

<110> CJ CheilJedang Corporation

<120> Microorganisms producing putrescine and method for producing
putrescine using the same

<130> KPA151281-KR

<160> 21

<170> KopatentIn 2.0

<210> 1

<211> 48

<212> DNA

<213> Artificial Sequence

<220>

<223> CbFdh primer 1

<400> 1

ctacagacca tggctaagat cgtttagtc ttatatgatg ctggtaac 48

<210> 2

<211> 46

<212> DNA

<213> Artificial Sequence

<220>

<223> CbFdh primer 2

<400> 2

tatctcgagt tattcttat cgtgttacc gtaagcttg gtaacg 46

<210> 3

<211> 20

<212> DNA

<213> Artificial Sequence

<220>

<223> T7 promoter primer

<400> 3

taatacgact cactataggg 20

<210> 4

<211> 19

<212> DNA

<213> Artificial Sequence

<220>
<223> T7 terminator primer

<400> 4
gctagtatt gctcagcgg 19

<210> 5
<211> 28
<212> DNA
<213> Artificial Sequence

<220>
<223> CJ7 promoter primer 1

<400> 5
gaaggatcca tagcctaccg atgtagat 28

<210> 6
<211> 31
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<213> Artificial Sequence

<220>
<223> CJ7 promoter primer 2

<400> 6
aattctagaa gtgttcctt tcgttgaggta c 31

<210> 7
<211> 33
<212> DNA
<213> Artificial Sequence

<220>
<223> CbFdh primer 3

<400> 7
gaatctagaa tggctaagat cgtttagtc tta 33

<210> 8
<211> 34
<212> DNA
<213> Artificial Sequence

<220>
<223> CbFdh primer 4

<400> 8
aatgtcgact tatttcttat cgtgtttacc gtaa

34

<210> 9
<211> 1098
<212> DNA
<213> Artificial Sequence

<220>
<223> CbFdh gene

<400> 9
atggctaaga tcgttttagt cttatatgat gctggttaagc acgctgctga tgaagaaaaa 60
ttatatgggt gtactgaaaa taaattaggt attgctaatt ggftaaaaga tcaaggctcat 120
gaactaatta ctacttctga taaagaaggt gaaacaagtg aattggataa acatatccca 180
gatgctgata ttatcatcac cactcctttc catcctgctt atatcactaa ggaaagactt 240
gacaaggcta agaacttaaa attagtcgtt gtcgctgggtg ttggttctga tcacattgat 300
ttagattata ttaatcaaac aggtaagaaa atctcagtc tggaagttac aggttctaata 360
gtgtgtctctg ttgctgaaca cggtgtcatg accatgcttg tcttggttag aaatttcgtt 420
ccagcacatg aacaaattat taaccacgat tgggagggtg ctgctatcgc taaggatgct 480
tacgatatcg aaggtaaaac tatcgtacc attggtgctg gtagaattgg ttacagagtc 540
ttggaaagat tactcccatf taatccaaaa gaattattat actacgatta tcaagcttta 600
ccaaaagaag ctgaagaaaa agttgggtgct agaagagttg aaaatattga agaattagtt 660
gctcaagctg atatcgttac agttaatgct ccattacacg caggtaaaaa aggtttaatt 720
aataaggaat tattatctaa atttaaaaaa ggtgcttggt tagtcaatac cgcaagaggt 780
gctatttggt ttgctgaaga tgttcagca gctttagaat ctggtaatt aagaggttac 840
gggtggtgatg ttggttccc acaaccagct ccaaaggatc acctatggag agatatgaga 900
aataaatatg gtgctggtaa tgccatgact cctcactact ctggtactac ttagacgct 960
caaacaagat acgctgaagg tactaaaaat attttggaat cattctttac cggtaaattt 1020
gattacagac cacaagatat tatcttatta aatggtgaat acgttaccaa agcttacggt 1080
aaacacgata agaaataa 1098

