln Glu Ile
130 135 140

Glu Ser Ser Pro Ser Pro Cys Gly Val His Ile Arg Arg Gly Asp Leu
145 150 155 160

Ser Gln Pro His Ile Val Tyr Gly Asn Pro Thr Ser Asn Glu Tyr Phe
165 170 175

Ala Lys Ser Ile Glu Leu Met Cys Leu Leu His Pro Gln Ser Ser Phe
180 185 190

Tyr Leu Phe Ser Asp Asp Leu Ala Phe Val Lys Glu Gln Ile Val Pro
195 200 205

Leu Leu Lys Gly Lys Thr Tyr Arg Ile Cys Asp Val Asn Asn Pro Ser
210 215 220

Gln Gly Tyr Leu Asp Leu Tyr Leu Leu Ser Arg Cys Arg Asn Ile Ile
225 230 235 240

Gly Ser Gln Gly Ser Met Gly Glu Phe Ala Lys Val Leu Ser Pro His
245 250 255

Asn Pro Leu Leu Ile Thr Pro Arg Tyr Arg Asn Ile Phe Lys Glu Val
260 265 270

Glu Asn Val Met Cys Val Asn Trp Gly Glu Ser Val Gln His Pro Pro
275 280 285

Leu Val Cys Ser Ala Pro Pro Pro Leu Val Ser Gln Leu Lys Arg Asn
290 295 300

Ala Pro Leu Asn Ser Arg Leu Tyr Lys Glu Lys Asp Asn Ala Ser Ala
305 310 315 320

<210> 17
<211> 361
<212> PRT
<213> Brachyspira pilosicoli

<400> 17

Met Ala Pro Lys His Leu Ile Asn Leu Tyr Tyr Ile Asp Ile Ser Ile
1 5 10 15

Leu Tyr Val Lys Ile Lys Gln Lys Ser Lys Ile Phe Ile Asn Phe Met
20 25 30

Leu Tyr Asn Asn Tyr Glu His Leu Ile Asn Lys Ile Val Arg Ile Ile
35 40 45

Pro Ile Lys Lys His Arg Asp Asn Leu Arg Asn Ile Leu Tyr Asp Ile
50 55 60

Val Asn Ser Leu Tyr Lys Ile Glu Tyr Ile Ser Lys Glu Leu Asn Lys
65 70 75 80

Lys Arg Asn Asn Asn Asp Ser Gly Ile Val Ile Ile Glu Cys Gln Gly
85 90 95

Gly Leu Ala Asp Gln Phe Trp Lys Tyr Ile Leu Gly Glu Ser Ile Lys
100 105 110

Lys His Tyr Asn Phe Thr Val Lys Tyr Asp Ile Thr Trp Phe Asp Tyr
115 120 125

Lys His Lys Asp Ile Asp Gly Lys Asp Glu Arg Pro Phe Glu Leu Ile
130 135 140

Lys Leu Cys Pro Asp Ile Asp Phe Lys Ile Ala Ser Tyr Asp Glu Ile
145 150 155 160

Phe Phe Tyr Lys Ala Cys Phe Ser Val Ile Asn Glu Ser Tyr Phe Gly
165 170 175

Tyr Asp Ile Asn Asn Tyr Leu Glu Asn Asn Lys Asn Leu Phe Leu Tyr
180 185 190

Ser Tyr Pro Arg Ile Leu Asp Ile Asn Val Ser Asp Ile Thr Lys Asn
195 200 205

Ile Asp Leu Asp Lys Tyr His Tyr Ser Thr Leu Lys Glu Asp Asn Leu
210 215 220

Val Leu Tyr Asn Glu Leu Lys Asn Ser Glu Ser Val Ala Ile His Ile
225 230 235 240

Arg Leu Gly Asp Ser Tyr Val Met Ser Cys Phe Lys Glu Val Phe Asn
245 250 255

Ser Ser Tyr Glu Asn Tyr Ala Asn Tyr Phe Ile Glu Ser Ile Asn Lys
260 265 270

Leu Ser Asn Glu Leu Lys Asn Pro Thr Phe Phe Phe Phe Ser Asp Asp
275 280 285

Ile Asp Trp Val Asn Lys Asn Ile Ile Lys Lys Leu Asn Asn Arg Ile
290 295 300

Ser Tyr Lys Val Ser Ser Cys Lys Asn Pro Pro Tyr Leu Asp Ile Tyr
305 310 315 320

Leu Met Ser Asn Ala Lys His Tyr Ile Ile Ser Leu Gly Gly Phe Gly
325 330 335

Asp Leu Ala Thr Arg Phe Asn Asn Asn Glu Asn Lys Ile Val Ile Lys
340 345 350

Ala Cys Lys Phe Gln Tyr Asp Tyr Leu
355 360

<210> 18
<211> 286
<212> PRT
<213> Yersinia sp.

