

PhoenixTemp39976.tmp.txt
SEQUENCE LISTING

<110> DSM IP Assets B.V.
Mueller, Ulrike Maria
Perkins, John B.
Trefzer, Axel Christoph

<120> Butanol production in a prokaryotic cell

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<141> 2007-12-18

<160> 23

<170> PatentIn version 3.2

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Asn Glu Val Ile Leu Gly Asn Val Leu Gln Ala Gly Leu Gly Gln Asn
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Pro Ala Arg Gln Ala Ser Phe Lys Ala Gly Leu Pro Val Glu Ile Pro
65 70 75 80

Ala Met Thr Ile Asn Lys Val Cys Gly Ser Gly Leu Arg Thr Val Ser
85 90 95

Leu Ala Ala Gln Ile Ile Lys Ala Gly Asp Ala Asp Val Ile Ile Ala
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Gly Gly Met Glu Asn Met Ser Arg Ala Pro Tyr Leu Ala Asn Asn Ala
115 120 125

Arg Trp Gly Tyr Arg Met Gly Asn Ala Lys Phe Val Asp Glu Met Ile
130 135 140

Thr Asp Gly Leu Trp Asp Ala Phe Asn Asp Tyr His Met Gly Ile Thr
145 150 155 160

Ala Glu Asn Ile Ala Glu Arg Trp Asn Ile Ser Arg Glu Glu Gln Asp
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Glu Phe Ala Leu Ala Ser Gln Lys Lys Ala Glu Glu Ala Ile Lys Ser
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Gly Gln Phe Lys Asp Glu Ile Val Pro Val Val Ile Lys Gly Arg Lys
195 200 205

Gly Glu Thr Val Val Asp Thr Asp Glu His Pro Arg Phe Gly Ser Thr
210 215 220

Ile Glu Gly Leu Ala Lys Leu Lys Pro Ala Phe Lys Lys Asp Gly Thr
225 230 235 240

Val Thr Ala Gly Asn Ala Ser Gly Leu Asn Asp Cys Ala Ala Val Leu
245 250 255

Val Ile Met Ser Ala Glu Lys Ala Lys Glu Leu Gly Val Lys Pro Leu
260 265 270

Ala Lys Ile Val Ser Tyr Gly Ser Ala Gly Val Asp Pro Ala Ile Met
275 280 285

Gly Tyr Gly Pro Phe Tyr Ala Thr Lys Ala Ala Ile Glu Lys Ala Gly
290 295 300

Trp Thr Val Asp Glu Leu Asp Leu Ile Glu Ser Asn Glu Ala Phe Ala
305 310 315 320

Ala Gln Ser Leu Ala Val Ala Lys Asp Leu Lys Phe Asp Met Asn Lys
325 330 335

Val Asn Val Asn Gly Gly Ala Ile Ala Leu Gly His Pro Ile Gly Ala
340 345 350

Ser Gly Ala Arg Ile Leu Val Thr Leu Val His Ala Met Gln Lys Arg
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Lys Arg Pro Asp Lys Val Ile Gly Met His Phe Phe Asn Pro Ala Pro
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Thr Phe Asp Ala Val Lys Glu Thr Ser Ile Ala Ile Gly Lys Asp Pro
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Val Glu Val Ala Glu Ala Pro Gly Phe Val Val Asn Arg Ile Leu Ile
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Pro Met Ile Asn Glu Ala Val Gly Ile Leu Ala Glu Gly Ile Ala Ser
195 200 205

Val Glu Asp Ile Asp Lys Ala Met Lys Leu Gly Ala Asn His Pro Met
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Gly Pro Leu Glu Leu Gly Asp Phe Ile Gly Leu Asp Ile Cys Leu Ala
225 230 235 240

Ile Met Asp Val Leu Tyr Ser Glu Thr Gly Asp Ser Lys Tyr Arg Pro
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Leu Ile Phe Thr Ala Gln Asn Ile Lys Ala Asp Glu Ala Leu Arg Ile
165 170 175

