

32028-WO-PCT\_ST25  
SEQUENCE LISTING

<110> DSM IP ASSETS B.V.

<120> MICROBIAL PRODUCTION OF NICOTINIC ACID RIBOSIDE

<130> 32028

<160> 30

<170> PatentIn version 3.5

<210> 1

<211> 410

<212> PRT

<213> Escherichia coli

<400> 1

Met Ser Ser Phe Asp Tyr Leu Lys Thr Ala Ile Lys Gln Gln Gly Cys  
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Thr Leu Gln Gln Val Ala Asp Ala Ser Gly Met Thr Lys Gly Tyr Leu  
20 25 30

Ser Gln Leu Leu Asn Ala Lys Ile Lys Ser Pro Ser Ala Gln Lys Leu  
35 40 45

Glu Ala Leu His Arg Phe Leu Gly Leu Glu Phe Pro Arg Gln Lys Lys  
50 55 60

Thr Ile Gly Val Val Phe Gly Lys Phe Tyr Pro Leu His Thr Gly His  
65 70 75 80

Ile Tyr Leu Ile Gln Arg Ala Cys Ser Gln Val Asp Glu Leu His Ile  
85 90 95

Ile Met Gly Phe Asp Asp Thr Arg Asp Arg Ala Leu Phe Glu Asp Ser  
100 105 110

Ala Met Ser Gln Gln Pro Thr Val Pro Asp Arg Leu Arg Trp Leu Leu  
115 120 125

Gln Thr Phe Lys Tyr Gln Lys Asn Ile Arg Ile His Ala Phe Asn Glu  
130 135 140

Glu Gly Met Glu Pro Tyr Pro His Gly Trp Asp Val Trp Ser Asn Gly  
145 150 155 160

Ile Lys Lys Phe Met Ala Glu Lys Gly Ile Gln Pro Asp Leu Ile Tyr  
165 170 175

Thr Ser Glu Glu Ala Asp Ala Pro Gln Tyr Met Glu His Leu Gly Ile  
180 185 190

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

32028-WO-PCT\_ST25

Ala Gln Ile Arg Glu Asn Pro Phe Arg Tyr Trp Glu Tyr Ile Pro Thr  
210 215 220

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

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

Thr Thr Ser Ala Trp Glu Tyr Gly Arg Asp Tyr Val Phe Ser His Leu  
260 265 270

Gly Gly Asp Glu Ile Ala Leu Gln Tyr Ser Asp Tyr Asp Lys Ile Ala  
275 280 285

Leu Gly His Ala Gln Tyr Ile Asp Phe Ala Val Lys Tyr Ala Asn Lys  
290 295 300

Val Ala Phe Ile Asp Thr Asp Phe Val Thr Thr Gln Ala Phe Cys Lys  
305 310 315 320

Lys Tyr Glu Gly Arg Glu His Pro Phe Val Gln Ala Leu Ile Asp Glu  
325 330 335

Tyr Arg Phe Asp Leu Val Ile Leu Leu Glu Asn Asn Thr Pro Trp Val  
340 345 350

Ala Asp Gly Leu Arg Ser Leu Gly Ser Ser Val Asp Arg Lys Glu Phe  
355 360 365

Gln Asn Leu Leu Val Glu Met Leu Glu Glu Asn Asn Ile Glu Phe Val  
370 375 380

Arg Val Glu Glu Glu Asp Tyr Asp Ser Arg Phe Leu Arg Cys Val Glu  
385 390 395 400

Leu Val Arg Glu Met Met Gly Glu Gln Arg  
405 410

<210> 2  
<211> 180  
<212> PRT  
<213> Bacillus subtilis

<400> 2

Met Thr Glu Glu Leu Lys Leu Met Gly Ala Asn Arg Arg Asp Gln Leu  
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Leu Leu Trp Leu Lys Glu Ser Lys Ser Pro Leu Thr Gly Gly Glu Leu  
20 25 30

Ala Lys Lys Ala Asn Val Ser Arg Gln Val Ile Val Gln Asp Ile Ser  
 35 40 45

Leu Leu Lys Ala Lys Asn Val Pro Ile Ile Ala Thr Ser Gln Gly Tyr  
 50 55 60

Val Tyr Met Asp Ala Ala Ala Gln Gln His Gln Gln Ala Glu Arg Ile  
 65 70 75 80

Ile Ala Cys Leu His Gly Pro Glu Arg Thr Glu Glu Glu Leu Gln Leu  
 85 90 95

Ile Val Asp Glu Gly Val Thr Val Lys Asp Val Lys Ile Glu His Pro  
 100 105 110

Val Tyr Gly Asp Leu Thr Ala Ala Ile Gln Val Gly Thr Arg Lys Glu  
 115 120 125

Val Ser His Phe Ile Lys Lys Ile Asn Ser Thr Asn Ala Ala Tyr Leu  
 130 135 140

Ser Gln Leu Thr Asp Gly Val His Leu His Thr Leu Thr Ala Pro Asp  
 145 150 155 160

Glu His Arg Ile Asp Gln Ala Cys Gln Ala Leu Glu Glu Ala Gly Ile  
 165 170 175

Leu Ile Lys Asp  
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<210> 3

<211> 214

<212> PRT

<213> Corynebacterium glutamicum

<400> 3

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

Val Pro Arg Thr Arg Glu Pro His Leu Asn Lys Trp Ala Leu Pro Gly  
 35 40 45

Gly Trp Leu Pro Pro His Glu Glu Leu Glu Asp Ala Ala Ala Arg Thr  
 50 55 60

Leu Ala Glu Thr Thr Gly Leu His Pro Ser Tyr Leu Glu Gln Leu Tyr  
 65 70 75 80

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

32028-WO-PCT\_ST25

Val Tyr Trp Ala Leu Val Arg Ala Asp Glu Ala Leu Lys Ala Ile Pro  
100 105 110

Gly Glu Asn Val Gln Trp Phe Pro Ala Asp His Leu Pro Glu Leu Ala  
115 120 125

Phe Asp His Asn Asp Ile Val Lys Tyr Ala Leu Glu Arg Leu Arg Thr  
130 135 140

Lys Val Glu Tyr Ser Glu Ile Ala His Ser Phe Leu Gly Glu Thr Phe  
145 150 155 160

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

Leu Asp Ala Ala Asn Phe Arg Arg Ser Val Ala Thr Ser Pro Asp Leu  
180 185 190

Ile Asp Thr Gly Glu Val Leu Ala Gly Thr Pro His Arg Pro Pro Lys  
195 200 205

Leu Phe Arg Phe Gln Arg  
210

<210> 4  
<211> 213  
<212> PRT  
<213> Escherichia coli  
<400> 4

Met Lys Ser Leu Gln Ala Leu Phe Gly Gly Thr Phe Asp Pro Val His  
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Tyr Gly His Leu Lys Pro Val Glu Thr Leu Ala Asn Leu Ile Gly Leu  
20 25 30

Thr Arg Val Thr Ile Ile Pro Asn Asn Val Pro Pro His Arg Pro Gln  
35 40 45

Pro Glu Ala Asn Ser Val Gln Arg Lys His Met Leu Glu Leu Ala Ile  
50 55 60

Ala Asp Lys Pro Leu Phe Thr Leu Asp Glu Arg Glu Leu Lys Arg Asn  
65 70 75 80

Ala Pro Ser Tyr Thr Ala Gln Thr Leu Lys Glu Trp Arg Gln Glu Gln  
85 90 95

Gly Pro Asp Val Pro Leu Ala Phe Ile Ile Gly Gln Asp Ser Leu Leu  
100 105 110

## 32028-WO-PCT\_ST25

Thr Phe Pro Thr Trp Tyr Glu Tyr Glu Thr Ile Leu Asp Asn Ala His  
115 120 125

Leu Ile Val Cys Arg Arg Pro Gly Tyr Pro Leu Glu Met Ala Gln Pro  
130 135 140

Gln Tyr Gln Gln Trp Leu Glu Asp His Leu Thr His Asn Pro Glu Asp  
145 150 155 160

Leu His Leu Gln Pro Ala Gly Lys Ile Tyr Leu Ala Glu Thr Pro Trp  
165 170 175

Phe Asn Ile Ser Ala Thr Ile Ile Arg Glu Arg Leu Gln Asn Gly Glu  
180 185 190

Ser Cys Glu Asp Leu Leu Pro Glu Pro Val Leu Thr Tyr Ile Asn Gln  
195 200 205

Gln Gly Leu Tyr Arg  
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<210> 5