<210> 10

<211> 365
<212> PRT
<213> Artificial Sequence

<220>
<223> CbFdh protein

<400> 10

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

Asp Glu Glu Lys Leu Tyr Gly Cys Thr Glu Asn Lys Leu Gly Ile Ala
20 25 30

Asn Trp Leu Lys Asp Gln Gly His Glu Leu Ile Thr Thr Ser Asp Lys
35 40 45

Glu Gly Glu Thr Ser Glu Leu Asp Lys His Ile Pro Asp Ala Asp Ile
50 55 60

Ile Ile Thr Thr Pro Phe His Pro Ala Tyr Ile Thr Lys Glu Arg Leu
65 70 75 80

Asp Lys Ala Lys Asn Leu Lys Leu Val Val Val Ala Gly Val Gly Ser
85 90 95

Asp His Ile Asp Leu Asp Tyr Ile Asn Gln Thr Gly Lys Lys Ile Ser
100 105 110

Val Leu Glu Val Thr Gly Ser Asn Val Val Ser Val Ala Glu His Val
115 120 125

Val Met Thr Met Leu Val Leu Val Arg Asn Phe Val Pro Ala His Glu
130 135 140

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

Tyr Asp Ile Glu Gly Lys Thr Ile Ala Thr Ile Gly Ala Gly Arg Ile
165 170 175

Gly Tyr Arg Val Leu Glu Arg Leu Leu Pro Phe Asn Pro Lys Glu Leu
180 185 190

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

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

Ile Val Thr Val Asn Ala Pro Leu His Ala Gly Thr Lys Gly Leu Ile
225 230 235 240

Asn Lys Glu Leu Leu Ser Lys Phe Lys Lys Gly Ala Trp Leu Val Asn

245 250 255

Thr Ala Arg Gly Ala Ile Cys Val Ala Glu Asp Val Ala Ala Ala Leu
260 265 270

Glu Ser Gly Gln Leu Arg Gly Tyr Gly Gly Asp Val Trp Phe Pro Gln
275 280 285

Pro Ala Pro Lys Asp His Pro Trp Arg Asp Met Arg Asn Lys Tyr Gly
290 295 300

Ala Gly Asn Ala Met Thr Pro His Tyr Ser Gly Thr Thr Leu Asp Ala
305 310 315 320

Gln Thr Arg Tyr Ala Glu Gly Thr Lys Asn Ile Leu Glu Ser Phe Phe
325 330 335

Thr Gly Lys Phe Asp Tyr Arg Pro Gln Asp Ile Ile Leu Leu Asn Gly
340 345 350

Glu Tyr Val Thr Lys Ala Tyr Gly Lys His Asp Lys Lys
355 360 365

<210> 11

<211> 319

<212> PRT

<213> Artificial Sequence

<220>

<223> Ornithine carbamoyl transferase (argF)