<400> 18

Met Phe Met Lys Ile Ser Val Leu Val Gln Gly Gly Leu Gly Asn Gln
1 5 10 15

Leu Phe Gln Ile Ala Trp Ala Asn Tyr Leu Val Arg Lys Tyr Gln Tyr
20 25 30

Asn Val Glu Ile Asn Leu Gln Leu Leu Tyr Ser Gln Ser Gln His Ala
35 40 45

Ser Ile Asn Phe Ser Gln Leu Ile Gly Lys Val Pro Leu Leu Ser Val
50 55 60

Ser Lys Glu Lys Leu Ile Met Leu Asp Asp Arg Leu Ser Ser Lys Ile
65 70 75 80

Ile Arg Lys Ser Leu Arg Ile Leu Gly Val His Ser Ile Pro Asn Ile
85 90 95

Leu Leu His Asp Tyr Asp Ala Leu Thr Asp Phe Glu His Cys Asn Lys
100 105 110

Met Ala Asn Tyr Arg Tyr Gln Phe Gly Tyr Phe Gln Phe Ile Glu Ala
115 120 125

Ala Ile Phe Ser Arg Asp Ile Phe Leu Ser Asn Met Arg Ser Ile His
130 135 140

Gly Glu Phe Ile Lys Lys Cys Glu Ser Glu Phe Phe Glu Arg His Tyr

145 150 155 160

Val Gly Ile His Ile Arg Arg Gly Asp Phe Ile Lys Ser Thr Asp Pro
165 170 175

Leu His Leu Ala Thr Gly Ile Asp Tyr Ile Lys Lys Ser Ile Lys Lys
180 185 190

Phe Asn Asn Arg Asn Phe Ile Val Phe Ser Asp Asp Ile Gly Trp Cys
195 200 205

Arg Asp Lys Leu Gly Glu Ser Asp Gly Ile Val Tyr Phe Ser Gly Asn
210 215 220

Ser Ala Ile Glu Asp Phe Ile Gly Leu Met Cys Cys Lys Asp Phe Ile
225 230 235 240

Leu Ser Gly Ser Thr Phe Ser Trp Trp Ala Ala Ile Leu Ser Leu Asn
245 250 255

Glu Asn Thr Arg Val Val Ile Pro Asn Ser Lys Ala Gln Phe Met Ser
260 265 270

Ile Glu Ala Asn Thr Arg Ile Gly Trp Asp Phe Glu Val Val
275 280 285

<210> 19
<211> 300
<212> PRT
<213> Gramella forsetii

<400> 19

Met Ser Asn Lys Asn Pro Val Ile Val Glu Ile Met Gly Gly Leu Gly
1 5 10 15

Asn Gln Met Phe Gln Phe Ala Val Ala Lys Leu Leu Ala Glu Lys Asn
20 25 30

Ser Ser Val Leu Leu Val Asp Thr Asn Phe Tyr Lys Glu Ile Ser Gln
35 40 45

Asn Leu Lys Asp Phe Pro Arg Tyr Phe Ser Leu Gly Ile Phe Asp Ile
50 55 60

Ser Tyr Lys Met Gly Thr Glu Asn Gly Met Val Asn Phe Lys Asn Leu
65 70 75 80

Ser Phe Lys Asn Arg Val Ser Arg Lys Leu Gly Leu Asn Tyr Pro Lys
85 90 95

Ile Phe Lys Glu Lys Ser Tyr Arg Phe Asp Ala Asp Leu Phe Asn Lys
100 105 110

Lys Thr Pro Ile Tyr Leu Lys Gly Tyr Phe Gln Ser Tyr Lys Tyr Phe
115 120 125

Ile Gly Val Glu Ser Lys Ile Arg Gln Trp Phe Glu Phe Pro Tyr Glu
130 135 140

Asn Leu Gly Val Gly Asn Glu Glu Ile Lys Ser Lys Ile Leu Glu Lys
145 150 155 160

Thr Ser Val Ser Val His Ile Arg Arg Gly Asp Tyr Val Glu Asn Lys
165 170 175

Lys Thr Lys Glu Phe His Gly Asn Cys Ser Leu Glu Tyr Tyr Lys Asn
180 185 190

Ala Ile Thr Tyr Phe Leu Asp Ile Val Lys Glu Phe Asn Ile Val Phe
195 200 205

Phe Ser Asp Asp Ile Ser Trp Val Arg Asp Glu Phe Lys Asp Leu Pro
210 215 220

Asn Glu Lys Val Phe Val Thr Gly Asn Leu His Glu Asn Ser Trp Lys
225 230 235 240

Asp Met Tyr Leu Met Ser Leu Cys Asp His Asn Ile Ile Ala Asn Ser
245 250 255

Ser Phe Ser Trp Trp Ala Ala Trp Leu Asn Asn Asn Ser Glu Lys Asn
260 265 270

Val Ile Ala Pro Lys Lys Trp Phe Ala Asp Ile Asp Gln Glu Gln Lys
275 280 285

Ser Leu Asp Leu Leu Pro Pro Ser Trp Ile Arg Met
290 295 300

<210> 20
<211> 281
<212> PRT
<213> Francisella philomiragia ssp. philomiragia

<400> 20