<211> 189

<212> PRT

<213> Bacillus subtilis

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Met Lys Lys Ile Gly Ile Phe Gly Gly Thr Phe Asp Pro Pro His Asn  
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Glu Ile Trp Phe Met Pro Asn Gln Ile Pro Pro His Lys Gln Asn Glu  
35 40 45

Asp Tyr Thr Asp Ser Phe His Arg Val Glu Met Leu Lys Leu Ala Ile  
50 55 60

Gln Ser Asn Pro Ser Phe Lys Leu Glu Leu Val Glu Met Glu Arg Glu  
65 70 75 80

Gly Pro Ser Tyr Thr Phe Asp Thr Val Ser Leu Leu Lys Gln Arg Tyr  
85 90 95

Pro Asn Asp Gln Leu Phe Phe Ile Ile Gly Ala Asp Met Ile Glu Tyr  
100 105 110

Leu Pro Lys Trp Tyr Lys Leu Asp Glu Leu Leu Asn Leu Ile Gln Phe  
115 120 125

Ile Gly Val Lys Arg Pro Gly Phe His Val Glu Thr Pro Tyr Pro Leu  
130 135 140

Leu Phe Ala Asp Val Pro Glu Phe Glu Val Ser Ser Thr Met Ile Arg  
145 150 155 160

Glu Arg Phe Lys Ser Lys Lys Pro Thr Asp Tyr Leu Ile Pro Asp Lys  
165 170 175

Val Lys Lys Tyr Val Glu Glu Asn Gly Leu Tyr Glu Ser  
180 185

<210> 6  
<211> 226  
<212> PRT  
<213> Corynebacterium glutamicum  
<400> 6

Met Arg Thr Leu Tyr Cys Pro Leu Met Thr Thr Thr Val Lys Arg Arg  
1 5 10 15

Ala Arg Ile Gly Ile Met Gly Gly Thr Phe Asp Pro Ile His Asn Gly  
20 25 30

His Leu Val Ala Gly Ser Glu Val Ala Asp Arg Phe Asp Leu Asp Leu  
35 40 45

Val Val Tyr Val Pro Thr Gly Gln Pro Trp Gln Lys Ala Asn Lys Lys  
50 55 60

Val Ser Pro Ala Glu Asp Arg Tyr Leu Met Thr Val Ile Ala Thr Ala  
65 70 75 80

Ser Asn Pro Arg Phe Met Val Ser Arg Val Asp Ile Asp Arg Gly Gly  
85 90 95

Asp Thr Tyr Thr Ile Asp Thr Leu Gln Asp Leu Ser Lys Gln Tyr Pro  
100 105 110

Asp Ala Gln Leu Tyr Phe Ile Thr Gly Ala Asp Ala Leu Ala Gln Ile  
115 120 125

Val Thr Trp Arg Asp Trp Glu Lys Thr Phe Glu Leu Ala His Phe Val  
130 135 140

Gly Val Thr Arg Pro Gly Tyr Glu Leu Asp Gly Asn Ile Ile Pro Glu  
145 150 155 160

Met His Gln Asp Arg Val Ser Leu Val Asp Ile Pro Ala Met Ala Ile  
165 170 175

Ser Ser Thr Asp Cys Arg Glu Arg Ser Ser Glu Glu Arg Pro Val Trp  
180 185 190

Tyr Leu Val<sub>195</sub> Pro Asp Gly Val Val<sub>200</sub> Gln Tyr Ile Ala Lys<sub>205</sub> Arg Gln Leu

Tyr Arg<sub>210</sub> Pro Glu Gly Ser Asp<sub>215</sub> Lys Asp Met Asp Pro<sub>220</sub> Lys Gly Gln Asn

Gln Ala  
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<211> 239  
<212> PRT  
<213> Escherichia coli

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Phe Leu Glu<sub>35</sub> Asp Ala Arg Glu Val<sub>40</sub> Asn Asn Val Arg Gly<sub>45</sub> Met Leu Gly

Phe Thr<sub>50</sub> Gly Thr Tyr Lys Gly<sub>55</sub> Arg Lys Ile Ser Val<sub>60</sub> Met Gly His Gly

Met Gly Ile Pro Ser Cys<sub>70</sub> Ser Ile Tyr Thr Lys<sub>75</sub> Glu Leu Ile Thr Asp<sub>80</sub>

Phe Gly Val Lys Lys<sub>85</sub> Ile Ile Arg Val Gly<sub>90</sub> Ser Cys Gly Ala Val<sub>95</sub> Leu

Pro His Val Lys<sub>100</sub> Leu Arg Asp Val Val<sub>105</sub> Ile Gly Met Gly Ala<sub>110</sub> Cys Thr

Asp Ser Lys<sub>115</sub> Val Asn Arg Ile Arg<sub>120</sub> Phe Lys Asp His Asp<sub>125</sub> Phe Ala Ala

Ile Ala<sub>130</sub> Asp Phe Asp Met Val<sub>135</sub> Arg Asn Ala Val Asp<sub>140</sub> Ala Ala Lys Ala

Leu Gly Ile Asp Ala Arg<sub>150</sub> Val Gly Asn Leu Phe<sub>155</sub> Ser Ala Asp Leu Phe<sub>160</sub>

Tyr Ser Pro Asp Gly<sub>165</sub> Glu Met Phe Asp Val<sub>170</sub> Met Glu Lys Tyr Gly<sub>175</sub> Ile

Leu Gly Val Glu<sub>180</sub> Met Glu Ala Ala Gly<sub>185</sub> Ile Tyr Gly Val Ala<sub>190</sub> Ala Glu

Phe Gly Ala<sub>195</sub> Lys Ala Leu Thr Ile<sub>200</sub> Cys Thr Val Ser Asp<sub>205</sub> His Ile Arg

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

<210> 8  
 <211> 233  
 <212> PRT  
 <213> Bacillus subtilis

<400> 8

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

Leu Glu Asn Val Glu Cys Tyr Asn Glu Val Arg Gly Met Tyr Gly Phe  
 35 40 45

Thr Gly Thr Tyr Lys Gly Lys Lys Ile Ser Val Gln Gly Thr Gly Met  
 50 55 60

Gly Val Pro Ser Ile Ser Ile Tyr Val Asn Glu Leu Ile Gln Ser Tyr  
 65 70 75 80

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

Asp Val Lys Val Arg Asp Val Ile Leu Ala Met Thr Ser Ser Thr Asp  
 100 105 110

Ser Gln Met Asn Arg Val Ala Phe Gly Ser Val Asp Phe Ala Pro Cys  
 115 120 125

Ala Asp Phe Glu Leu Leu Lys Asn Ala Tyr Asp Ala Ala Lys Asp Lys  
 130 135 140

Gly Val Pro Val Thr Val Gly Ser Val Phe Thr Ala Asp Gln Phe Tyr  
 145 150 155 160

Asn Asp Asp Ser Gln Ile Glu Lys Leu Ala Lys Tyr Gly Val Leu Gly  
 165 170 175

Val Glu Met Glu Thr Thr Ala Leu Tyr Thr Leu Ala Ala Lys His Gly  
 180 185 190

Arg Lys Ala Leu Ser Ile Leu Thr Val Ser Asp His Val Leu Thr Gly  
 195 200 205

Glu Glu Thr Thr Ala Glu Glu Arg Gln Thr Thr Phe His Asp Met Ile  
 210 215 220

Glu Val Ala Leu His Ser Val Ser Gln  
 225 230

<210> 9  
 <211> 191  
 <212> PRT  
 <213> Acinetobacter baylyi

<400> 9

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

Ala Phe Ile Leu Tyr Gly Tyr Leu Phe Phe Ser Phe Lys Leu Tyr Gly  
 35 40 45

Glu Thr Ile Leu Gln Gly Phe Phe Ile Ile Ile Asn Phe Tyr Gly Phe  
 50 55 60

Tyr Tyr Trp Leu Lys Gly Lys Gln Thr Glu His Glu Ile Arg Ile Val  
 65 70 75 80

Ala Ile Pro Ala Lys Thr Val Ile Ile Gln Met Leu Leu Ala Ala Leu  
 85 90 95

Gly Gly Leu Ile Phe Gly Leu Ser Leu Lys His Phe Thr Asp Ala Ala  
 100 105 110

Val Pro Met Leu Asp Ser Gln Leu Ala Ala Phe Ser Leu Leu Ala Thr  
 115 120 125

Tyr Trp Thr Ser Arg Lys His Ile Ala Thr Trp Val Leu Trp Val Phe  
 130 135 140

Val Asp Ile Val Tyr Val Gly Met Phe Ile Tyr Lys Asp Leu Tyr Leu  
 145 150 155 160