<400> 11

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

Thr Pro Ala Glu Gln Ala Glu Val Leu Thr Leu Ala Ala Lys Leu Lys
20 25 30

Ala Ala Pro Phe Ser Glu Arg Pro Leu Glu Gly Pro Lys Ser Val Ala
35 40 45

Val Leu Phe Asp Lys Thr Ser Thr Arg Thr Arg Phe Ser Phe Asp Ala
50 55 60

Gly Ile Ala His Leu Gly Gly His Ala Ile Val Val Asp Ser Gly Ser
65 70 75 80

Ser Gln Met Gly Lys Gly Glu Ser Leu Gln Asp Thr Ala Ala Val Leu
85 90 95

Ser Arg Tyr Val Glu Ala Ile Val Trp Arg Thr Tyr Ala His Ser Asn
100 105 110

Phe His Ala Met Ala Glu Thr Ser Thr Val Pro Leu Val Asn Ser Leu
115 120 125

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

Val Glu Asn Leu Ser Pro Glu Glu Gly Pro Ala Gly Leu Lys Gly Lys
145 150 155 160

Lys Ala Val Tyr Leu Gly Asp Gly Asp Asn Asn Met Ala Asn Ser Tyr
165 170 175

Met Ile Gly Phe Ala Thr Ala Gly Met Asp Ile Ser Ile Ile Ala Pro
180 185 190

Glu Gly Phe Gln Pro Arg Ala Glu Phe Val Glu Arg Ala Glu Lys Arg
195 200 205

Gly Gln Glu Thr Gly Ala Lys Val Val Val Thr Asp Ser Leu Asp Glu
210 215 220

Val Ala Gly Ala Asp Val Val Ile Thr Asp Thr Trp Val Ser Met Gly
225 230 235 240

Met Glu Asn Asp Gly Ile Asp Arg Thr Thr Pro Phe Val Pro Tyr Gln
245 250 255

Val Asn Asp Glu Val Met Ala Lys Ala Asn Asp Gly Ala Ile Phe Leu
260 265 270

His Cys Leu Pro Ala Tyr Arg Gly Lys Glu Val Ala Ala Ser Val Ile
275 280 285

Asp Gly Pro Ala Ser Lys Val Phe Asp Glu Ala Glu Asn Arg Leu His
290 295 300

Ala Gln Lys Ala Leu Leu Val Trp Leu Leu Ala Asn Gln Pro Arg
305 310 315

<210> 12

<211> 533

<212> PRT

<213> Artificial Sequence

<220>

<223> Glutamate exporter

<400> 12

Met Ile Leu Gly Val Pro Ile Gln Tyr Leu Leu Tyr Ser Leu Trp Asn
1 5 10 15

Trp Ile Val Asp Thr Gly Phe Asp Val Ala Ile Ile Leu Val Leu Ala
20 25 30

Phe Leu Ile Pro Arg Ile Gly Arg Leu Ala Met Arg Ile Ile Lys Arg
35 40 45

Arg Val Glu Ser Ala Ala Asp Ala Asp Thr Thr Lys Asn Gln Leu Ala
50 55 60

Phe Ala Gly Val Gly Val Tyr Ile Ala Gln Ile Val Ala Phe Phe Met
65 70 75 80

Leu Ala Val Ser Ala Met Gln Ala Phe Gly Phe Ser Leu Ala Gly Ala
85 90 95

Ala Ile Pro Ala Thr Ile Ala Ser Ala Ala Ile Gly Leu Gly Ala Gln
100 105 110

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

Gln Phe Gly Val Gly Asp Trp Val Arg Phe Glu Gly Asn Gly Ile Val
130 135 140

Val Glu Gly Thr Val Ile Glu Ile Thr Met Arg Ala Thr Lys Ile Arg
145 150 155 160

Thr Ile Ala Gln Glu Thr Val Ile Ile Pro Asn Ser Thr Ala Lys Val
165 170 175

Cys Ile Asn Asn Ser Asn Asn Trp Ser Arg Ala Val Val Val Ile Pro
180 185 190

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

Glu Ala Ala Thr Arg Arg Ala Leu Gly Gln Glu Lys Ile Ala Pro Glu
210 215 220

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

Thr Val Val Gly Met Pro Trp Met Val Thr Met Arg Phe Leu Val Gln
245 250 255

Val Thr Ala Gly Asn Gln Trp Leu Val Glu Arg Ala Ile Arg Thr Glu
260 265 270

Ile Ile Ser Glu Phe Trp Glu Glu Tyr Gly Ser Ala Thr Thr Thr Ser
275 280 285

Gly Thr Leu Ile Asp Ser Leu His Val Glu His Glu Glu Pro Lys Thr
290 295 300

Ser Leu Ile Asp Ala Ser Pro Gln Ala Leu Lys Glu Pro Lys Pro Glu
305 310 315 320

Ala Ala Ala Thr Val Ala Ser Leu Ala Ala Ser Ser Asn Asp Asp Ala
 325 330 335
 Asp Asn Ala Asp Ala Ser Val Ile Asn Ala Gly Asn Pro Glu Lys Glu
 340 345 350
 Leu Asp Ser Asp Val Leu Glu Gln Glu Leu Ser Ser Glu Glu Pro Glu
 355 360 365
 Glu Thr Ala Lys Pro Asp His Ser Leu Arg Gly Phe Phe Arg Thr Asp
 370 375 380
 Tyr Tyr Pro Asn Arg Trp Gln Lys Ile Leu Ser Phe Gly Gly Arg Val
 385 390 395 400
 Arg Met Ser Thr Ser Leu Leu Leu Gly Ala Leu Leu Leu Leu Ser Leu
 405 410 415
 Phe Lys Val Met Thr Val Glu Pro Ser Glu Asn Trp Gln Asn Ser Ser
 420 425 430
 Gly Trp Leu Ser Pro Ser Thr Ala Thr Ser Thr Ala Val Thr Thr Ser
 435 440 445
 Glu Thr Ser Ala Pro Val Ser Thr Pro Ser Met Thr Val Pro Thr Thr
 450 455 460
 Val Glu Glu Thr Pro Thr Met Glu Ser Asn Val Glu Thr Gln Gln Glu
 465 470 475 480
 Thr Ser Thr Pro Ala Thr Ala Thr Pro Gln Arg Ala Asp Thr Ile Glu
 485 490 495
 Pro Thr Glu Glu Ala Thr Ser Gln Glu Glu Thr Thr Ala Ser Gln Thr
 500 505 510
 Gln Ser Pro Ala Val Glu Ala Pro Thr Ala Val Gln Glu Thr Val Ala
 515 520 525
 Pro Thr Ser Thr Pro
 530

<210> 13
 <211> 711
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Ornithine decarboxylase (ODC)

<400> 13
 Met Lys Ser Met Asn Ile Ala Ala Ser Ser Glu Leu Val Ser Arg Leu
 1 5 10 15