Met Lys Ile Ile Lys Ile Gln Gly Gly Leu Gly Asn Gln Met Phe Gln
1 5 10 15

Tyr Ala Phe Tyr Lys Ser Leu Lys Asn Asn Cys Ile Asp Cys Tyr Val
20 25 30

Asp Ile Lys Asn Tyr Asp Thr Tyr Lys Leu His Tyr Gly Phe Glu Leu
35 40 45

Asn Arg Ile Phe Lys Asn Ile Asp Leu Ser Phe Ala Arg Lys Tyr His
50 55 60

Lys Lys Glu Val Leu Gly Lys Leu Phe Ser Ile Ile Pro Ser Lys Phe
65 70 75 80

Ile Val Lys Phe Asn Lys Asn Tyr Ile Leu Gln Lys Asn Phe Ala Phe
85 90 95

Asp Lys Ala Tyr Phe Glu Ile Asp Asn Cys Tyr Leu Asp Gly Tyr Trp
100 105 110

Gln Ser Glu Lys Tyr Phe Lys Lys Ile Thr Lys Asp Ile Tyr Asp Ala
115 120 125

Phe Thr Phe Glu Pro Leu Asp Ser Ile Asn Phe Glu Phe Leu Lys Asn
130 135 140

Ile Gln Asp Tyr Asn Leu Val Ser Ile His Val Arg Arg Gly Asp Tyr
145 150 155 160

Val Asn His Pro Leu His Gly Gly Ile Cys Asp Leu Glu Tyr Tyr Asn
165 170 175

Lys Ala Ile Ser Phe Ile Arg Ser Lys Val Ala Asn Val His Phe Leu
180 185 190

Val Phe Ser Asn Asp Ile Leu Trp Cys Lys Asp Asn Leu Lys Leu Asp
195 200 205

Arg Val Thr Tyr Ile Asp His Asn Arg Trp Met Asp Ser Tyr Lys Asp
210 215 220

Met His Leu Met Ser Leu Cys Lys His Asn Ile Ile Ala Asn Ser Ser
225 230 235 240

Phe Ser Trp Trp Gly Ala Trp Leu Asn Gln Asn Asp Asp Lys Ile Val
245 250 255

Ile Ala Pro Ser Lys Trp Phe Asn Asp Asp Lys Ile Asn Gln Lys Asp
260 265 270

Ile Cys Pro Asn Ser Trp Val Arg Ile
275 280

<210> 21
<211> 294
<212> PRT
<213> Pseudogulbenkiania ferrooxidans

<400> 21

Met Ile Ile Val Arg Leu Met Gly Gly Met Gly Asn Gln Leu Phe Gln
1 5 10 15

Tyr Ala Thr Ala Phe Ala Leu Ser Lys Arg Lys Ser Glu Pro Leu Val
20 25 30

Leu Asp Thr Arg Phe Phe Asp His Tyr Thr Leu His Gly Gly Tyr Lys
35 40 45

Leu Asp His Phe Asn Ile Ser Ala Arg Ile Leu Ser Lys Glu Glu Glu
50 55 60

Ser Leu Tyr Pro Asn Trp Gln Ala Asn Leu Leu Leu Arg Tyr Pro Ile
65 70 75 80

Ile Asp Arg Ala Phe Lys Lys Trp His Val Glu Arg Gln Phe Thr Tyr
85 90 95

Gln Asp Arg Ile Tyr Arg Met Lys Arg Gly Gln Ala Leu Leu Gly Tyr
100 105 110

Trp Gln Ser Glu Leu Tyr Phe Gln Glu Tyr Arg Lys Glu Ile Ser Ala
115 120 125

Glu Phe Thr Leu Lys Glu Gln Ser Ser Val Thr Ala Gln Gln Ile Ser
130 135 140

Val Ala Met Gln Gly Gly Asn Ser Val Ala Val His Ile Arg Arg Gly
145 150 155 160

Asp Tyr Leu Ser Asn Pro Ser Ala Leu Arg Thr His Gly Ile Cys Ser
165 170 175

Leu Gly Tyr Tyr Asn His Ala Met Ser Leu Leu Asn Glu Arg Ile Asn
180 185 190

Asp Ala Gln Phe Tyr Ile Phe Ser Asp Asp Ile Ala Trp Ala Lys Glu
195 200 205

Asn Ile Lys Ile Gly Lys Thr Ser Lys Asn Leu Ile Phe Ile Glu Gly
210 215 220

Glu Ser Val Glu Thr Asp Phe Trp Leu Met Thr Gln Ser Lys His His
225 230 235 240

Ile Ile Ala Asn Ser Thr Phe Ser Trp Trp Gly Ala Trp Leu Ala Asn
245 250 255

Asn Thr Asp Glu Gln Leu Val Ile Cys Pro Ser Pro Trp Phe Asp Asp
260 265 270

Lys Asn Leu Ser Glu Thr Asp Leu Ile Pro Lys Ser Trp Ile Arg Leu
275 280 285

Asn Lys Asp Leu Pro Val
290

<210> 22
<211> 292
<212> PRT
<213> Sideroxydans lithotrophicus

<400> 22

Met Val Ile Ser Asn Ile Ile Gly Gly Leu Gly Asn Gln Met Phe Gln