Thr Ala Gly Leu Tyr Ala Ala Phe Val Val Met Ala Ala Phe Gly Trp  
 165 170 175

Trp Gln Trp Glu Gln Val Lys Arg Lys Gln Arg Ser Gly Leu Ile  
 180 185 190

<210> 10  
 <211> 230  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 10

32028-WO-PCT\_ST25

Met Asn Pro Ile Thr Glu Leu Leu Asp Ala Thr Leu Trp Ile Gly Gly  
1 5 10 15

Val Pro Ile Leu Trp Arg Glu Ile Ile Gly Asn Val Phe Gly Leu Phe  
20 25 30

Ser Ala Trp Ala Gly Met Arg Arg Ile Val Trp Ala Trp Pro Ile Gly  
35 40 45

Ile Ile Gly Asn Ala Leu Leu Phe Thr Val Phe Met Gly Gly Leu Phe  
50 55 60

His Thr Pro Gln Asn Leu Asp Leu Tyr Gly Gln Ala Gly Arg Gln Ile  
65 70 75 80

Met Phe Ile Ile Val Ser Gly Tyr Gly Trp Tyr Gln Trp Ser Ala Ala  
85 90 95

Lys Arg Arg Ala Leu Thr Pro Glu Asn Ala Val Ala Val Val Pro Arg  
100 105 110

Trp Ala Ser Thr Lys Glu Arg Ala Gly Ile Val Ile Ala Ala Val Val  
115 120 125

Gly Thr Leu Ser Phe Ala Trp Ile Phe Gln Ala Leu Gly Ser Trp Gly  
130 135 140

Pro Trp Ala Asp Ala Trp Ile Phe Val Gly Ser Ile Leu Ala Thr Tyr  
145 150 155 160

Gly Met Ala Arg Gly Trp Thr Glu Phe Trp Leu Ile Trp Ile Ala Val  
165 170 175

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

Ala Val Leu Tyr Leu Val Tyr Gly Ala Phe Val Ser Trp Gly Phe Val  
195 200 205

Val Trp Leu Arg Val Gln Lys Ala Asp Lys Ala Arg Ala Leu Glu Ala  
210 215 220

Gln Glu Ser Val Thr Val  
225 230

<210> 11  
<211> 239  
<212> PRT  
<213> Escherichia coli

<400> 11

Met Asp Phe Phe Ser Val Gln Asn Ile Leu Val His Ile Pro Ile Gly  
Page 10

1                      5                      10                      15  
 Ala Gly Gly Tyr Asp Leu Ser Trp Ile Glu Ala Val Gly Thr Ile Ala  
                                  20                                   25                                   30  
 Gly Leu Leu Cys Ile Gly Leu Ala Ser Leu Glu Lys Ile Ser Asn Tyr  
                                  35                                   40                                   45  
 Phe Phe Gly Leu Ile Asn Val Thr Leu Phe Gly Ile Ile Phe Phe Gln  
                                  50                                   55                                   60  
 Ile Gln Leu Tyr Ala Ser Leu Leu Leu Gln Val Phe Phe Phe Ala Ala  
                                  65                                   70                                   75                                   80  
 Asn Ile Tyr Gly Trp Tyr Ala Trp Ser Arg Gln Thr Ser Gln Asn Glu  
                                  85                                   90                                   95  
 Ala Glu Leu Lys Ile Arg Trp Leu Pro Leu Pro Lys Ala Leu Ser Trp  
                                  100                                   105                                   110  
 Leu Ala Val Cys Val Val Ser Ile Gly Leu Met Thr Val Phe Ile Asn  
                                  115                                   120                                   125  
 Pro Val Phe Ala Phe Leu Thr Arg Val Ala Val Met Ile Met Gln Ala  
                                  130                                   135                                   140  
 Leu Gly Leu Gln Val Val Met Pro Glu Leu Gln Pro Asp Ala Phe Pro  
                                  145                                   150                                   155                                   160  
 Phe Trp Asp Ser Cys Met Met Val Leu Ser Ile Val Ala Met Ile Leu  
                                  165                                   170                                   175  
 Met Thr Arg Lys Tyr Val Glu Asn Trp Leu Leu Trp Val Ile Ile Asn  
                                  180                                   185                                   190  
 Val Ile Ser Val Val Ile Phe Ala Leu Gln Gly Val Tyr Ala Met Ser  
                                  195                                   200                                   205  
 Leu Glu Tyr Ile Ile Leu Thr Phe Ile Ala Leu Asn Gly Ser Arg Met  
                                  210                                   215                                   220  
 Trp Ile Asn Ser Ala Arg Glu Arg Gly Ser Arg Ala Leu Ser His  
                                  225                                   230                                   235  
  
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 <212> PRT  
 <213> Escherichia coli  
  
 <400> 12  
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                                  1                                   5                                   10                                   15

32028-WO-PCT\_ST25

Thr Leu Ala Ser Glu Thr Ala Leu Ala Tyr Glu Gln Asp Lys Thr Tyr  
20 25 30

Lys Ile Thr Val Leu His Thr Asn Asp His His Gly His Phe Trp Arg  
35 40 45

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

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

Ser Gly Gly Asp Ile Asn Thr Gly Val Pro Glu Ser Asp Leu Gln Asp  
85 90 95

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

Ala Ile Gly Asn His Glu Phe Asp Asn Pro Leu Thr Val Leu Arg Gln  
115 120 125

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

Lys Ser Thr Gly Glu Arg Leu Phe Lys Pro Trp Ala Leu Phe Lys Arg  
145 150 155 160

Gln Asp Leu Lys Ile Ala Val Ile Gly Leu Thr Thr Asp Asp Thr Ala  
165 170 175

Lys Ile Gly Asn Pro Glu Tyr Phe Thr Asp Ile Glu Phe Arg Lys Pro  
180 185 190

Ala Asp Glu Ala Lys Leu Val Ile Gln Glu Leu Gln Gln Thr Glu Lys  
195 200 205

Pro Asp Ile Ile Ile Ala Ala Thr His Met Gly His Tyr Asp Asn Gly  
210 215 220

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

Pro Ala Gly Ser Leu Ala Met Ile Val Gly Gly His Ser Gln Asp Pro  
245 250 255

Val Cys Met Ala Ala Glu Asn Lys Lys Gln Val Asp Tyr Val Pro Gly  
260 265 270

Thr Pro Cys Lys Pro Asp Gln Gln Asn Gly Ile Trp Ile Val Gln Ala  
275 280 285

His Glu Trp Gly Lys Tyr Val Gly Arg Ala Asp Phe Glu Phe Arg Asn  
 290 295 300  
 Gly Glu Met Lys Met Val Asn Tyr Gln Leu Ile Pro Val Asn Leu Lys  
 305 310 315 320  
 Lys Lys Val Thr Trp Glu Asp Gly Lys Ser Glu Arg Val Leu Tyr Thr  
 325 330 335  
 Pro Glu Ile Ala Glu Asn Gln Gln Met Ile Ser Leu Leu Ser Pro Phe  
 340 345 350  
 Gln Asn Lys Gly Lys Ala Gln Leu Glu Val Lys Ile Gly Glu Thr Asn  
 355 360 365  
 Gly Arg Leu Glu Gly Asp Arg Asp Lys Val Arg Phe Val Gln Thr Asn  
 370 375 380  
 Met Gly Arg Leu Ile Leu Ala Ala Gln Met Asp Arg Thr Gly Ala Asp  
 385 390 395 400  
 Phe Ala Val Met Ser Gly Gly Gly Ile Arg Asp Ser Ile Glu Ala Gly  
 405 410 415  
 Asp Ile Ser Tyr Lys Asn Val Leu Lys Val Gln Pro Phe Gly Asn Val  
 420 425 430  
 Val Val Tyr Ala Asp Met Thr Gly Lys Glu Val Ile Asp Tyr Leu Thr  
 435 440 445  
 Ala Val Ala Gln Met Lys Pro Asp Ser Gly Ala Tyr Pro Gln Phe Ala  
 450 455 460  
 Asn Val Ser Phe Val Ala Lys Asp Gly Lys Leu Asn Asp Leu Lys Ile  
 465 470 475 480  
 Lys Gly Glu Pro Val Asp Pro Ala Lys Thr Tyr Arg Met Ala Thr Leu  
 485 490 495  
 Asn Phe Asn Ala Thr Gly Gly Asp Gly Tyr Pro Arg Leu Asp Asn Lys  
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 Pro Gly Tyr Val Asn Thr Gly Phe Ile Asp Ala Glu Val Leu Lys Ala  
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 Gly Glu Val Ser Trp Gln  
 545 550