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

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35

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65 70 75 80

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Leu Ile Asn Glu His Gly Thr Glu Glu Gln Lys Gln Lys Tyr Leu Val
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Pro Leu Ala Lys Gly Glu Lys Ile Gly Ala Tyr Gly Leu Thr Glu Pro
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Gly Thr Lys Gly Ile Ser Ala Phe Ile Ile Glu Lys Gly Phe Lys Gly
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Thr Thr Glu Leu Val Phe Glu Asp Met Ile Val Pro Val Glu Asn Met
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Ile Gly Lys Glu Gly Lys Gly Phe Pro Ile Ala Met Lys Thr Leu Asp
225 230 235 240

Gly Gly Arg Ile Gly Ile Ala Ala Gln Ala Leu Gly Ile Ala Glu Gly
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Ala Phe Asn Glu Ala Arg Ala Tyr Met Lys Glu Arg Lys Gln Phe Gly
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Arg Ser Leu Asp Lys Phe Gln Gly Leu Ala Trp Met Met Ala Asp Met
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Asp Val Ala Ile Glu Ser Ala Arg Tyr Leu Val Tyr Lys Ala Ala Tyr
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Leu Lys Gln Ala Gly Leu Pro Tyr Thr Val Asp Ala Ala Arg Ala Lys
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Lys Ile Phe Lys Gln Cys Ala Ile Ala Ala Ala Lys Glu Arg Ile Asn
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Leu Ala Lys Leu Ala Val Glu Glu Thr Gly Ile Gly Leu Val Glu Asp
50 55 60

Lys Ile Ile Lys Asn His Phe Ala Ala Glu Tyr Ile Tyr Asn Lys Tyr
65 70 75 80

Lys Asn Glu Lys Thr Cys Gly Ile Ile Asp His Asp Asp Ser Leu Gly
85 90 95

Ile Thr Lys Val Ala Glu Pro Ile Gly Ile Val Ala Ala Ile Val Pro
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Thr Thr Asn Pro Thr Ser Thr Ala Ile Phe Lys Ser Leu Ile Ser Leu
115 120 125

Lys Thr Arg Asn Ala Ile Phe Phe Ser Pro His Pro Arg Ala Lys Lys
130 135 140

Ser Thr Ile Ala Ala Ala Lys Leu Ile Leu Asp Ala Ala Val Lys Ala
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Gly Ala Pro Lys Asn Ile Ile Gly Trp Ile Asp Glu Pro Ser Ile Glu
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Leu Ser Gln Asp Leu Met Ser Glu Ala Asp Ile Ile Leu Ala Thr Gly
180 185 190

Gly Pro Ser Met Val Lys Ala Ala Tyr Ser Ser Gly Lys Pro Ala Ile
195 200 205

Gly Val Gly Ala Gly Asn Thr Pro Ala Ile Ile Asp Glu Ser Ala Asp
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Ile Asp Met Ala Val Ser Ser Ile Ile Leu Ser Lys Thr Tyr Asp Asn
225 230 235 240

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325 330 335

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Lys Ala Gln Arg Leu Ile Glu Leu Gly Gly Ser Gly His Thr Ser Ser
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370 375 380

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Page 10

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aatcctaggt atccacttat aagtgaactt aaggatatct atataaaatc attttaa 2577

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<210> 11
<211> 862
<212> PRT
<213> Clostridium acetobutylicum

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<400> 11

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Met Lys Val Thr Thr Val Lys Glu Leu Asp Glu Lys Leu Lys Val Ile
1          5          10          15

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```

Lys Glu Ala Gln Lys Lys Phe Ser Cys Tyr Ser Gln Glu Met Val Asp
          20          25          30

```

```

Glu Ile Phe Arg Asn Ala Ala Met Ala Ala Ile Asp Ala Arg Ile Glu
          35          40          45

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Leu Ala Lys Ala Ala Val Leu Glu Thr Gly Met Gly Leu Val Glu Asp
          50          55          60

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Lys Val Ile Lys Asn His Phe Ala Gly Glu Tyr Ile Tyr Asn Lys Tyr
          65          70          75          80

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Lys Asp Glu Lys Thr Cys Gly Ile Ile Glu Arg Asn Glu Pro Tyr Gly
          85          90          95