1 5 10 15

Tyr Ala Ala Ala Arg Ala Leu Ser Leu Lys Leu Glu Val Pro Leu Lys
20 25 30

Leu Asp Ile Ser Gly Phe Thr Asn Tyr Ala Leu His Gln Gly Phe Glu
35 40 45

Leu Asp Arg Ile Phe Gly Cys Lys Ile Glu Ile Ala Ser Glu Ala Asp
50 55 60

Val His Glu Ile Leu Gly Trp Gln Ser Ala Ser Gly Ile Arg Arg Val
65 70 75 80

Val Ser Arg Pro Gly Met Ser Ile Phe Arg Arg Lys Gly Phe Val Val
85 90 95

Glu Pro His Phe Ser Tyr Trp Asn Gly Ile Arg Lys Ile Thr Gly Asp
100 105 110

Cys Tyr Leu Ala Gly Tyr Trp Gln Ser Glu Lys Tyr Phe Leu Asp Ala
115 120 125

Ala Val Glu Ile Arg Lys Asp Phe Ser Phe Lys Leu Pro Leu Asp Ser
130 135 140

His Asn Ala Glu Leu Ala Glu Lys Ile Asp Gln Glu Asn Ala Val Ser
145 150 155 160

Leu His Ile Arg Arg Gly Asp Tyr Ala Asn Asn Pro Leu Thr Ala Ala
165 170 175

Thr His Gly Leu Cys Ser Leu Asp Tyr Tyr Arg Lys Ser Ile Lys His
180 185 190

Ile Ala Gly Gln Val Arg Asn Pro Tyr Phe Phe Val Phe Ser Asp Asp

195 200 205

Ile Ala Trp Val Lys Asp Asn Leu Glu Ile Glu Phe Pro Ser Gln Tyr
210 215 220

Val Asp Tyr Asn His Gly Ser Met Ser Phe Asn Asp Met Arg Leu Met
225 230 235 240

Ser Leu Cys Lys His His Ile Ile Ala Asn Ser Ser Phe Ser Trp Trp
245 250 255

Gly Ala Trp Leu Asn Pro Asn Pro Glu Lys Val Val Ile Ala Pro Glu
260 265 270

Arg Trp Phe Ala Asn Arg Thr Asp Val Gln Asp Leu Leu Pro Pro Gly
275 280 285

Trp Val Lys Leu
290

<210> 23
<211> 303
<212> PRT
<213> Providencia alcalifaciens

<400> 23

Met Lys Ile Asn Gly Lys Glu Ser Ser Met Lys Ile Lys Gln Lys Lys
1 5 10 15

Ile Ile Ser His Leu Ile Gly Gly Leu Gly Asn Gln Leu Phe Gln Tyr
20 25 30

Ala Thr Ser Tyr Ala Leu Ala Lys Glu Asn Asn Ala Lys Ile Val Ile
35 40 45

Asp Asp Arg Leu Phe Lys Lys Tyr Lys Leu His Gly Gly Tyr Arg Leu
50 55 60

Asp Lys Leu Asn Ile Ile Gly Glu Lys Ile Ser Ser Ile Asp Lys Leu
65 70 75 80

Leu Phe Pro Leu Ile Leu Cys Lys Leu Ser Gln Lys Glu Asn Phe Ile
85 90 95

Phe Lys Ser Thr Lys Lys Phe Ile Leu Glu Lys Lys Thr Ser Ser Phe
100 105 110

Lys Tyr Leu Thr Phe Ser Asp Lys Glu His Thr Lys Met Leu Ile Gly
115 120 125

Tyr Trp Gln Asn Ala Ile Tyr Phe Gln Lys Tyr Phe Ser Glu Leu Lys
130 135 140

Glu Met Phe Val Pro Leu Asp Ile Ser Gln Glu Gln Leu Asp Leu Ser
145 150 155 160

Ile Gln Ile His Ala Gln Gln Ser Val Ala Leu His Val Arg Arg Gly
165 170 175

Asp Tyr Ile Ser Asn Lys Asn Ala Leu Ala Met His Gly Ile Cys Ser
180 185 190

Ile Asp Tyr Tyr Lys Asn Ser Ile Gln His Ile Asn Ala Lys Leu Glu
195 200 205

Lys Pro Phe Phe Tyr Ile Phe Ser Asn Asp Lys Leu Trp Cys Glu Glu
210 215 220

Asn Leu Thr Pro Leu Phe Asp Gly Asn Phe His Ile Val Glu Asn Asn
225 230 235 240

Ser Gln Glu Ile Asp Leu Trp Leu Ile Ser Gln Cys Gln His His Ile
245 250 255

Ile Ala Asn Ser Thr Phe Ser Trp Trp Gly Ala Trp Leu Ala Asn Ser
260 265 270

Asp Ser Gln Ile Val Ile Thr Pro Asp Pro Trp Phe Asn Lys Glu Ile
275 280 285

Asp Ile Pro Ser Pro Val Leu Ser His Trp Leu Lys Leu Lys Lys
290 295 300

<210> 24
<211> 288
<212> PRT
<213> Pseudoalteromonas haloplanktis

<400> 24

Met Ile Lys Val Lys Ala Ile Gly Gly Leu Gly Asn Gln Leu Phe Gln