<211> 1462  
 <212> PRT  
 <213> Bacillus subtilis

<400> 13

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Met Arg Ile Gln Lys Arg Arg Thr His Val Glu Asn Ile Leu Arg Ile
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Leu Leu Pro Pro Ile Met Ile Leu Ser Leu Ile Leu Pro Thr Pro Pro
20      25      30

Ile His Ala Glu Glu Ser Ala Ala Pro Gln Val His Leu Ser Ile Leu
35      40      45

Ala Thr Thr Asp Ile His Ala Asn Met Met Asp Tyr Asp Tyr Tyr Ser
50      55      60

Asp Lys Glu Thr Ala Asp Phe Gly Leu Ala Arg Thr Ala Gln Leu Ile
65      70      75      80

Gln Lys His Arg Glu Gln Asn Pro Asn Thr Leu Leu Val Asp Asn Gly
85      90      95

Asp Leu Ile Gln Gly Asn Pro Leu Gly Glu Tyr Ala Val Lys Tyr Gln
100     105

Lys Asp Asp Ile Ile Ser Gly Thr Lys Thr His Pro Ile Ile Ser Val
115     120     125

Met Asn Ala Leu Lys Tyr Asp Ala Gly Thr Leu Gly Asn His Glu Phe
130     135     140

Asn Tyr Gly Leu Asp Phe Leu Asp Gly Thr Ile Lys Gly Ala Asp Phe
145     150     155     160

Pro Ile Val Asn Ala Asn Val Lys Thr Thr Ser Gly Glu Asn Arg Tyr
165     170     175

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

Glu Gln Lys Val Lys Val Gly Tyr Ile Gly Phe Val Pro Pro Gln Ile
195     200     205

Met Thr Trp Asp Lys Lys Asn Leu Glu Gly Gln Val Gln Val Gln Asp
210     215     220

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

Ala Asp Val Ile Ile Ala Leu Ala His Thr Gly Ile Glu Lys Gln Ala
245     250     255

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32028-WO-PCT\_ST25

Gln Ser Ser Gly Ala Glu Asn Ala Val Phe Asp Leu Ala Thr Lys Thr  
260 265 270

Lys Gly Ile Asp Ala Ile Ile Ser Gly His Gln His Gly Leu Phe Pro  
275 280 285

Ser Ala Glu Tyr Ala Gly Val Ala Gln Phe Asn Val Glu Lys Gly Thr  
290 295 300

Ile Asn Gly Ile Pro Val Val Met Pro Ser Ser Trp Gly Lys Tyr Leu  
305 310 315 320

Gly Val Ile Asp Leu Lys Leu Glu Lys Ala Asp Gly Ser Trp Lys Val  
325 330 335

Ala Asp Ser Lys Gly Ser Ile Glu Ser Ile Ala Gly Asn Val Thr Ser  
340 345 350

Arg Asn Glu Thr Val Thr Asn Thr Ile Gln Gln Thr His Gln Asn Thr  
355 360 365

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

Ser Phe Phe Ala Gln Val Lys Asp Asp Pro Ser Ile Gln Ile Val Thr  
385 390 395 400

Asp Ala Gln Lys Trp Tyr Ala Glu Lys Glu Met Lys Asp Thr Glu Tyr  
405 410 415

Lys Asn Leu Pro Ile Leu Ser Ala Gly Ala Pro Phe Lys Ala Gly Gly  
420 425 430

Arg Asn Gly Ala Asn Tyr Tyr Thr Asn Ile Pro Ala Gly Asp Leu Ala  
435 440 445

Ile Lys Asn Val Gly Asp Leu Tyr Leu Tyr Asp Asn Thr Val Gln Ile  
450 455 460

Val Lys Leu Thr Gly Ser Glu Val Lys Asp Trp Leu Glu Met Ser Ala  
465 470 475 480

Gly Gln Phe Asn Gln Ile Asp Pro Ala Lys Gly Gly Asp Gln Ala Leu  
485 490 495

Leu Asn Glu Asn Phe Arg Ser Tyr Asn Phe Asp Val Ile Asp Gly Val  
500 505 510

Thr Tyr Gln Val Asp Val Thr Lys Pro Ala Lys Tyr Asn Glu Asn Gly  
515 520 525

Lys Val Ile Asn Ala Asp Ser Arg Ile Ile Asn Leu Ser Tyr Glu  
 530 535 540  
 Gly Lys Pro Ile Ser Pro Ser Gln Glu Phe Leu Val Val Thr Asn Asn  
 545 550 555 560  
 Tyr Arg Ala Ser Gly Gly Gly Gly Phe Pro His Leu Thr Ser Asp Lys  
 565 570 575  
 Ile Val His Gly Ser Ala Val Glu Asn Arg Gln Val Leu Met Asp Tyr  
 580 585 590  
 Ile Ile Glu Gln Lys Thr Val Asn Pro Lys Ala Asp Asn Asn Trp Ser  
 595 600 605  
 Ile Ala Pro Val Ser Gly Thr Asn Leu Thr Phe Glu Ser Ser Leu Leu  
 610 615 620  
 Ala Lys Pro Phe Ala Asp Lys Ala Asp Asp Val Ala Tyr Val Gly Lys  
 625 630 635 640  
 Ser Ala Asn Glu Gly Tyr Gly Val Tyr Lys Leu Gln Phe Asp Asp Asp  
 645 650 655  
 Ser Asn Pro Asp Pro Pro Lys Asp Gly Leu Trp Asp Leu Thr Val Met  
 660 665 670  
 His Thr Asn Asp Thr His Ala His Leu Asp Asp Ala Ala Arg Arg Met  
 675 680 685  
 Thr Lys Ile Asn Glu Val Arg Ser Glu Thr Asn His Asn Ile Leu Leu  
 690 695 700  
 Asp Ala Gly Asp Val Phe Ser Gly Asp Leu Tyr Phe Thr Lys Trp Asn  
 705 710 715 720  
 Gly Leu Ala Asp Leu Lys Met Met Asn Met Met Gly Tyr Asp Ala Met  
 725 730 735  
 Thr Phe Gly Asn His Glu Phe Asp Lys Gly Pro Thr Val Leu Ser Asp  
 740 745 750  
 Phe Leu Ser Gly Asn Ser Ala Thr Val Asp Pro Ala Asn Arg Tyr His  
 755 760 765  
 Phe Glu Ala Pro Glu Phe Pro Ile Val Ser Ala Asn Val Asp Val Ser  
 770 775 780  
 Asn Glu Pro Lys Leu Lys Ser Phe Val Lys Lys Pro Gln Thr Phe Thr  
 785 790 795 800  
 Ala Gly Glu Lys Lys Glu Ala Gly Ile His Pro Tyr Ile Leu Leu Asp

805

810

815

Val Asp Gly Glu Lys Val Ala Val Phe Gly Leu Thr Thr Glu Asp Thr  
                   820                                  825                                  830

Ala Thr Thr Ser Ser Pro Gly Lys Ser Ile Val Phe Asn Asp Ala Phe  
                   835                                  840                                  845

Glu Thr Ala Gln Asn Thr Val Lys Ala Ile Gln Glu Glu Glu Lys Val  
           850                                  855                                  860

Asn Lys Ile Ile Ala Leu Thr His Ile Gly His Asn Arg Asp Leu Glu  
  865                                  870                                  875                                  880

Leu Ala Lys Lys Val Lys Gly Ile Asp Leu Ile Ile Gly Gly His Thr  
                   885                                  890                                  895

His Thr Leu Val Asp Lys Met Glu Val Val Asn Asn Glu Glu Pro Thr  
                   900                                  905                                  910

Ile Val Ala Gln Ala Lys Glu Tyr Gly Gln Phe Leu Gly Arg Val Asp  
                   915                                  920                                  925

Val Ala Phe Asp Glu Lys Gly Val Val Gln Thr Asp Lys Ser Asn Leu  
           930                                  935                                  940

Ser Val Leu Pro Ile Asp Glu His Thr Glu Glu Asn Pro Glu Ala Lys  
  945                                  950                                  955                                  960

Gln Glu Leu Asp Gln Phe Lys Asn Glu Leu Glu Asp Val Lys Asn Glu  
                   965                                  970                                  975