Ser Ser His Arg Arg Val Val Ala Leu Gly Asp Thr Asp Phe Thr Asp
20 25 30

Val Ala Ala Val Val Ile Thr Ala Ala Asp Ser Arg Ser Gly Ile Leu
35 40 45

Ala Leu Leu Lys Arg Thr Gly Phe His Leu Pro Val Phe Leu Tyr Ser
50 55 60

Glu His Ala Val Glu Leu Pro Ala Gly Val Thr Ala Val Ile Asn Gly
65 70 75 80

Asn Glu Gln Gln Trp Leu Glu Leu Glu Ser Ala Ala Cys Gln Tyr Glu
85 90 95

Glu Asn Leu Leu Pro Pro Phe Tyr Asp Thr Leu Thr Gln Tyr Val Glu
100 105 110

Met Gly Asn Ser Thr Phe Ala Cys Pro Gly His Gln His Gly Ala Phe
115 120 125

Phe Lys Lys His Pro Ala Gly Arg His Phe Tyr Asp Phe Phe Gly Glu
130 135 140

Asn Val Phe Arg Ala Asp Met Cys Asn Ala Asp Val Lys Leu Gly Asp
145 150 155 160

Leu Leu Ile His Glu Gly Ser Ala Lys Asp Ala Gln Lys Phe Ala Ala
165 170 175

Lys Val Phe His Ala Asp Lys Thr Tyr Phe Val Leu Asn Gly Thr Ser
180 185 190

Ala Ala Asn Lys Val Val Thr Asn Ala Leu Leu Thr Arg Gly Asp Leu
195 200 205

Val Leu Phe Asp Arg Asn Asn His Lys Ser Asn His His Gly Ala Leu
210 215 220

Ile Gln Ala Gly Ala Thr Pro Val Tyr Leu Glu Ala Ser Arg Asn Pro
225 230 235 240

Phe Gly Phe Ile Gly Gly Ile Asp Ala His Cys Phe Asn Glu Glu Tyr
245 250 255

Leu Arg Gln Gln Ile Arg Asp Val Ala Pro Glu Lys Ala Asp Leu Pro
260 265 270

Arg Pro Tyr Arg Leu Ala Ile Ile Gln Leu Gly Thr Tyr Asp Gly Thr
275 280 285

Val Tyr Asn Ala Arg Gln Val Ile Asp Thr Val Gly His Leu Cys Asp
290 295 300

Tyr Ile Leu Phe Asp Ser Ala Trp Val Gly Tyr Glu Gln Phe Ile Pro
 305 310 315 320

Met Met Ala Asp Ser Ser Pro Leu Leu Leu Glu Leu Asn Glu Asn Asp
 325 330 335

Pro Gly Ile Phe Val Thr Gln Ser Val His Lys Gln Gln Ala Gly Phe
 340 345 350

Ser Gln Thr Ser Gln Ile His Lys Lys Asp Asn His Ile Arg Gly Gln
 355 360 365

Ala Arg Phe Cys Pro His Lys Arg Leu Asn Asn Ala Phe Met Leu His
 370 375 380

Ala Ser Thr Ser Pro Phe Tyr Pro Leu Phe Ala Ala Leu Asp Val Asn
 385 390 395 400

Ala Lys Ile His Glu Gly Glu Ser Gly Arg Arg Leu Trp Ala Glu Cys
 405 410 415

Val Glu Ile Gly Ile Glu Ala Arg Lys Ala Ile Leu Ala Arg Cys Lys
 420 425 430

Leu Phe Arg Pro Phe Ile Pro Pro Val Val Asp Gly Lys Leu Trp Gln
 435 440 445

Asp Tyr Pro Thr Ser Val Leu Ala Ser Asp Arg Arg Phe Phe Ser Phe
 450 455 460

Glu Pro Gly Ala Lys Trp His Gly Phe Glu Gly Tyr Ala Ala Asp Gln
 465 470 475 480

Tyr Phe Val Asp Pro Cys Lys Leu Leu Leu Thr Thr Pro Gly Ile Asp
 485 490 495

Ala Glu Thr Gly Glu Tyr Ser Asp Phe Gly Val Pro Ala Thr Ile Leu
 500 505 510

Ala His Tyr Leu Arg Glu Asn Gly Ile Val Pro Glu Lys Cys Asp Leu
 515 520 525

Asn Ser Ile Leu Phe Leu Leu Thr Pro Ala Glu Ser His Glu Lys Leu
 530 535 540

Ala Gln Leu Val Ala Met Leu Ala Gln Phe Glu Gln His Ile Glu Asp
 545 550 555 560

Asp Ser Pro Leu Val Glu Val Leu Pro Ser Val Tyr Asn Lys Tyr Pro
 565 570 575

Val Arg Tyr Arg Asp Tyr Thr Leu Arg Gln Leu Cys Gln Glu Met His
 580 585 590

Asp Leu Tyr Val Ser Phe Asp Val Lys Asp Leu Gln Lys Ala Met Phe

595 600 605

Arg Gln Gln Ser Phe Pro Ser Val Val Met Asn Pro Gln Asp Ala His
610 615 620

Ser Ala Tyr Ile Arg Gly Asp Val Glu Leu Val Arg Ile Arg Asp Ala
625 630 635 640

Glu Gly Arg Ile Ala Ala Glu Gly Ala Leu Pro Tyr Pro Pro Gly Val
645 650 655

Leu Cys Val Val Pro Gly Glu Val Trp Gly Gly Ala Val Gln Arg Tyr
660 665 670

Phe Leu Ala Leu Glu Glu Gly Val Asn Leu Leu Pro Gly Phe Ser Pro
675 680 685

Glu Leu Gln Gly Val Tyr Ser Glu Thr Asp Ala Asp Gly Val Lys Arg
690 695 700

Leu Tyr Gly Tyr Val Leu Lys
705 710

<210> 14

<211> 388

<212> PRT

<213> Artificial Sequence

<220>

<223> Acetyl glutamate synthase or Ornithine acetyl transferase (ArgJ)