1 5 10 15

Tyr Ala Thr Ala Arg Ala Ile Ala Glu Lys Arg Gly Asp Gly Val Val
20 25 30

Val Asp Met Ser Asp Phe Ser Ser Tyr Lys Thr His Pro Phe Cys Leu
35 40 45

Asn Lys Phe Arg Cys Lys Ala Thr Tyr Glu Ser Lys Pro Lys Leu Ile
50 55 60

Asn Lys Leu Leu Ser Asn Glu Lys Ile Arg Asn Leu Leu Gln Lys Leu
65 70 75 80

Gly Phe Ile Lys Lys Tyr Tyr Phe Glu Thr Gln Leu Pro Phe Asn Glu
85 90 95

Asp Val Leu Leu Asn Asn Ser Ile Asn Tyr Leu Thr Gly Tyr Phe Gln
100 105 110

Ser Glu Lys Tyr Phe Leu Ser Ile Arg Glu Cys Leu Leu Asp Glu Leu
115 120 125

Thr Leu Ile Glu Asp Leu Asn Ile Ala Glu Thr Ala Val Ser Lys Ala
130 135 140

Ile Lys Asn Ala Lys Asn Ser Ile Ser Ile His Ile Arg Arg Gly Asp
145 150 155 160

Tyr Val Ser Asn Glu Gly Ala Asn Lys Thr His Gly Val Cys Asp Ser
165 170 175

Asp Tyr Phe Lys Lys Ala Leu Asn Tyr Phe Ser Glu Arg Lys Leu Leu
180 185 190

Asp Glu His Thr Glu Leu Phe Ile Phe Ser Asp Asp Ile Glu Trp Cys
195 200 205

Arg Asn Asn Leu Ser Phe Asp Tyr Lys Met Asn Phe Val Asp Gly Ser
210 215 220

Ser Glu Arg Pro Glu Val Asp Met Val Leu Met Ser Gln Cys Lys His
225 230 235 240

Gln Val Ile Ser Asn Ser Thr Phe Ser Trp Trp Gly Ala Trp Leu Asn
245 250 255

Lys Asn Asp Glu Lys Val Val Val Ala Pro Lys Glu Trp Phe Lys Ser
260 265 270

Thr Asp Leu Asp Ser Thr Asp Ile Val Pro Asn Gln Trp Ile Lys Leu
275 280 285

<210> 25
<211> 291
<212> PRT

<213> Roseovarius nubinhibens

<400> 25

Met Thr Asp Thr Pro Pro Pro Ser Gln Val Ile Thr Ser Arg Leu Phe
1 5 10 15

Gly Gly Ala Gly Asn Gln Leu Phe Gln Tyr Ala Ala Gly Arg Ala Leu
20 25 30

Ala Asp Arg Leu Gly Cys Asp Leu Met Ile Asp Ala Arg Tyr Val Ala
35 40 45

Gly Ser Arg Asp Arg Gly Asp Cys Phe Thr His Phe Ala Lys Ala Arg
50 55 60

Leu Arg Arg Asp Val Ala Leu Pro Pro Ala Lys Ser Asp Gly Pro Leu
65 70 75 80

Arg Tyr Ala Leu Trp Arg Lys Phe Gly Arg Ser Pro Arg Phe His Arg
85 90 95

Glu Arg Gly Leu Gly Val Asp Pro Glu Phe Phe Asn Leu Pro Arg Gly
100 105 110

Thr Tyr Leu His Gly Tyr Trp Gln Ser Glu Gln Tyr Phe Gly Pro Asp
115 120 125

Thr Asp Ala Leu Arg Arg Asp Leu Thr Leu Thr Thr Ala Leu Asp Ala
130 135 140

Pro Asn Ala Ala Met Ala Ala Gln Ile Asp Ala Ala Pro Cys Pro Val
145 150 155 160

Ser Phe His Val Arg Arg Gly Asp Tyr Ile Ala Ala Gly Ala Tyr Ala
165 170 175

Ala Cys Thr Pro Asp Tyr Tyr Arg Ala Ala Ala Asp His Leu Ala Thr
180 185 190

Thr Leu Gly Lys Pro Leu Thr Cys Phe Ile Phe Ser Asn Asp Pro Ala
195 200 205

Trp Ala Arg Asp Asn Leu Asp Leu Gly Gln Asp Gln Val Ile Val Asp
210 215 220

Leu Asn Asp Glu Ala Thr Gly His Phe Asp Met Ala Leu Met Ala Arg
225 230 235 240

Cys Ala His His Val Ile Ala Asn Ser Thr Phe Ser Trp Trp Gly Ala
245 250 255

Trp Leu Asn Pro Asp Pro Asp Lys Leu Val Val Ala Pro Arg Asn Trp
260 265 270

Phe Ala Thr Gln Ala Leu His Asn Pro Asp Leu Ile Pro Glu Gln Trp
275 280 285

His Arg Leu
290

<210> 26
<211> 292
<212> PRT
<213> Desulfovibrio alaskensis

<400> 26

Met Lys Phe Val Gly Val Trp Ile Leu Gly Gly Leu Gly Asn Gln Met
1 5 10 15