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Ile Thr Lys Ile Ala Glu Pro Ile Gly Val Val Ala Ala Ile Ile Pro
          100          105          110

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Val Thr Asn Pro Thr Ser Thr Thr Ile Phe Lys Ser Leu Ile Ser Leu
 115 120 125
 Lys Thr Arg Asn Gly Ile Phe Phe Ser Pro His Pro Arg Ala Lys Lys
 130 135 140
 Ser Thr Ile Leu Ala Ala Lys Thr Ile Leu Asp Ala Ala Val Lys Ser
 145 150 155 160
 Gly Ala Pro Glu Asn Ile Ile Gly Trp Ile Asp Glu Pro Ser Ile Glu
 165 170 175
 Leu Thr Gln Tyr Leu Met Gln Lys Ala Asp Ile Thr Leu Ala Thr Gly
 180 185 190
 Gly Pro Ser Leu Val Lys Ser Ala Tyr Ser Ser Gly Lys Pro Ala Ile
 195 200 205
 Gly Val Gly Pro Gly Asn Thr Pro Val Ile Ile Asp Glu Ser Ala His
 210 215 220
 Ile Lys Met Ala Val Ser Ser Ile Ile Leu Ser Lys Thr Tyr Asp Asn
 225 230 235 240
 Gly Val Ile Cys Ala Ser Glu Gln Ser Val Ile Val Leu Lys Ser Ile
 245 250 255
 Tyr Asn Lys Val Lys Asp Glu Phe Gln Glu Arg Gly Ala Tyr Ile Ile
 260 265 270
 Lys Lys Asn Glu Leu Asp Lys Val Arg Glu Val Ile Phe Lys Asp Gly
 275 280 285
 Ser Val Asn Pro Lys Ile Val Gly Gln Ser Ala Tyr Thr Ile Ala Ala
 290 295 300
 Met Ala Gly Ile Lys Val Pro Lys Thr Thr Arg Ile Leu Ile Gly Glu
 305 310 315 320
 Val Thr Ser Leu Gly Glu Glu Glu Pro Phe Ala His Glu Lys Leu Ser
 325 330 335
 Pro Val Leu Ala Met Tyr Glu Ala Asp Asn Phe Asp Asp Ala Leu Lys
 340 345 350
 Lys Ala Val Thr Leu Ile Asn Leu Gly Gly Leu Gly His Thr Ser Gly
 355 360 365
 Ile Tyr Ala Asp Glu Ile Lys Ala Arg Asp Lys Ile Asp Arg Phe Ser
 370 375 380
 Ser Ala Met Lys Thr Val Arg Thr Phe Val Asn Ile Pro Thr Ser Gln
 Page 14

385 390 395 400
 Gly Ala Ser Gly Asp Leu Tyr Asn Phe Arg Ile Pro Pro Ser Phe Thr
 405 410 415
 Leu Gly Cys Gly Phe Trp Gly Gly Asn Ser Val Ser Glu Asn Val Gly
 420 425 430
 Pro Lys His Leu Leu Asn Ile Lys Thr Val Ala Glu Arg Arg Glu Asn
 435 440 445
 Met Leu Trp Phe Arg Val Pro His Lys Val Tyr Phe Lys Phe Gly Cys
 450 455 460
 Leu Gln Phe Ala Leu Lys Asp Leu Lys Asp Leu Lys Lys Lys Arg Ala
 465 470 475 480
 Phe Ile Val Thr Asp Ser Asp Pro Tyr Asn Leu Asn Tyr Val Asp Ser
 485 490 495
 Ile Ile Lys Ile Leu Glu His Leu Asp Ile Asp Phe Lys Val Phe Asn
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 Lys Val Gly Arg Glu Ala Asp Leu Lys Thr Ile Lys Lys Ala Thr Glu
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 Glu Met Ser Ser Phe Met Pro Asp Thr Ile Ile Ala Leu Gly Gly Thr
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 Pro Glu Met Ser Ser Ala Lys Leu Met Trp Val Leu Tyr Glu His Pro
 545 550 555 560
 Glu Val Lys Phe Glu Asp Leu Ala Ile Lys Phe Met Asp Ile Arg Lys
 565 570 575
 Arg Ile Tyr Thr Phe Pro Lys Leu Gly Lys Lys Ala Met Leu Val Ala
 580 585 590
 Ile Thr Thr Ser Ala Gly Ser Gly Ser Glu Val Thr Pro Phe Ala Leu
 595 600 605
 Val Thr Asp Asn Asn Thr Gly Asn Lys Tyr Met Leu Ala Asp Tyr Glu
 610 615 620
 Met Thr Pro Asn Met Ala Ile Val Asp Ala Glu Leu Met Met Lys Met
 625 630 635 640
 Pro Lys Gly Leu Thr Ala Tyr Ser Gly Ile Asp Ala Leu Val Asn Ser
 645 650 655
 Ile Glu Ala Tyr Thr Ser Val Tyr Ala Ser Glu Tyr Thr Asn Gly Leu
 660 665 670