Lys Val Gly Tyr Thr Asp Val Ala Leu Asp Gly Gln Arg Glu His Val  
                   980                                  985                                  990

Arg Thr Lys Glu Thr Asn Leu Gly Asn Phe Ile Ala Asp Gly Met Leu  
                   995                                  1000                                  1005

Ala Lys Ala Lys Glu Ala Ala Gly Ala Arg Ile Ala Ile Thr Asn  
  1010                                  1015                                  1020

Gly Gly Gly Ile Arg Ala Gly Ile Asp Lys Gly Asp Ile Thr Leu  
  1025                                  1030                                  1035

Gly Glu Val Leu Asn Val Met Pro Phe Gly Asn Thr Leu Tyr Val  
  1040                                  1045                                  1050

Ala Asp Leu Thr Gly Lys Gln Ile Lys Glu Ala Leu Glu Gln Gly  
  1055                                  1060                                  1065

Leu Ser Asn Val Glu Asn Gly Gly Gly Ala Phe Pro Gln Val Ala  
  1070                                  1075                                  1080

32028-WO-PCT\_ST25

Gly	Ile 1085	Glu	Tyr	Thr	Phe	Thr 1090	Leu	Asn	Asn	Lys	Pro 1095	Gly	His	Arg
Val	Leu 1100	Glu	Val	Lys	Ile	Glu 1105	Ser	Pro	Asn	Gly	Asp 1110	Lys	Val	Ala
Ile	Asn 1115	Thr	Asp	Asp	Thr	Tyr 1120	Arg	Val	Ala	Thr	Asn 1125	Asn	Phe	Val
Gly	Ala 1130	Gly	Gly	Asp	Gly	Tyr 1135	Ser	Val	Phe	Thr	Glu 1140	Ala	Ser	His
Gly	Glu 1145	Asp	Leu	Gly	Tyr	Val 1150	Asp	Tyr	Glu	Ile	Phe 1155	Thr	Glu	Gln
Leu	Lys 1160	Lys	Leu	Gly	Asn	Lys 1165	Val	Ser	Pro	Lys	Val 1170	Glu	Gly	Arg
Ile	Lys 1175	Glu	Val	Phe	Leu	Pro 1180	Thr	Lys	Gln	Lys	Asp 1185	Gly	Ser	Trp
Thr	Leu 1190	Asp	Glu	Asp	Lys	Phe 1195	Ala	Ile	Tyr	Ala	Lys 1200	Asn	Ala	Asn
Thr	Pro 1205	Phe	Val	Tyr	Tyr	Gly 1210	Ile	His	Glu	Gly	Ser 1215	Gln	Glu	Lys
Pro	Ile 1220	Asn	Leu	Lys	Val	Lys 1225	Lys	Asp	Gln	Val	Lys 1230	Leu	Leu	Lys
Glu	Arg 1235	Glu	Ser	Asp	Pro	Ser 1240	Leu	Thr	Met	Phe	Asn 1245	Tyr	Trp	Tyr
Ser	Met 1250	Lys	Met	Pro	Met	Ala 1255	Asn	Leu	Lys	Thr	Ala 1260	Asp	Thr	Ala
Ile	Gly 1265	Ile	Lys	Ser	Thr	Gly 1270	Glu	Leu	Asp	Val	Ser 1275	Leu	Ser	Asp
Val	Tyr 1280	Asp	Phe	Thr	Val	Lys 1285	Gln	Lys	Gly	Lys	Glu 1290	Ile	Lys	Ser
Phe	Lys 1295	Glu	Pro	Val	Gln	Leu 1300	Ser	Leu	Arg	Met	Phe 1305	Asp	Ile	Glu
Glu	Ala 1310	His	Asn	Pro	Ala	Ile 1315	Tyr	His	Val	Asp	Arg 1320	Lys	Lys	Lys
Ala	Phe 1325	Thr	Lys	Thr	Gly	His 1330	Gly	Ser	Val	Asp	Asp 1335	Asp	Met	Val

32028-WO-PCT\_ST25

Thr Gly Tyr Thr Asn His Phe Ser Glu Tyr Thr Ile Leu Asn Ser  
 1340 1345 1350  
 Gly Ser Asn Asn Lys Pro Pro Ala Phe Pro Ser Asp Gln Pro Thr  
 1355 1360 1365  
 Gly Gly Asp Asp Gly Asn His Gly Gly Gly Ser Asp Lys Pro Gly  
 1370 1375 1380  
 Gly Lys Gln Pro Thr Asp Gly Asn Gly Gly Asn Asp Thr Pro Pro  
 1385 1390 1395  
 Gly Thr Gln Pro Thr Asn Gly Ser Gly Gly Asn Gly Ser Gly Gly  
 1400 1405 1410  
 Ser Gly Thr Asp Gly Pro Ala Gly Gly Leu Leu Pro Asp Thr Ala  
 1415 1420 1425  
 Thr Ser Met Tyr Ser Ile Leu Leu Ala Gly Phe Leu Ile Ser Ala  
 1430 1435 1440  
 Leu Gly Thr Ala Met Tyr Leu His Gln Arg Arg Lys Gln Asn Arg  
 1445 1450 1455  
 Ala Asn Gln Ala  
 1460

<210> 14  
 <211> 694  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 14

Met Lys Arg Leu Ser Arg Ala Ala Leu Ala Val Val Ala Thr Thr Ala  
 1 5 10 15  
 Val Ser Phe Ser Ala Leu Ala Val Pro Ala Phe Ala Asp Glu Ala Ser  
 20 25 30  
 Asn Val Glu Leu Asn Ile Leu Gly Val Thr Asp Phe His Gly His Ile  
 35 40 45  
 Glu Gln Lys Ala Val Lys Asp Asp Lys Gly Val Ile Thr Gly Tyr Ser  
 50 55 60  
 Glu Met Gly Ala Ser Gly Val Ala Cys Tyr Val Asp Ala Glu Arg Ala  
 65 70 75 80  
 Asp Asn Pro Asn Thr Arg Phe Ile Thr Val Gly Asp Asn Ile Gly Gly  
 85 90 95  
 Ser Pro Phe Val Ser Ser Ile Leu Lys Asp Glu Pro Thr Leu Gln Ala

100

105

110

Leu Ser Ala Ile Gly Val Asp Ala Ser Ala Leu Gly Asn His Glu Phe  
 115 120 125

Asp Gln Gly Tyr Ser Asp Leu Val Asn Arg Val Ser Leu Asp Gly Ser  
 130 135 140

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

Pro Ala Pro Ala Lys Ser Glu Ile Ile Glu Met Asp Gly Val Lys Ile  
 165 170 175

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

Ala Gly Ile Glu Gly Ile Thr Phe Thr Gly Asp Ile Asp Ala Ile Asn  
 195 200 205

Ala Glu Ala Asp Arg Val Ile Glu Ala Gly Glu Ala Asp Val Val Ile  
 210 215 220

Ala Leu Ile His Ala Glu Ala Ala Pro Thr Asp Leu Phe Ser Asn Asn  
 225 230 235 240

Val Asp Val Val Phe Ser Gly His Thr His Phe Asp Tyr Val Ala Glu  
 245 250 255

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

Glu Tyr Gly Lys Val Ile Ser Asp Val Glu Ile Ser Tyr Asp Arg Glu  
 275 280 285

Ala Gly Lys Ile Thr Asn Ile Glu Ala Lys Asn Val Ser Ala Thr Asp  
 290 295 300

Val Val Glu Asn Cys Glu Thr Pro Asn Thr Ala Val Asp Ala Ile Val  
 305 310 315 320