Phe Gln Phe Ala Ala Ala Tyr Ala Leu Ala Lys Arg Met Gly Gly Glu
20 25 30

Leu Arg Leu Asp Leu Ser Gly Phe Lys Lys Tyr Pro Leu Arg Ser Tyr

35 40 45

Ser Leu Asp Leu Phe Thr Val Asp Thr Pro Leu Trp His Gly Leu Pro
50 55 60

Met Ser Gln Arg Arg Phe Arg Ile Pro Met Asp Ala Trp Thr Arg Gly
65 70 75 80

Ser Arg Leu Pro Leu Val Pro Ser Pro Pro Phe Val Met Ala Lys Glu
85 90 95

Lys Asn Phe Ala Phe Ser Pro Ile Val Tyr Glu Leu Gln Gln Ser Cys
100 105 110

Tyr Leu Tyr Gly Tyr Trp Gln Ser Tyr Arg Tyr Phe Gln Asp Val Glu
115 120 125

Asp Asp Ile Arg Thr Leu Phe Ser Leu Ser Arg Phe Ala Thr Leu Glu
130 135 140

Leu Ala Pro Val Val Ala Gln Leu Asn Glu Val Glu Ser Val Ala Val
145 150 155 160

His Leu Arg Arg Gly Asp Tyr Ile Thr Asp Ala Ala Ser Asn Ala Val
165 170 175

His Gly Val Cys Gly Ile Asp Tyr Tyr Gln Arg Ser Met Ser Leu Val
180 185 190

Arg Arg Ser Thr Thr Lys Pro Ile Phe Tyr Ile Phe Ser Asp Glu Pro
195 200 205

Glu Val Ala Lys Lys Leu Phe Ala Thr Glu Asp Asp Val Val Val Met
210 215 220

Pro Ser Arg Arg Gln Glu Glu Asp Leu Leu Leu Met Ser Arg Cys Lys

225 230 235 240

His His Ile Ile Ala Asn Ser Ser Phe Ser Trp Trp Ala Ala Trp Leu
245 250 255

Gly Lys Arg Ala Ser Gly Leu Cys Ile Ala Pro Arg Tyr Trp Phe Ala
260 265 270

Arg Pro Lys Leu Glu Ser Thr Tyr Leu Phe Asp Leu Ile Pro Asp Glu
275 280 285

Trp Leu Leu Leu
290

<210> 27
<211> 293
<212> PRT
<213> Thermosynechococcus elongates

<400> 27

Met Ile Ile Val His Leu Cys Gly Gly Leu Gly Asn Gln Met Phe Gln
1 5 10 15

Tyr Ala Ala Gly Leu Ala Ala Ala His Arg Ile Gly Ser Glu Val Lys
20 25 30

Phe Asp Thr His Trp Phe Asp Ala Thr Cys Leu His Gln Gly Leu Glu
35 40 45

Leu Arg Arg Val Phe Gly Leu Glu Leu Pro Glu Pro Ser Ser Lys Asp
50 55 60

Leu Arg Lys Val Leu Gly Ala Cys Val His Pro Ala Val Arg Arg Leu
65 70 75 80

Leu Ala Gly His Phe Leu His Gly Leu Arg Pro Lys Ser Leu Val Ile
85 90 95

Gln Pro His Phe His Tyr Trp Thr Gly Phe Glu His Leu Pro Asp Asn
100 105 110

Val Tyr Leu Glu Gly Tyr Trp Gln Ser Glu Arg Tyr Phe Ser Asn Ile
115 120 125

Ala Asp Ile Ile Arg Gln Gln Phe Arg Phe Val Glu Pro Leu Asp Pro
130 135 140

His Asn Ala Ala Leu Met Asp Glu Met Gln Ser Gly Val Ser Val Ser
145 150 155 160

Leu His Ile Arg Arg Gly Asp Tyr Phe Asn Asn Pro Gln Met Arg Arg
165 170 175

Val His Gly Val Asp Leu Ser Glu Tyr Tyr Pro Ala Ala Val Ala Thr
180 185 190

Met Ile Glu Lys Thr Asn Ala Glu Arg Phe Tyr Val Phe Ser Asp Asp
195 200 205

Pro Gln Trp Val Leu Glu His Leu Lys Leu Pro Val Ser Tyr Thr Val
210 215 220

Val Asp His Asn Arg Gly Ala Ala Ser Tyr Arg Asp Met Gln Leu Met
225 230 235 240

Ser Ala Cys Arg His His Ile Ile Ala Asn Ser Thr Phe Ser Trp Trp
245 250 255

Gly Ala Trp Leu Asn Pro Arg Pro Asp Lys Val Val Ile Ala Pro Arg
260 265 270

His Trp Phe Asn Val Asp Val Phe Asp Thr Arg Asp Leu Tyr Cys Pro
275 280 285

Gly Trp Ile Val Leu
290

<210> 28
<211> 331
<212> PRT
<213> Bacteroides fragilis

<400> 28

Met Cys Asp Cys Leu Ser Ile Ile Leu Leu Val Lys Met Lys Lys Ile
1 5 10 15

Tyr Leu Lys Phe Val Asp Phe Trp Asp Gly Phe Asp Thr Ile Ser Asn