PhoenixTemp39976.tmp.txt

Ala Leu Glu Ala Ile Arg Leu Ile Phe Lys Tyr Leu Pro Glu Ala Tyr
675 680 685

Lys Asn Gly Arg Thr Asn Glu Lys Ala Arg Glu Lys Met Ala His Ala
690 695 700

Ser Thr Met Ala Gly Met Ala Ser Ala Asn Ala Phe Leu Gly Leu Cys
705 710 715 720

His Ser Met Ala Ile Lys Leu Ser Ser Glu His Asn Ile Pro Ser Gly
725 730 735

Ile Ala Asn Ala Leu Leu Ile Glu Glu Val Ile Lys Phe Asn Ala Val
740 745 750

Asp Asn Pro Val Lys Gln Ala Pro Cys Pro Gln Tyr Lys Tyr Pro Asn
755 760 765

Thr Ile Phe Arg Tyr Ala Arg Ile Ala Asp Tyr Ile Lys Leu Gly Gly
770 775 780

Asn Thr Asp Glu Glu Lys Val Asp Leu Leu Ile Asn Lys Ile His Glu
785 790 795 800

Leu Lys Lys Ala Leu Asn Ile Pro Thr Ser Ile Lys Asp Ala Gly Val
805 810 815

Leu Glu Glu Asn Phe Tyr Ser Ser Leu Asp Arg Ile Ser Glu Leu Ala
820 825 830

Leu Asp Asp Gln Cys Thr Gly Ala Asn Pro Arg Phe Pro Leu Thr Ser
835 840 845

Glu Ile Lys Glu Met Tyr Ile Asn Cys Phe Lys Lys Gln Pro
850 855 860

<210> 12
<211> 2589
<212> DNA
<213> Clostridium acetobutylicum

<400> 12
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gcagcaatcg acgcaaggat agagctagca aaagcagctg ttttggaac cggtatgggc 180
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aaggatgaaa aaacctgcgg tataattgaa cgaaatgaac cctacggaat tacaaaaata 300
gcagaaccta taggagttgt agctgctata atccctgtaa caaacccac atcaacaaca 360
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PhoenixTemp39976.tmp.txt

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cgtgaagtga	tttttaaaga	tggatccgta	aaccctaaaa	tagtcggaca	gtcagcttat	900
actatagcag	ctatggctgg	cataaaagta	cctaaaacca	caagaatatt	aataggagaa	960
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caaccttaa 2589

<210> 13
<211> 389
<212> PRT
<213> Clostridium acetobutylicum
<400> 13

Met Leu Ser Phe Asp Tyr Ser Ile Pro Thr Lys Val Phe Phe Gly Lys
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Gly Lys Ile Asp Val Ile Gly Glu Glu Ile Lys Lys Tyr Gly Ser Arg
20 25 30