Ala Ala Ala Val Glu Ala Ala Glu Glu Ala Gly Asn Glu Val Val Ala  
 325 330 335

Thr Ile Asp Asn Gly Phe Tyr Arg Gly Ala Asp Glu Glu Gly Thr Thr  
 340 345 350

Gly Ser Asn Arg Gly Val Glu Ser Ser Leu Ser Asn Leu Ile Ala Glu  
 355 360 365

Ala Gly Leu Trp Ala Val Asn Asp Ala Thr Ile Leu Asn Ala Asp Ile  
 370 375 380

32028-WO-PCT\_ST25

Gly Ile Met Asn Ala Gly Gly Val Arg Ala Asp Leu Glu Ala Gly Glu  
 385 390 395 400  
 Val Thr Phe Ala Asp Ala Tyr Ala Thr Gln Asn Phe Ser Asn Thr Tyr  
 405 410 415  
 Gly Val Arg Glu Val Ser Gly Ala Gln Phe Lys Glu Ala Leu Glu Gln  
 420 425 430  
 Gln Trp Lys Glu Thr Gly Asp Arg Pro Arg Leu Ala Leu Gly Leu Ser  
 435 440 445  
 Ser Asn Val Gln Tyr Ser Tyr Asp Glu Thr Arg Glu Tyr Gly Asp Arg  
 450 455 460  
 Ile Thr His Ile Thr Phe Asn Gly Glu Pro Met Asp Met Lys Glu Thr  
 465 470 475 480  
 Tyr Arg Val Thr Gly Ser Ser Phe Leu Leu Ala Gly Gly Asp Ser Phe  
 485 490 495  
 Thr Ala Phe Ala Glu Gly Gly Pro Ile Ala Glu Thr Gly Met Val Asp  
 500 505 510  
 Ile Asp Leu Phe Asn Asn Tyr Ile Ala Ala His Pro Asp Ala Pro Ile  
 515 520 525  
 Arg Ala Asn Gln Ser Ser Val Gly Ile Ala Leu Ser Gly Pro Ala Val  
 530 535 540  
 Ala Glu Asp Gly Thr Leu Val Pro Gly Glu Glu Leu Thr Val Asp Leu  
 545 550 555 560  
 Ser Ser Leu Ser Tyr Thr Gly Pro Glu Ala Lys Pro Thr Thr Val Glu  
 565 570 575  
 Val Thr Val Gly Thr Glu Lys Lys Thr Ala Asp Val Asp Asn Thr Ile  
 580 585 590  
 Val Pro Gln Phe Asp Ser Thr Gly Lys Ala Thr Val Thr Leu Thr Val  
 595 600 605  
 Pro Glu Gly Ala Thr Ser Val Lys Ile Ala Thr Asp Asn Gly Thr Thr  
 610 615 620  
 Phe Glu Leu Pro Val Thr Val Asn Gly Glu Gly Asn Asn Asp Asp Asp  
 625 630 635 640  
 Asp Asp Lys Glu Gln Gln Ser Ser Gly Ser Ser Asp Ala Gly Ser Leu  
 645 650 655

32028-WO-PCT\_ST25

Val Ala Val Leu Gly Val Leu Gly Ala Leu Gly Gly Leu Val Ala Phe  
660 665 670

Phe Leu Asn Ser Ala Gln Gly Ala Pro Phe Leu Ala Gln Leu Gln Ala  
675 680 685

Met Phe Ala Gln Phe Met  
690

<210> 15  
<211> 400  
<212> PRT  
<213> Escherichia coli

<400> 15

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

Ala Tyr Lys Leu His Met Gln Gln Ala Val Phe His His Tyr Tyr Asp  
20 25 30

Val His Val Ala Ala Glu Phe Arg Cys Arg Gly Asp Asp Leu Leu Gly  
35 40 45

Ile Tyr Ala Asp Ala Ile Arg Glu Gln Val Gln Ala Met Gln His Leu  
50 55 60

Arg Leu Gln Asp Asp Glu Tyr Gln Trp Leu Ser Ala Leu Pro Phe Phe  
65 70 75 80

Lys Ala Asp Tyr Leu Asn Trp Leu Arg Glu Phe Arg Phe Asn Pro Glu  
85 90 95

Gln Val Thr Val Ser Asn Asp Asn Gly Lys Leu Asp Ile Arg Leu Ser  
100 105 110

Gly Pro Trp Arg Glu Val Ile Leu Trp Glu Val Pro Leu Leu Ala Val  
115 120 125

Ile Ser Glu Met Val His Arg Tyr Arg Ser Pro Gln Ala Asp Val Ala  
130 135 140

Gln Ala Leu Asp Thr Leu Glu Ser Lys Leu Val Asp Phe Ser Ala Leu  
145 150 155 160

Thr Ala Gly Leu Asp Met Ser Arg Phe His Leu Met Asp Phe Gly Thr  
165 170 175

Arg Arg Arg Phe Ser Arg Glu Val Gln Glu Thr Ile Val Lys Arg Leu  
180 185 190

Gln Gln Glu Ser Trp Phe Val Gly Thr Ser Asn Tyr Asp Leu Ala Arg  
Page 22

195

200

205

Arg Leu Ser Leu Thr Pro Met Gly Thr Gln Ala His Glu Trp Phe Gln  
 210 215 220

Ala His Gln Gln Ile Ser Pro Asp Leu Ala Asn Ser Gln Arg Ala Ala  
 225 230 235 240

Leu Ala Ala Trp Leu Glu Glu Tyr Pro Asp Gln Leu Gly Ile Ala Leu  
 245 250 255

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

Phe Ala Ser Arg Tyr Gln Gly Leu Arg His Asp Ser Gly Asp Pro Val  
 275 280 285

Glu Trp Gly Glu Lys Ala Ile Ala His Tyr Glu Lys Leu Gly Ile Asp  
 290 295 300

Pro Gln Ser Lys Thr Leu Val Phe Ser Asp Asn Leu Asp Leu Arg Lys  
 305 310 315 320

Ala Val Glu Leu Tyr Arg His Phe Ser Ser Arg Val Gln Leu Ser Phe  
 325 330 335

Gly Ile Gly Thr Arg Leu Thr Cys Asp Ile Pro Gln Val Lys Pro Leu  
 340 345 350

Asn Ile Val Ile Lys Leu Val Glu Cys Asn Gly Lys Pro Val Ala Lys  
 355 360 365

Leu Ser Asp Ser Pro Gly Lys Thr Ile Cys His Asp Lys Ala Phe Val  
 370 375 380

Arg Ala Leu Arg Lys Ala Phe Asp Leu Pro His Ile Lys Lys Ala Ser  
 385 390 395 400

<210> 16

<211> 490

<212> PRT

<213> Bacillus subtilis

<400> 16

Met Leu Glu Tyr Gly Phe Lys Asp Asp Ser Leu Ser Leu His Thr Asp  
 1 5 10 15

Leu Tyr Gln Ile Asn Met Ala Glu Thr Tyr Trp Arg Asp Gly Ile His  
 20 25 30

Glu Lys Lys Ala Ile Phe Glu Leu Phe Phe Arg Arg Leu Pro Phe Glu  
 35 40 45

32028-WO-PCT\_ST25

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

## 32028-WO-PCT\_ST25

Ile Thr Ala Tyr Asp Gln Pro Ala Leu Gly Ala Val Tyr Lys Leu Val  
 325 330 335

Ala Ile Glu Glu Asp Gly Lys Met Val Asp Thr Ile Lys Ile Ser Ser  
 340 345 350

Asn Pro Glu Lys Val Thr Thr Pro Gly Arg Lys Lys Val Tyr Arg Ile  
 355 360 365

Ile Asn Gln Ser Asn His His Ser Glu Gly Asp Tyr Ile Ala Leu Tyr  
 370 375 380

Asp Glu Gln Val Asn Asp Gln Lys Arg Leu Arg Met Phe His Pro Val  
 385 390 395 400

His Thr Phe Ile Ser Lys Phe Val Thr Asn Phe Tyr Ala Lys Asp Leu  
 405 410 415

His Glu Leu Ile Phe Glu Lys Gly Ile Leu Cys Tyr Gln Asn Pro Glu  
 420 425 430

Ile Ser Asp Ile Gln Gln Tyr Val Gln Asp Asn Leu Ser Leu Leu Trp  
 435 440 445

Glu Glu Tyr Lys Arg Ile Ser Lys Pro Glu Glu Tyr Pro Val Asp Leu  
 450 455 460

Ser Glu Asp Cys Trp Ser Asn Lys Met Gln Arg Ile His Glu Val Lys  
 465 470 475 480