<400> 14

Met Ala Glu Lys Gly Ile Thr Ala Pro Lys Gly Phe Val Ala Ser Ala
1 5 10 15

Thr Thr Ala Gly Ile Lys Ala Ser Gly Asn Pro Asp Met Ala Leu Val
20 25 30

Val Asn Gln Gly Pro Glu Phe Ser Ala Ala Ala Val Phe Thr Arg Asn
35 40 45

Arg Val Phe Ala Ala Pro Val Lys Val Ser Arg Glu Asn Val Ala Asp
50 55 60

Gly Gln Ile Arg Ala Val Leu Tyr Asn Ala Gly Asn Ala Asn Ala Cys
65 70 75 80

Asn Gly Leu Gln Gly Glu Lys Asp Ala Arg Glu Ser Val Ser His Leu
85 90 95

Ala Gln Asn Leu Gly Leu Glu Asp Ser Asp Ile Gly Val Cys Ser Thr
100 105 110

Gly Leu Ile Gly Glu Leu Leu Pro Met Asp Lys Leu Asn Ala Gly Ile
115 120 125

Asp Gln Leu Thr Ala Glu Gly Ala Leu Gly Asp Asn Gly Ala Ala Ala
130 135 140

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

Phe Ala Asp Gly Trp Thr Val Gly Gly Met Gly Lys Gly Val Gly Met
165 170 175

Met Ala Pro Ser Leu Ala Thr Met Leu Val Cys Leu Thr Thr Asp Ala
180 185 190

Ser Val Thr Gln Glu Met Ala Gln Ile Ala Leu Ala Asn Ala Thr Ala
195 200 205

Val Thr Phe Asp Thr Leu Asp Ile Asp Gly Ser Thr Ser Thr Asn Asp
210 215 220

Thr Val Phe Leu Leu Ala Ser Gly Ala Ser Gly Ile Thr Pro Thr Gln
225 230 235 240

Asp Glu Leu Asn Asp Ala Val Tyr Ala Ala Cys Ser Asp Ile Ala Ala
245 250 255

Lys Leu Gln Ala Asp Ala Glu Gly Val Thr Lys Arg Val Ala Val Thr
260 265 270

Val Val Gly Thr Thr Asn Asn Glu Gln Ala Ile Asn Ala Ala Arg Thr
275 280 285

Val Ala Arg Asp Asn Leu Phe Lys Cys Ala Met Phe Gly Ser Asp Pro
290 295 300

Asn Trp Gly Arg Val Leu Ala Ala Val Gly Met Ala Asp Ala Asp Met
305 310 315 320

Glu Pro Glu Lys Ile Ser Val Phe Phe Asn Gly Gln Ala Val Cys Leu
325 330 335

Asp Ser Thr Gly Ala Pro Gly Ala Arg Glu Val Asp Leu Ser Gly Ala
340 345 350

Asp Ile Asp Val Arg Ile Asp Leu Gly Thr Ser Gly Glu Gly Gln Ala
355 360 365

Thr Val Arg Thr Thr Asp Leu Ser Phe Ser Tyr Val Glu Ile Asn Ser
370 375 380

Ala Tyr Ser Ser
385

<210> 15
<211> 317
<212> PRT
<213> Artificial Sequence

<220>
<223> Acetyl glutamate kinase (ArgB)

<400> 15
Met Asn Asp Leu Ile Lys Asp Leu Gly Ser Glu Val Arg Ala Asn Val
1 5 10 15
Leu Ala Glu Ala Leu Pro Trp Leu Gln His Phe Arg Asp Lys Ile Val
20 25 30
Val Val Lys Tyr Gly Gly Asn Ala Met Val Asp Asp Asp Leu Lys Ala
35 40 45
Ala Phe Ala Ala Asp Met Val Phe Leu Arg Thr Val Gly Ala Lys Pro
50 55 60
Val Val Val His Gly Gly Gly Pro Gln Ile Ser Glu Met Leu Asn Arg
65 70 75 80
Val Gly Leu Gln Gly Glu Phe Lys Gly Gly Phe Arg Val Thr Thr Pro
85 90 95
Glu Val Met Asp Ile Val Arg Met Val Leu Phe Gly Gln Val Gly Arg
100 105 110
Asp Leu Val Gly Leu Ile Asn Ser His Gly Pro Tyr Ala Val Gly Thr
115 120 125
Ser Gly Glu Asp Ala Gly Leu Phe Thr Ala Gln Lys Arg Met Val Asn
130 135 140
Ile Asp Gly Val Pro Thr Asp Ile Gly Leu Val Gly Asp Ile Ile Asn
145 150 155 160
Val Asp Ala Ser Ser Leu Met Asp Ile Ile Glu Ala Gly Arg Ile Pro
165 170 175
Val Val Ser Thr Ile Ala Pro Gly Glu Asp Gly Gln Ile Tyr Asn Ile
180 185 190
Asn Ala Asp Thr Ala Ala Gly Ala Leu Ala Ala Ala Ile Gly Ala Glu
195 200 205
Arg Leu Leu Val Leu Thr Asn Val Glu Gly Leu Tyr Thr Asp Trp Pro
210 215 220
Asp Lys Ser Ser Leu Val Ser Lys Ile Lys Ala Thr Glu Leu Glu Ala
225 230 235 240

Ile Leu Pro Gly Leu Asp Ser Gly Met Ile Pro Lys Met Glu Ser Cys
245 250 255

Leu Asn Ala Val Arg Gly Gly Val Ser Ala Ala His Val Ile Asp Gly
260 265 270

Arg Ile Ala His Ser Val Leu Leu Glu Leu Leu Thr Met Gly Gly Ile
275 280 285

Gly Thr Met Val Leu Pro Asp Val Phe Asp Arg Glu Asn Tyr Pro Glu
290 295 300

Gly Thr Val Phe Arg Lys Asp Asp Lys Asp Gly Glu Leu
305 310 315

<210> 16

<211> 357

<212> PRT

<213> Artificial Sequence

<220>

<223> Acetyl gamma glutamyl phosphate reductase (ArgC)