Val Leu Ile Val Tyr Gly Gly Gly Ser Ile Lys Arg Asn Gly Ile Tyr
35 40 45

Asp Arg Ala Thr Ala Ile Leu Lys Glu Asn Asn Ile Ala Phe Tyr Glu
50 55 60

Leu Ser Gly Val Glu Pro Asn Pro Arg Ile Thr Thr Val Lys Lys Gly
65 70 75 80

Ile Glu Ile Cys Arg Glu Asn Asn Val Asp Leu Val Leu Ala Ile Gly
85 90 95

Gly Gly Ser Ala Ile Asp Cys Ser Lys Val Ile Ala Ala Gly Val Tyr
100 105 110

Tyr Asp Gly Asp Thr Trp Asp Met Val Lys Asp Pro Ser Lys Ile Thr
115 120 125

Lys Val Leu Pro Ile Ala Ser Ile Leu Thr Leu Ser Ala Thr Gly Ser
130 135 140

Glu Met Asp Gln Ile Ala Val Ile Ser Asn Met Glu Thr Asn Glu Lys
145 150 155 160

Leu Gly Val Gly His Asp Asp Met Arg Pro Lys Phe Ser Val Leu Asp
165 170 175

Pro Thr Tyr Thr Phe Thr Val Pro Lys Asn Gln Thr Ala Ala Gly Thr
180 185 190

Ala Asp Ile Met Ser His Thr Phe Glu Ser Tyr Phe Ser Gly Val Glu
195 200 205

Gly Ala Tyr Val Gln Asp Gly Ile Ala Glu Ala Ile Leu Arg Thr Cys
210 215 220

PhoenixTemp39976.tmp.txt

Ile Lys Tyr Gly Lys Ile Ala Met Glu Lys Thr Asp Asp Tyr Glu Ala
225 230 235 240

Arg Ala Asn Leu Met Trp Ala Ser Ser Leu Ala Ile Asn Gly Leu Leu
245 250 255

Ser Leu Gly Lys Asp Arg Lys Trp Ser Cys His Pro Met Glu His Glu
260 265 270

Leu Ser Ala Tyr Tyr Asp Ile Thr His Gly Val Gly Leu Ala Ile Leu
275 280 285

Thr Pro Asn Trp Met Glu Tyr Ile Leu Asn Asp Asp Thr Leu His Lys
290 295 300

Phe Val Ser Tyr Gly Ile Asn Val Trp Gly Ile Asp Lys Asn Lys Asp
305 310 315 320

Asn Tyr Glu Ile Ala Arg Glu Ala Ile Lys Asn Thr Arg Glu Tyr Phe
325 330 335

Asn Ser Leu Gly Ile Pro Ser Lys Leu Arg Glu Val Gly Ile Gly Lys
340 345 350

Asp Lys Leu Glu Leu Met Ala Lys Gln Ala Val Arg Asn Ser Gly Gly
355 360 365

Thr Ile Gly Ser Leu Arg Pro Ile Asn Ala Glu Asp Val Leu Glu Ile
370 375 380

Phe Lys Lys Ser Tyr
385

<210> 14
<211> 1170
<212> DNA
<213> Clostridium acetobutylicum

<400> 14
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gtaattggag aagaaattaa gaaatatggc tcaagagtgc ttatagttta tggcggagga 120
agtataaaaa ggaacggtat atatgataga gcaacagcta tattaaga aaacaatata 180
gctttctatg aactttcagg agtagagcca aatcctagga taacaacagt aaaaaaggc 240
atagaaatat gtagagaaaa taatgtggat ttagtattag caataggggg aggaagtgca 300
atagactgtt ctaaggtaat tgcagctgga gtttattatg atggcgatac atgggacatg 360
gttaaagatc catctaaaat aactaaagtt cttccaattg caagtatact tactctttca 420
gcaacagggt ctgaaatgga tcaaattgca gtaatttcaa atatggagac taatgaaaag 480
cttggagtag gacatgatga tatgagacct aaattttcag tgtagatcc tacatatact 540

PhoenixTemp39976.tmp.txt

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ttaagaacat gtataaagta tggaaaaata gcaatggaga agactgatga ttacgaggct 720
agagctaatt tgatgtgggc ttcaagttta gctataaatg gtctattatc acttggttaag 780
gatagaaaat ggagttgtca tcctatggaa cactaggtta gtgcatatta tgatataaca 840
catgggttag gacttgcaat tttaacacct aattggatgg aatatattct aaatgacgat 900
acacttcata aatttgtttc ttatggaata aatgtttggg gaatagacaa gaacaaagat 960
aactatgaaa tagcacgaga ggctattaaa aatacgagag aatactttta ttcatggggt 1020
attccttcaa agcttagaga agttggaata ggaaaagata aactagaact aatggcaaag 1080
caagctgtta gaaattctgg aggaacaata ggaagtttaa gaccaataaa tgcagaggat 1140
gttcttgaga tattttaaaa atcttattaa 1170