Ser Arg Ile Glu Glu Glu Leu Glu Glu Glu  
 485 490

<210> 17  
 <211> 446  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 17

Met Asn Thr Asn Pro Ser Glu Phe Ser Ser Asn Arg Ser Thr Ala Leu  
 1 5 10 15

Leu Thr Asp Lys Tyr Glu Leu Thr Met Leu Gln Ala Ala Leu Ala Asp  
 20 25 30

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

Pro Asn Glu Arg Arg Tyr Gly Val Val Ala Gly Thr Ala Arg Val Leu  
 50 55 60

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

32028-WO-PCT\_ST25

Asp Phe Leu Asp Asp Arg Thr Leu Glu Tyr Leu Arg Asn Tyr Arg Phe  
                     85                    90                    95  
 Thr Gly Gln Val Asp Gly Tyr Arg Glu Gly Glu Ile Tyr Phe Pro Gln  
                     100                    105                    110  
 Ser Pro Leu Leu Thr Val Arg Gly Thr Phe Ala Glu Cys Val Ile Leu  
                     115                    120                    125  
 Glu Thr Val Ile Leu Ser Ile Met Asn Ala Asp Ser Ala Val Ala Ser  
                     130                    135                    140  
 Ala Ala Ala Arg Met Val Thr Ala Ala Asp Gly Arg Pro Ile Ile Glu  
                     145                    150                    155                    160  
 Met Gly Ser Arg Arg Thr His Glu Tyr Ser Ala Val Thr Ala Ser Arg  
                     165                    170                    175  
 Ala Ala Tyr Leu Ala Gly Phe Ser Thr Thr Ser Asn Leu Glu Ala Ala  
                     180                    185                    190  
 Tyr Arg Tyr Gly Ile Pro Ala Ser Gly Thr Ser Ala His Ala Trp Thr  
                     195                    200                    205  
 Leu Leu His Ile Asn Asp Asp Gly Thr Pro Asn Glu Ala Ala Ala Phe  
                     210                    215                    220  
 Lys Ala Gln Val Glu Ser Leu Gly Val Asp Thr Thr Leu Leu Val Asp  
                     225                    230                    235                    240  
 Thr Tyr Asp Ile Thr Gln Gly Val Ala Thr Ala Ile Glu Val Ala Gly  
                     245                    250                    255  
 Pro Asp Leu Gly Gly Val Arg Ile Asp Ser Gly Asp Leu Gly Val Leu  
                     260                    265                    270  
 Ala Arg Lys Val Arg Lys Gln Leu Asp Asp Leu Asn Ala His Asn Thr  
                     275                    280                    285  
 Lys Ile Val Val Ser Ser Asp Leu Asp Glu Phe Ala Ile Ala Gly Leu  
                     290                    295                    300  
 Arg Gly Glu Pro Val Asp Val Phe Gly Val Gly Thr Ser Val Val Thr  
                     305                    310                    315                    320  
 Gly Ser Gly Ala Pro Thr Ala Gly Leu Val Tyr Lys Ile Val Glu Val  
                     325                    330                    335  
 Ala Gly His Pro Val Ala Lys Arg Ser Arg Asn Lys Glu Ser Tyr Gly  
                     340                    345                    350

32028-WO-PCT\_ST25

Gly Gly Lys Lys Ala Val Arg Thr His Arg Lys Ser Gly Thr Ala Ile  
355 360 365

Glu Glu Ile Val Tyr Pro Phe Asn Ala Glu Ala Pro Asp Thr Gly Lys  
370 375 380

Leu Asp Thr Leu Ser Leu Thr Ile Pro Leu Met Arg Asp Gly Glu Ile  
385 390 395 400

Val Pro Gly Leu Pro Thr Leu Glu Asp Ser Arg Ala Tyr Leu Ala Lys  
405 410 415

Gln Leu Val Ser Leu Pro Trp Glu Gly Leu Ala Leu Ser Arg Asp Glu  
420 425 430

Pro Val Leu His Thr Arg Phe Val Gly Phe Pro Pro Ala Ala  
435 440 445

<210> 18  
<211> 271  
<212> PRT  
<213> Bacillus subtilis  
<400> 18

Met Lys Asp Arg Ile Glu Arg Ala Ala Ala Phe Ile Lys Gln Asn Leu  
1 5 10 15

Pro Glu Ser Pro Lys Ile Gly Leu Ile Leu Gly Ser Gly Leu Gly Ile  
20 25 30

Leu Ala Asp Glu Ile Glu Asn Pro Val Lys Leu Lys Tyr Glu Asp Ile  
35 40 45

Pro Glu Phe Pro Val Ser Thr Val Glu Gly His Ala Gly Gln Leu Val  
50 55 60

Leu Gly Thr Leu Glu Gly Val Ser Val Ile Ala Met Gln Gly Arg Phe  
65 70 75 80

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

Val Met Lys Ala Leu Gly Val Glu Ala Leu Ile Val Thr Asn Ala Ala  
100 105 110

Gly Gly Val Asn Thr Glu Phe Arg Ala Gly Asp Leu Met Ile Ile Thr  
115 120 125

Asp His Ile Asn Phe Met Gly Thr Asn Pro Leu Ile Gly Pro Asn Glu  
130 135 140

Ala Asp Phe Gly Ala Arg Phe Pro Asp Met Ser Ser Ala Tyr Asp Lys  
Page 27

145                      150                      155                      160  
 Asp Leu Ser Ser Leu<sub>165</sub> Ala Glu Lys Ile Ala<sub>170</sub> Lys Asp Leu Asn Ile<sub>175</sub> Pro  
 Ile Gln Lys Gly<sub>180</sub> Val Tyr Thr Ala Val<sub>185</sub> Thr Gly Pro Ser Tyr<sub>190</sub> Glu Thr  
 Pro Ala Glu<sub>195</sub> Val Arg Phe Leu Arg<sub>200</sub> Thr Met Gly Ser Asp<sub>205</sub> Ala Val Gly  
 Met Ser<sub>210</sub> Thr Val Pro Glu Val<sub>215</sub> Ile Val Ala Asn His<sub>220</sub> Ala Gly Met Arg  
 Val<sub>225</sub> Leu Gly Ile Ser Cys<sub>230</sub> Ile Ser Asn Ala Ala<sub>235</sub> Ala Gly Ile Leu Asp<sub>240</sub>  
 Gln Pro Leu Ser His<sub>245</sub> Asp Glu Val Met Glu<sub>250</sub> Val Thr Glu Lys Val<sub>255</sub> Lys  
 Ala Gly Phe Leu<sub>260</sub> Lys Leu Val Lys Ala<sub>265</sub> Ile Val Ala Gln Tyr<sub>270</sub> Glu  
 <210> 19  
 <211> 433  
 <212> PRT  
 <213> Bacillus subtilis  
 <400> 19  
 Met Arg Met Val<sub>5</sub> Asp Ile Ile Ile Lys<sub>10</sub> Lys Gln Asn Gly Lys<sub>15</sub> Glu Leu  
 Thr Thr Glu<sub>20</sub> Glu Ile Gln Phe Phe Val<sub>25</sub> Asn Gly Tyr Thr Asp<sub>30</sub> Gly Ser  
 Ile Pro Asp<sub>35</sub> Tyr Gln Ala Ser Ala<sub>40</sub> Leu Ala Met Ala<sub>45</sub> Ile Phe Phe Gln  
 Asp Met<sub>50</sub> Ser Asp Arg Glu Arg<sub>55</sub> Ala Asp Leu Thr Met<sub>60</sub> Ala Met Val Asn  
 Ser Gly Glu Thr Ile Asp<sub>70</sub> Leu Ser Ala Ile Glu<sub>75</sub> Gly Ile Lys Val Asp<sub>80</sub>  
 Lys His Ser Thr Gly<sub>85</sub> Gly Val Gly Asp Thr<sub>90</sub> Thr Thr Leu Val<sub>95</sub> Leu Ala  
 Pro Leu Val<sub>100</sub> Ala Ala Leu Asp Val Pro<sub>105</sub> Val Ala Lys Met Ser<sub>110</sub> Gly Arg  
 Gly Leu Gly<sub>115</sub> His Thr Gly Gly Thr<sub>120</sub> Ile Asp Lys Leu Glu<sub>125</sub> Ala Ile Met