<400> 16

Met Ile Met His Asn Val Tyr Gly Val Thr Met Thr Ile Lys Val Ala
1 5 10 15

Ile Ala Gly Ala Ser Gly Tyr Ala Gly Gly Glu Ile Leu Arg Leu Leu
20 25 30

Leu Gly His Pro Ala Tyr Ala Ser Gly Glu Leu Glu Ile Gly Ala Leu
35 40 45

Thr Ala Ala Ser Thr Ala Gly Ser Thr Leu Gly Glu Leu Met Pro His
50 55 60

Ile Pro Gln Leu Ala Asp Arg Val Ile Gln Asp Thr Thr Ala Glu Thr
65 70 75 80

Leu Ala Gly His Asp Val Val Phe Leu Gly Leu Pro His Gly Phe Ser
85 90 95

Ala Glu Ile Ala Leu Gln Leu Gly Pro Asp Val Thr Val Ile Asp Cys
100 105 110

Ala Ala Asp Phe Arg Leu Gln Asn Ala Ala Asp Trp Glu Lys Phe Tyr
115 120 125

Gly Ser Glu His Gln Gly Thr Trp Pro Tyr Gly Ile Pro Glu Met Pro
130 135 140

Gly His Arg Glu Ala Leu Arg Gly Ala Lys Arg Val Ala Val Pro Gly
145 150 155 160

Cys Phe Pro Thr Gly Ala Thr Leu Ala Leu Leu Pro Ala Val Gln Ala
165 170 175

Gly Leu Ile Glu Pro Asp Val Ser Val Val Ser Ile Thr Gly Val Ser
180 185 190

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

Gly Ser Leu Lys Ala Tyr Asn Thr Ser Gly Lys His Arg His Thr Pro
210 215 220

Glu Ile Ala Gln Asn Leu Gly Glu Val Ser Asp Lys Pro Val Lys Val
225 230 235 240

Ser Phe Thr Pro Val Leu Ala Pro Leu Pro Arg Gly Ile Leu Thr Thr
245 250 255

Ala Thr Ala Pro Leu Lys Glu Gly Val Thr Ala Glu Gln Ala Arg Ala
260 265 270

Val Tyr Glu Glu Phe Tyr Ala Gln Glu Thr Phe Val His Val Leu Pro
275 280 285

Glu Gly Ala Gln Pro Gln Thr Gln Ala Val Leu Gly Ser Asn Met Cys
290 295 300

His Val Gln Val Glu Ile Asp Glu Glu Ala Gly Lys Val Leu Val Thr
305 310 315 320

Ser Ala Ile Asp Asn Leu Thr Lys Gly Thr Ala Gly Ala Ala Val Gln
325 330 335

Cys Met Asn Leu Ser Val Gly Phe Asp Glu Ala Ala Gly Leu Pro Gln
340 345 350

Val Gly Val Ala Pro
355

<210> 17

<211> 391

<212> PRT

<213> Artificial Sequence

<220>

<223> Acetyl ornithine aminotransferase (ArgD)

<400> 17

Met Ser Thr Leu Glu Thr Trp Pro Gln Val Ile Ile Asn Thr Tyr Gly
1 5 10 15

Thr Pro Pro Val Glu Leu Val Ser Gly Lys Gly Ala Thr Val Thr Asp

20	25	30			
Asp	Gln	Gly	Asn	Val	Tyr
35	40	45	Ile	Asp	Leu
			Leu	Ala	Gly
			Ile	Ala	Val
			Asn		
Ala	Leu	Gly	His	Ala	His
50	55	60	Pro	Ala	Ile
			Ile	Glu	Ala
			Val	Thr	Asn
			Gln		
Ile	Gly	Gln	Leu	Gly	His
65	70	75	80	Val	Ser
			Asn	Leu	Phe
			Ala	Ser	Arg
			Pro	Val	
Val	Glu	Val	Ala	Glu	Glu
85	90	95	Leu	Ile	Lys
			Arg	Phe	Ser
			Leu	Asp	Asp
			Ala		
Thr	Leu	Ala	Ala	Gln	Thr
100	105	110	Arg	Val	Phe
			Phe	Cys	Asn
			Ser	Gly	Ala
			Glu		
Ala	Asn	Glu	Ala	Ala	Phe
115	120	125	Lys	Ile	Ala
			Arg	Leu	Thr
			Gly	Arg	Ser
			Arg		
Ile	Leu	Ala	Ala	Val	His
130	135	140	Gly	Phe	His
			Gly	Arg	Thr
			Met	Gly	Ser
			Leu		
Ala	Leu	Thr	Gly	Gln	Pro
145	150	155	160	Asp	Lys
				Arg	Glu
				Ala	Phe
				Leu	Pro
				Met	Pro
Ser	Gly	Val	Glu	Phe	Tyr
165	170	175	Pro	Tyr	Gly
			Asp	Thr	Asp
			Tyr	Leu	Arg
			Lys		
Met	Val	Glu	Thr	Asn	Pro
180	185	190	Thr	Asp	Val
			Ala	Ala	Ile
			Phe	Leu	Glu
			Pro		
Ile	Gln	Gly	Glu	Thr	Gly
195	200	205	Val	Val	Pro
			Ala	Pro	Glu
			Gly	Phe	Leu
			Lys		
Ala	Val	Arg	Glu	Leu	Cys
210	215	220	Asp	Glu	Tyr
			Gly	Ile	Leu
			Met	Ile	Thr
			Asp		
Glu	Val	Gln	Thr	Gly	Val
225	230	235	240	Gly	Arg
				Thr	Gly
				Asp	Phe
				Phe	Ala
				His	Gln
His	Asp	Gly	Val	Val	Pro
245	250	255	Asp	Val	Val
			Thr	Met	Ala
			Lys	Gly	Leu
			Gly		
Gly	Gly	Leu	Pro	Ile	Gly
260	265	270	Ala	Cys	Leu
			Ala	Thr	Gly
			Arg	Ala	Ala
			Glu		
Leu	Met	Thr	Pro	Gly	Lys
275	280	285	His	Gly	Thr
			Thr	Phe	Gly
			Gly	Gly	Asn
			Pro	Val	
Ala	Cys	Ala	Ala	Ala	Lys
290	295	300	Ala	Val	Leu
			Ser	Val	Val
			Asp	Asp	Ala
			Phe		
Cys	Ala	Glu	Val	Ala	Arg
305	310	315	320	Lys	Gly
				Glu	Leu
				Phe	Lys
				Glu	Leu
				Leu	Ala