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<210> 15
 <211> 390
 <212> PRT
 <213> Clostridium acetobutylicum

<400> 15

Met Val Asp Phe Glu Tyr Ser Ile Pro Thr Arg Ile Phe Phe Gly Lys
 1 5 10 15

Asp Lys Ile Asn Val Leu Gly Arg Glu Leu Lys Lys Tyr Gly Ser Lys
 20 25 30

Val Leu Ile Val Tyr Gly Gly Gly Ser Ile Lys Arg Asn Gly Ile Tyr
 35 40 45

Asp Lys Ala Val Ser Ile Leu Glu Lys Asn Ser Ile Lys Phe Tyr Glu
 50 55 60

Leu Ala Gly Val Glu Pro Asn Pro Arg Val Thr Thr Val Glu Lys Gly
 65 70 75 80

Val Lys Ile Cys Arg Glu Asn Gly Val Glu Val Val Leu Ala Ile Gly
 85 90 95

Gly Gly Ser Ala Ile Asp Cys Ala Lys Val Ile Ala Ala Ala Cys Glu
 100 105 110

Tyr Asp Gly Asn Pro Trp Asp Ile Val Leu Asp Gly Ser Lys Ile Lys
 115 120 125

Arg Val Leu Pro Ile Ala Ser Ile Leu Thr Ile Ala Ala Thr Gly Ser
 130 135 140

Glu Met Asp Thr Trp Ala Val Ile Asn Asn Met Asp Thr Asn Glu Lys
 145 150 155 160

PhoenixTemp39976.tmp.txt

Leu Ile Ala Ala His Pro Asp Met Ala Pro Lys Phe Ser Ile Leu Asp
165 170 175

Pro Thr Tyr Thr Tyr Thr Val Pro Thr Asn Gln Thr Ala Ala Gly Thr
180 185 190

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

Thr Ala Tyr Leu Gln Asp Arg Met Ala Glu Ala Leu Leu Arg Thr Cys
210 215 220

Ile Lys Tyr Gly Gly Ile Ala Leu Glu Lys Pro Asp Asp Tyr Glu Ala
225 230 235 240

Arg Ala Asn Leu Met Trp Ala Ser Ser Leu Ala Ile Asn Gly Leu Leu
245 250 255

Thr Tyr Gly Lys Asp Thr Asn Trp Ser Val His Leu Met Glu His Glu
260 265 270

Leu Ser Ala Tyr Tyr Asp Ile Thr His Gly Val Gly Leu Ala Ile Leu
275 280 285

Thr Pro Asn Trp Met Glu Tyr Ile Leu Asn Asn Asp Thr Val Tyr Lys
290 295 300

Phe Val Glu Tyr Gly Val Asn Val Trp Gly Ile Asp Lys Glu Lys Asn
305 310 315 320

His Tyr Asp Ile Ala His Gln Ala Ile Gln Lys Thr Arg Asp Tyr Phe
325 330 335

Val Asn Val Leu Gly Leu Pro Ser Arg Leu Arg Asp Val Gly Ile Glu
340 345 350

Glu Glu Lys Leu Asp Ile Met Ala Lys Glu Ser Val Lys Leu Thr Gly
355 360 365

Gly Thr Ile Gly Asn Leu Arg Pro Val Asn Ala Ser Glu Val Leu Gln
370 375 380

Ile Phe Lys Lys Ser Val
385 390

<210> 16
<211> 1173
<212> DNA
<213> Clostridium acetobutylicum

<400> 16
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PhoenixTemp39976.tmp.txt