20 25 30

Phe Ile Val Asp Ala Leu Ser Ile Gln Tyr Glu Val Val Leu Ser Asn
35 40 45

Glu Pro Asp Tyr Leu Phe Tyr Ser Cys Phe Gly Thr Ser His Leu Glu
50 55 60

Tyr Asp Cys Ile Lys Ile Met Phe Ile Gly Glu Asn Ile Val Pro Asp
65 70 75 80

Phe Asn Val Cys Asp Tyr Ala Ile Gly Phe Asn Tyr Ile Asp Phe Gly
85 90 95

Asp Arg Tyr Leu Arg Leu Pro Leu Tyr Ala Ile Tyr Asp Gly Phe Ser
100 105 110

Asn Leu Gln Asn Lys Lys Ile Asp Val Asn Lys Ala Leu Asp Arg Lys
115 120 125

Phe Cys Ser Ile Val Val Ser Asn Asn Lys Trp Ala Asp Pro Ile Arg
130 135 140

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

Gly Arg Ala Trp Asn Asn Ile Gly Gly Pro Val Asp Asn Lys Leu Asp
165 170 175

Phe Ile Ser Gln Tyr Lys Phe Asn Ile Ala Phe Glu Asn Ser Arg Val
180 185 190

Leu Gly Tyr Thr Thr Glu Lys Ile Met Glu Pro Met Gln Val Asn Ser
195 200 205

Ile Pro Val Tyr Trp Gly Asn Pro Leu Val Gly Lys Asp Phe Asn Val
210 215 220

Asp Ser Phe Val Asn Ala His Asp Phe Asp Ser Leu Glu Arg Leu Val
225 230 235 240

Glu Tyr Ile Ile Glu Leu Asp Ser Ser Lys Asp Lys Tyr Leu Glu Met
245 250 255

Leu Glu Lys Pro Trp Leu Leu Asp Lys Thr Tyr Leu Asp Trp Lys Gln
260 265 270

Leu Leu Leu Asn Phe Ile Asn Asn Ile Met Met Lys Ser Tyr Lys Asp
275 280 285

Ala Lys Tyr Leu Val Asn Tyr Gly His Ala Gly Lys Tyr Arg Asn Glu
290 295 300

Gln Arg Phe Trp Gly Arg Cys Glu Arg Lys Phe Lys Leu Gln Arg Ile
305 310 315 320

Ile Glu Tyr Tyr Ser Gln Leu Phe Asp Arg Lys
325 330

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<212> PRT
<213> Escherichia coli

<400> 29

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Phe Asp Ile Ser His Tyr Ala Glu Asn Asp Asp His Gly Gly Tyr Arg
35 40 45

Leu Asn Asn Leu Gln Ile Pro Glu Glu Tyr Leu Gln Tyr Tyr Thr Pro
50 55 60

Lys Ile Asn Asn Ile Tyr Lys Leu Leu Val Arg Gly Ser Arg Leu Tyr
65 70 75 80

Pro Asp Ile Phe Leu Phe Leu Gly Phe Cys Asn Glu Phe His Ala Tyr
85 90 95

Gly Tyr Asp Phe Glu Tyr Ile Ala Gln Lys Trp Lys Ser Lys Lys Tyr
100 105 110

Ile Gly Tyr Trp Gln Ser Glu His Phe Phe His Lys His Ile Leu Asp
115 120 125

Leu Lys Glu Phe Phe Ile Pro Lys Asn Val Ser Glu Gln Ala Asn Leu
130 135 140

Leu Ala Ala Lys Ile Leu Glu Ser Gln Ser Ser Leu Ser Ile His Ile
145 150 155 160

Arg Arg Gly Asp Tyr Ile Lys Asn Lys Thr Ala Thr Leu Thr His Gly
165 170 175

Val Cys Ser Leu Glu Tyr Tyr Lys Lys Ala Leu Asn Lys Ile Arg Asp
180 185 190

Leu Ala Met Ile Arg Asp Val Phe Ile Phe Ser Asp Asp Ile Phe Trp
195 200 205

Cys Lys Glu Asn Ile Glu Thr Leu Leu Ser Lys Lys Tyr Asn Ile Tyr
210 215 220

Tyr Ser Glu Asp Leu Ser Gln Glu Glu Asp Leu Trp Leu Met Ser Leu
225 230 235 240

Ala Asn His His Ile Ile Ala Asn Ser Ser Phe Ser Trp Trp Gly Ala
245 250 255

Tyr Leu Gly Ser Ser Ala Ser Gln Ile Val Ile Tyr Pro Thr Pro Trp
260 265 270

Tyr Asp Ile Thr Pro Lys Asn Thr Tyr Ile Pro Ile Val Asn His Trp
275 280 285

Ile Asn Val Asp Lys His Ser Ser Cys
290 295

<210> 30
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<212> PRT
<213> Thalassospira profundimaris