Lys Val Asp Gly Val Val Asp Val Arg Gly Arg Gly Leu Met Leu Gly
325 330 335

Val Val Leu Glu Arg Asp Val Ala Lys Gln Ala Val Leu Asp Gly Phe
340 345 350

Lys His Gly Val Ile Leu Asn Ala Pro Ala Asp Asn Ile Ile Arg Leu
355 360 365

Thr Pro Pro Leu Val Ile Thr Asp Glu Glu Ile Ala Asp Ala Val Lys
370 375 380

Ala Ile Ala Glu Thr Ile Ala
385 390

<210> 18

<211> 203

<212> PRT

<213> Artificial Sequence

<220>

<223> putrescine acetyltransferase

<400> 18

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

Val Asp Val Leu Val Glu Ala Phe Ala Asn Asp Pro Ala Phe Leu Arg
20 25 30

Trp Ile Pro Gln Pro Asp Pro Gly Ser Ala Lys Leu Arg Ala Leu Phe
35 40 45

Glu Leu Gln Ile Glu Lys Gln Tyr Ala Val Ala Gly Asn Ile Asp Val
50 55 60

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

Pro Asp Gly Asn His Ser Ala Lys Asp Gln Ala Ala Met Leu Pro Arg
85 90 95

Leu Val Ser Ile Phe Gly Ile Lys Ala Ala Gln Val Ala Trp Thr Asp
100 105 110

Leu Ser Ser Ala Arg Phe His Pro Lys Phe Pro His Trp Tyr Leu Tyr
115 120 125

Thr Val Ala Thr Ser Ser Ser Ala Arg Gly Thr Gly Val Gly Ser Ala
130 135 140

Leu Leu Asn His Gly Ile Ala Arg Ala Gly Asp Glu Ala Ile Tyr Leu

145 150 155 160
 Glu Ala Thr Ser Thr Arg Ala Ala Gln Leu Tyr Asn Arg Leu Gly Phe
 165 170 175
 Val Pro Leu Gly Tyr Ile Pro Ser Asp Asp Asp Gly Thr Pro Glu Leu
 180 185 190
 Ala Met Trp Lys Pro Pro Ala Met Pro Thr Val
 195 200

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 Val Asp Val Leu Val Glu Ala Phe Ala Asn Asp Pro Ala Phe Leu Arg
 20 25 30
 Trp Ile Pro Gln Pro Asp Pro Gly Ser Ala Lys Leu Arg Ala Leu Phe
 35 40 45
 Glu Leu Gln Ile Glu Lys Gln Tyr Ala Val Ala Gly Asn Ile Asp Val
 50 55 60
 Ala Arg Asp Ser Glu Gly Glu Ile Val Gly Val Ala Leu Trp Asp Arg
 65 70 75 80
 Pro Asp Gly Asn His Ser Ala Lys Asp Gln Ala Ala Ile Leu Pro Arg
 85 90 95
 Leu Val Ser Ile Phe Gly Ile Lys Ala Ala Gln Val Ala Trp Thr Asp
 100 105 110
 Leu Ser Ser Ala Arg Phe His Pro Lys Phe Pro His Trp Tyr Leu Tyr
 115 120 125
 Thr Val Ala Thr Ser Ser Ser Ala Arg Gly Thr Gly Val Gly Ser Ala
 130 135 140
 Leu Leu Asn His Gly Ile Ala Arg Ala Gly Asp Glu Ala Ile Tyr Leu
 145 150 155 160
 Glu Ala Thr Ser Thr Arg Ala Ala Gln Leu Tyr Asn Arg Leu Gly Phe
 165 170 175

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

Ala Met Trp Lys Pro Pro Ala Met Pro Thr Val
195 200

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<211> 494

<212> PRT

<213> putrescine exporting protein

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Met Thr Ser Glu Thr Leu Gln Ala Gln Ala Pro Thr Lys Thr Gln Arg
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Trp Ala Phe Leu Ala Val Ile Ser Gly Gly Leu Phe Leu Ile Gly Val
20 25 30