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agtataaaga gaaatggaat atatgataaa gctgtaagta tacttgaaaa aaacagtatt	180
aaattttatg aacttgcagg agtagagcca aatccaagag taactacagt tgaaaaagga	240
gttaaaatat gtagagaaaa tggagttgaa gtagtactag ctataggtgg aggaagtgc	300
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cacggcgtag ggcttgcaat tttaacacct aattggatgg agtatatttt aaataatgat	900
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cactatgaca tagcacatca agcaatacaa aaaacaagag attactttgt aaatgtacta	1020
ggtttaccat ctagactgag agatgttgga attgaagaag aaaaattgga cataatggca	1080
aaggaatcag taaagcttac aggaggaacc ataggaaacc taagaccagt aaacgcctcc	1140
gaagtcctac aaatattcaa aaaatctgtg taa	1173

<210> 17
 <211> 1179
 <212> DNA
 <213> Artificial sequence

<220>
 <223> thil gene codon optimised for L. plantarum

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gctggtatta agccagaaga tgtaaacgaa gtcatttttag gtaatgtttt gcaagccggt	180
ttaggtcaaa atccagctcg gcaagctagt ttttaaggctg gtttgccagt tgaaattcca	240
gccatgacga ttaataaggt ttgtggtagt ggtttacgga cggttagttt agctgcccag	300
attattaagg ctggtgatgc cgatgtcatt attgccggtg gtatggaaaa tatgagtcgg	360
gctccatatt tagctaataa tgcccgggtg ggttatcgga tgggtaatgc caagtttgtc	420
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gccagtcaaa aaaaggctga agaagccatt aagtcaggtc agtttaagga tgaaattgtc	600
ccagttgtca ttaagggctg gaagggtgaa acggttgttg atacggatga acatccacgg	660

PhoenixTemp39976.tmp.txt

tttggttagta cgattgaagg cttggccaag ttaaagccag cctttaaaaa ggatggtacg	720
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<210> 18
 <211> 849
 <212> DNA
 <213> Artificial sequence

<220>
 <223> hbd gene codon optimised for L. plantarum

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gatttgata atatttgtaa gccagaaacg attttgcta gtaatacgag ttcattgagt	360
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gaagctccag gttttgtcgt taatcggatt ttgattccaa tgattaatga agccgtcgg	600
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aatcatccga tgggtccatt ggaattgggt gattttattg gtttgatat ttgtttggcc	720
attatggatg ttttgtatag tgaaacgggt gattcaaagt atcggccaca cacgttgta	780
aaaaagtatg ttcgggctgg ttggttaggt cggaaaagtg gtaagggttt ttatgattat	840
tcaaagtaa	849

<210> 19
 <211> 786
 <212> DNA
 <213> Artificial sequence

<220>
 <223> crt gene codon optimised for L. plantarum

<400> 19

PhoenixTemp39976.tmp.txt

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agttttgttg ccggtgccga tattagtga atgaaggaaa tgaatacgat tgaagggcgg	240
aagttcggta ttttgggtaa taaggttttt cggcggttgg aattgttgga aaaaccagtc	300
attgctgccg ttaatggttt tgctttaggt ggtggttgtg aaattgccat gagttgtgat	360
attcggattg ccagtagtaa tgctcggttt ggtcaaccag aagttggttt aggtattacg	420
ccaggttttg gtggtacgca acggttaagt cggttagttg gtatgggtat ggccaagcaa	480
ttaattttta cggcccaaaa tattaaagcc gatgaagcct tacggattgg tttagtcaat	540
aaggtcgtcg agccaagtga attaatgaat acggccaagg aaattgcca taaaattggt	600
agtaatgccc cagttgccgt taagttaagt aagcaagcca ttaatcgggg tatgcaatgt	660
gatattgata cggccttggc ctttgaaagt gaagcttttg gtgaatgttt tagtacggaa	720
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cggtaa	786

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 <211> 1142
 <212> DNA
 <213> Artificial sequence

<220>
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aa 1142

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<210> 21
<211> 2577
<212> DNA
<213> Artificial sequence

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<220>
<223> adhE gene codon optimised for L. plantarum

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 <223> n is a, c, g, or t

<220>
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 <222> (8169)..(8173)
 <223> n is a, c, g, or t

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