<400> 30

Met Val Ile Val Lys Leu Leu Gly Gly Leu Gly Asn Gln Met Phe Gln
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Leu Asp Val Ser Ala Phe Ala His Tyr Asp Leu Arg Arg Tyr Glu Leu
35 40 45

Asp Asp Trp Asn Ile Thr Ala Arg Leu Ala Thr Ser Glu Glu Leu Ala
50 55 60

Arg Ser Gly Val Thr Ala Ala Pro Pro Ser Phe Phe Asp Arg Ile Ala
65 70 75 80

Arg Phe Leu Arg Ile Asp Leu Pro Val Asn Cys Phe Arg Glu Ala Ser
85 90 95

Phe Thr Tyr Asp Pro Arg Ile Leu Glu Val Ser Ser Pro Val Tyr Leu
100 105 110

Asp Gly Tyr Trp Gln Ser Glu Arg Tyr Phe Leu Asp Ile Glu Lys Lys
115 120 125

Leu Arg Gln Glu Phe Gln Leu Lys Ala Ser Ile Asp Ala Asn Asn His
130 135 140

Ser Phe Lys Lys Lys Ile Asp Gly Leu Gly Lys Gln Ala Val Ser Leu
145 150 155 160

His Val Arg Arg Gly Asp Tyr Val Thr Asn Pro Gln Thr Ala Ser Tyr
165 170 175

His Gly Val Cys Ser Leu Asp Tyr Tyr Arg Ala Ala Val Asp Tyr Ile
180 185 190

Ala Glu His Val Ser Asp Pro Cys Phe Phe Val Phe Ser Asp Asp Leu
195 200 205

Glu Trp Val Gln Thr Asn Leu Asn Ile Lys Gln Pro Ile Val Leu Val

210 215 220

Asp Ala Asn Gly Pro Asp Asn Gly Ala Ala Asp Met Ala Leu Met Met
225 230 235 240

Ala Cys Arg His His Ile Ile Ala Asn Ser Ser Phe Ser Trp Trp Gly
245 250 255

Ser Trp Leu Asn Pro Leu Asn Asp Lys Ile Ile Val Ala Pro Lys Lys
260 265 270

Trp Phe Gly Arg Ala Asn His Asp Thr Thr Asp Leu Val Pro Asp Ser
275 280 285

Trp Val Arg Leu
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<211> 2851
<212> DNA
<213> Unknown

<220>
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ttttgtttaa ctttaagaag gagatataca aatgtactat ttaaaaaaca caaacttttg 180

gatgttcggt ttattctttt tcttttactt ttttatcatg ggagcctact tcccgttttt 240

cccgatttgg ctacatgaca tcaaccatat cagcaaaagt gatacgggta ttatttttgc 300

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ctgggcgctg tgtgcctcga ttgtcggcat catgttcacc atcaataatc agtttgtttt 660

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<211> 4568
<212> DNA
<213> Unknown

<220>
<223> Expression construct for integration into E. coli genome.

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ggcgataccg taaagcacga ggaagcggtc agcccattcg ccgccaagct cttcagcaat 480

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<211> 4259
<212> DNA
<213> Unknown

<220>
<223> GalETKM operon comprising 19 bp mosaic end recognition site for the EZ-Tn5 transposase at its 5' end.

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<210> 41
<211> 6021
<212> DNA
<213> Unknown

<220>
<223> Expression construct comprising Bbhl gene with codon optimization for E. coli under control of Ptet promoter and conferring zeocin resistance.

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<211> 4543
<212> DNA
<213> Unknown

<220>
<223> Transposon cassette.

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tttgtttaac tttaagaagg agatatacaa atgaccatga ttacggattc actggccgtc 180

gttttacaac gtcgtgactg ggaaaaccct ggcgttaccc aacttaatcg ccttgcagca 240

catccccctt tcgccagctg gcgtaatagc gaagaggccc gcaccgatcg cccttcccaa 300

cagttgcgca gcctgaatgg cgaatggcgc tttgcctggt ttccggcacc agaagcggtg 360

ccggaaagct ggctggagtg cgatcttcct gaggccgata ctgtcgtcgt cccctcaaac 420

tggcagatgc acggttacga tgcgcccatc tacaccaacg tgacctatcc cattacggtc 480

aatccgccgt ttgttcccac ggagaatccg acgggttgtt actcgctcac atttaatgtt 540

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<223> Transposon cassette.

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tttgtttaac tttaagaagg agatatacaa atggaacatc gtgccttcaa atggccgcaa 180

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ggtaccgcat cgccgccgat gtggatgacc caggcgcatc cggaaatcct gtgggtggat 480

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<210> 45
<211> 28
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<210> 46
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gcggccgcgt cgacacgcaa aaagg 25

<210> 47
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<220>
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<400> 47
agtctgcgcg tctttcaggg cttcatcg 28

<210> 48
<211> 31
<212> DNA
<213> Unknown

<220>
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gatcccatgg aagttaaaat cattggtggt c 31

<210> 49
<211> 33
<212> DNA
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<220>
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<210> 54
<211> 47
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<220>
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<210> 55
<211> 45
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<220>
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<210> 56
<211> 54
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<220>
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