Asp Asn Ser Ile Leu Tyr Thr Ala Leu Pro Leu Leu Arg Glu Gln Leu
35 40 45

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

Leu Met Ala Gly Leu Leu Leu Gly Thr Gly Thr Leu Gly Asp Lys Ile
65 70 75 80

Gly His Arg Arg Met Phe Leu Met Gly Leu Ser Ile Phe Gly Ile Ala
85 90 95

Ser Leu Gly Ala Ala Phe Ala Pro Thr Ala Trp Ala Leu Val Ala Ala
100 105 110

Arg Ala Phe Leu Gly Ile Gly Ala Ala Thr Met Met Pro Ala Thr Leu
115 120 125

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

Ile Gly Ile Trp Gly Ser Val Ala Ile Leu Gly Ala Ala Ala Gly Pro
145 150 155 160

Ile Ile Gly Gly Ala Leu Leu Glu Phe Phe Trp Trp Gly Ser Val Phe
165 170 175

Leu Ile Asn Val Pro Val Ala Val Ile Ala Leu Ile Ala Thr Leu Phe
180 185 190

Val Ala Pro Ala Asn Ile Ala Asn Pro Ser Lys His Trp Asp Phe Leu
195 200 205

Ser Ser Phe Tyr Ala Leu Leu Thr Leu Ala Gly Leu Ile Ile Thr Ile
210 215 220

Lys Glu Ser Val Asn Thr Ala Arg His Met Pro Leu Leu Leu Gly Ala
225 230 235 240

Val Ile Met Leu Ile Ile Gly Ala Val Leu Phe Ser Ser Arg Gln Lys
 245 250 255

Lys Ile Glu Glu Pro Leu Leu Asp Leu Ser Leu Phe Arg Asn Arg Leu
 260 265 270

Phe Leu Gly Gly Val Val Ala Ala Gly Met Ala Met Phe Thr Val Ser
 275 280 285

Gly Leu Glu Met Thr Thr Ser Gln Arg Phe Gln Leu Ser Val Gly Phe
 290 295 300

Thr Pro Leu Glu Ala Gly Leu Leu Met Ile Pro Ala Ala Leu Gly Ser
305 310 315 320

Phe Pro Met Ser Ile Ile Gly Gly Ala Asn Leu His Arg Trp Gly Phe
 325 330 335

Lys Pro Leu Ile Ser Gly Gly Phe Ala Ala Thr Ala Val Gly Ile Ala
 340 345 350

Leu Cys Ile Trp Gly Ala Thr His Thr Asp Gly Leu Pro Phe Phe Ile
 355 360 365

Ala Gly Leu Phe Phe Met Gly Ala Gly Ala Gly Ser Val Met Ser Val
 370 375 380

Ser Ser Thr Ala Ile Ile Gly Ser Ala Pro Val Arg Lys Ala Gly Met
385 390 395 400

Ala Ser Ser Ile Glu Glu Val Ser Tyr Glu Phe Gly Thr Leu Leu Ser
 405 410 415

Val Ala Ile Leu Gly Ser Leu Phe Pro Phe Phe Tyr Ser Leu His Ala
 420 425 430

Pro Ala Glu Val Ala Asp Asn Phe Ser Ala Gly Val His His Ala Ile
 435 440 445

Asp Gly Asp Ala Ala Arg Ala Ser Leu Asp Thr Ala Tyr Ile Asn Val
 450 455 460

Leu Ile Ile Ala Leu Val Cys Ala Val Ala Ala Ala Leu Ile Ser Ser
465 470 475 480

Tyr Leu Phe Arg Gly Asn Pro Lys Gly Ala Asn Asn Ala His
 485 490

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<213> putrescine exporting protein

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Met Ile Ser Glu Thr Leu Gln Ala Gln Ala Pro Thr Lys Thr Gln Arg
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Trp Ala Phe Leu Ala Val Ile Ser Gly Gly Leu Phe Leu Ile Gly Val
20 25 30

Asp Asn Ser Ile Leu Tyr Thr Ala Leu Pro Leu Leu Arg Glu Gln Leu
35 40 45

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

Leu Met Ala Gly Leu Leu Leu Gly Thr Gly Thr Leu Gly Asp Lys Ile
65 70 75 80

Gly His Arg Arg Met Phe Leu Met Gly Leu Ser Ile Phe Gly Ile Ala
85 90 95

Ser Leu Gly Ala Ala Phe Ala Pro Thr Ala Trp Ala Leu Val Ala Ala
100 105 110

Arg Ala Phe Leu Gly Ile Gly Ala Ala Thr Met Met Pro Ala Thr Leu
115 120 125

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

Ile Gly Ile Trp Gly Ser Val Ala Ile Leu Gly Ala Ala Ala Gly Pro
145 150 155 160

Ile Ile Gly Gly Ala Leu Leu Glu Phe Phe Trp Trp Gly Ser Val Phe
165 170 175

Leu Ile Asn Val Pro Val Ala Val Ile Ala Leu Ile Ala Thr Leu Phe
180 185 190

Val Ala Pro Ala Asn Ile Ala Asn Pro Ser Lys His Trp Asp Phe Leu
195 200 205

Ser Ser Phe Tyr Ala Leu Leu Thr Leu Ala Gly Leu Ile Val Thr Ile
210 215 220

Lys Glu Ser Val Asn Thr Ala Arg His Leu Pro Leu Leu Val Gly Ala
225 230 235 240

Ile Ile Leu Leu Ile Ile Gly Ala Val Leu Phe Ser Ser Arg Gln Lys
245 250 255

Lys Ile Glu Glu Pro Leu Leu Asp Leu Ser Leu Phe Arg Asn Arg Leu
260 265 270

Phe Leu Gly Gly Val Val Ala Ala Gly Met Ala Met Phe Thr Val Ser

275 280 285

Gly Leu Glu Met Thr Thr Ser Gln Arg Phe Gln Leu Ser Val Gly Phe
290 295 300

Thr Pro Leu Glu Ala Gly Leu Leu Met Ile Pro Ala Ala Leu Gly Ser
305 310 315 320

Phe Pro Met Ser Ile Ile Gly Gly Ala Asn Leu His Arg Trp Gly Phe
325 330 335

Lys Pro Leu Ile Ser Gly Gly Phe Leu Ala Thr Ala Val Gly Ile Ala
340 345 350

Leu Cys Ile Trp Gly Ala Thr His Thr Asp Gly Leu Pro Phe Phe Ile
355 360 365

Ala Gly Leu Phe Phe Met Gly Ala Gly Ala Gly Ser Val Met Ser Val
370 375 380

Ser Ser Thr Ala Ile Ile Gly Ser Ala Pro Val Arg Lys Ala Gly Met
385 390 395 400

Ala Ser Ser Ile Glu Glu Val Ser Tyr Glu Phe Gly Thr Leu Leu Ser
405 410 415

Val Ala Ile Leu Gly Ser Leu Phe Pro Phe Phe Tyr Ser Leu His Ala
420 425 430

Pro Ala Glu Val Ala Asp Asn Phe Ser Ala Gly Val His His Ala Ile
435 440 445

Tyr Gly Asp Ala Ala Arg Ala Ser Leu Asp Thr Ala Tyr Ile Asn Val
450 455 460

Leu Ile Ile Ala Leu Val Cys Ala Val Ala Ala Ala Leu Ile Ser Ser
465 470 475 480

Tyr Leu Phe Arg Gly Asn Pro Lys Gly Ala Asn Asn Ala His
485 490