32028-WO-PCT\_ST25

Gly Phe His Val Glu Leu Thr Lys Asp Glu Phe Ile Lys Leu Val Asn  
 130 135 140  
 Arg Asp Lys Val Ala Val Ile Gly Gln Ser Gly Asn Leu Thr Pro Ala  
 145 150 155 160  
 Asp Lys Lys Leu Tyr Ala Leu Arg Asp Val Thr Gly Thr Val Asn Ser  
 165 170 175  
 Ile Pro Leu Ile Ala Ser Ser Ile Met Ser Lys Lys Ile Ala Ala Gly  
 180 185 190  
 Ala Asp Ala Ile Val Leu Asp Val Lys Thr Gly Ala Gly Ala Phe Met  
 195 200 205  
 Lys Thr Glu Glu Asp Ala Ala Glu Leu Ala Lys Ala Met Val Arg Ile  
 210 215 220  
 Gly Asn Asn Val Gly Arg Gln Thr Met Ala Val Ile Ser Asp Met Ser  
 225 230 235 240  
 Gln Pro Leu Gly Phe Ala Ile Gly Asn Ala Leu Glu Val Lys Glu Ala  
 245 250 255  
 Ile Asp Thr Leu Lys Gly Glu Gly Pro Glu Asp Leu His Glu Leu Val  
 260 265 270  
 Leu Thr Leu Gly Ser Gln Met Val Val Leu Ala Lys Lys Ala Asp Thr  
 275 280 285  
 Leu Asp Glu Ala Arg Ala Lys Leu Glu Glu Val Met Lys Asn Gly Lys  
 290 295 300  
 Ala Leu Glu Lys Phe Lys Asp Phe Leu Lys Asn Gln Gly Gly Asp Ser  
 305 310 315 320  
 Ser Ile Val Asp Asp Pro Ser Lys Leu Pro Gln Ala Ala Tyr Gln Ile  
 325 330 335  
 Asp Val Pro Ala Lys Glu Ala Gly Val Val Ser Glu Ile Val Ala Asp  
 340 345 350  
 Glu Ile Gly Val Ala Ala Met Leu Leu Gly Ala Gly Arg Ala Thr Lys  
 355 360 365  
 Glu Asp Glu Ile Asp Leu Ala Val Gly Ile Met Leu Arg Lys Lys Val  
 370 375 380  
 Gly Asp Lys Val Glu Lys Gly Glu Pro Leu Val Thr Leu Tyr Ala Asn  
 385 390 395 400

Arg Glu Asn Val Asp Glu Val Ile Ala Lys Val Tyr Asp Asn Ile Arg  
 405 410 415

Ile Ala Ala Glu Ala Lys Ala Pro Lys Leu Ile His Thr Leu Ile Thr  
 420 425 430

Glu

<210> 20  
 <211> 165  
 <212> PRT  
 <213> Escherichia coli

<400> 20

Met Thr Asp Ser Glu Leu Met Gln Leu Ser Glu Gln Val Gly Gln Ala  
 1 5 10 15

Leu Lys Ala Arg Gly Ala Thr Val Thr Thr Ala Glu Ser Cys Thr Gly  
 20 25 30

Gly Trp Val Ala Lys Val Ile Thr Asp Ile Ala Gly Ser Ala Trp  
 35 40 45

Phe Glu Arg Gly Phe Val Thr Tyr Ser Asn Glu Ala Lys Ala Gln Met  
 50 55 60

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

Pro Val Val Val Glu Met Ala Ile Gly Ala Leu Lys Ala Ala Arg Ala  
 85 90 95

Asp Tyr Ala Val Ser Ile Ser Gly Ile Ala Gly Pro Asp Gly Gly Ser  
 100 105 110

Glu Glu Lys Pro Val Gly Thr Val Trp Phe Ala Phe Ala Thr Ala Arg  
 115 120 125

Gly Glu Gly Ile Thr Arg Arg Glu Cys Phe Ser Gly Asp Arg Asp Ala  
 130 135 140

Val Arg Arg Gln Ala Thr Ala Tyr Ala Leu Gln Thr Leu Trp Gln Gln  
 145 150 155 160

Phe Leu Gln Asn Thr  
 165

<210> 21  
 <211> 416  
 <212> PRT  
 <213> Bacillus subtilis

<400> 21

32028-WO-PCT\_ST25

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

Leu Leu Gly Gln Ile Ala Asn Thr Asn Ala Gln Phe Ile Ser Lys Gln  
20 25 30

Leu Ala Glu Ile Gly Val His Val Phe Tyr His Thr Ala Val Gly Asp  
35 40 45

Asn Pro Glu Arg Leu Lys Gln Val Ile Arg Ile Ala Glu Glu Arg Ser  
50 55 60

Asp Phe Ile Ile Phe Ser Gly Gly Leu Gly Pro Thr Lys Asp Asp Leu  
65 70 75 80

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

Asp Glu Ala Phe Gln Ser Ile Glu Asp Tyr Pro Lys Arg Thr Lys Arg  
100 105 110

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

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

His Glu Ser Arg Tyr Tyr Met Leu Leu Pro Gly Pro Pro Ser Glu Leu  
145 150 155 160

Arg Pro Met Phe Glu Asn Glu Ala Lys Pro Leu Leu Leu Lys Lys Met  
165 170 175

Gly Ser Asn Glu Lys Ile Val Ser Thr Val Leu Arg Phe Phe Gly Ile  
180 185 190

Gly Glu Ser Gln Leu Glu Pro Asp Leu Glu Asp Ile Ile Asp Ala Gln  
195 200 205

Thr Asn Pro Thr Ile Ala Pro Leu Ala Ala Asp Gly Glu Val Thr Leu  
210 215 220

Arg Leu Thr Ala Lys His Ala Asp Glu Lys Glu Thr Glu Arg Leu Leu  
225 230 235 240

Lys Glu Thr Glu Ala Val Ile Leu Glu Arg Val Gly Glu Phe Phe Tyr  
245 250 255

Gly Tyr Asp Asp Thr Ser Leu Val Lys Glu Leu Ser Ile Ala Cys Lys  
260 265 270

Glu Lys Gly Ile Thr Ile Ser Ala Ala Glu Ser Phe Thr Gly Gly Leu  
 275 280 285

Phe Ser Glu Trp Leu Thr Asp His Ser Gly Ala Ser Lys Leu Phe Ala  
 290 295 300

Gly Gly Val Val Cys Tyr Thr Asn Asp Val Lys Gln Asn Val Leu Gly  
 305 310 315 320

Val Lys Lys Glu Thr Leu Asp Arg Phe Gly Ala Val Ser Lys Glu Cys  
 325 330 335

Ala Ser Glu Leu Ala Lys Gly Val Gln Lys Leu Thr Gly Ser Asp Ile  
 340 345 350

Gly Ile Ser Phe Thr Gly Val Ala Gly Pro Asp Ala Gln Glu Gly His  
 355 360 365

Glu Pro Gly His Val Phe Ile Gly Ile Ser Ala Asn Gly Lys Glu Glu  
 370 375 380

Val His Glu Phe His Phe Ala Gly Ser Arg Thr Gly Ile Arg Lys Arg  
 385 390 395 400

Gly Ala Lys Tyr Gly Cys His Leu Ile Leu Lys Leu Leu Glu Gln Lys  
 405 410 415

<210> 22

<211> 172

<212> PRT

<213> Corynebacterium glutamicum

<400> 22

Met Ser Glu Asn Leu Ala Gly Arg Val Val Glu Leu Leu Lys Ser Arg  
 1 5 10 15

Gly Glu Thr Leu Ala Phe Cys Glu Ser Leu Thr Ala Gly Leu Ala Ser  
 20 25 30

Ala Thr Ile Ala Glu Ile Pro Gly Ala Ser Val Val Leu Lys Gly Gly  
 35 40 45

Leu Val Thr Tyr Ala Thr Glu Leu Lys Val Ala Leu Ala Gly Val Pro  
 50 55 60

Gln Glu Leu Ile Asp Ala His Gly Val Val Ser Pro Gln Cys Ala Arg  
 65 70 75 80

Ala Met Ala Thr Gly Ala Ala His Arg Cys Gln Ala Asp Trp Ala Val  
 85 90 95

Ser Leu Thr Gly Val Ala Gly Pro Ser Lys Gln Asp Gly His Pro Val  
 100 105 110

Gly Glu Val Trp Ile Gly Val Ala Gly Pro Ala His Phe Gly Ala Ser  
115 120 125

Gly Thr Ile Asp Ala Tyr Arg Ala Phe Glu Ser Glu Gln Gln Val Ile  
130 135 140

Leu Ala Glu Leu Gly Arg His His Ile Arg Glu Ser Ala Val Gln Gln  
145 150 155 160

Ser Phe Arg Leu Leu Ile Asp His Ile Glu Ser Gln  
165 170

<210> 23

<211> 347

<212> PRT

<213> Escherichia coli

<400> 23

Met Ser Val Met Phe Asp Pro Asp Thr Ala Ile Tyr Pro Phe Pro Pro  
1 5 10 15

Lys Pro Thr Pro Leu Ser Ile Asp Glu Lys Ala Tyr Tyr Arg Glu Lys  
20 25 30

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

Tyr Thr Asp Pro Glu Ile Gln Gln Leu Ala Glu Glu Thr Gly Gly Cys  
50 55 60

Ile Ser Asp Ser Leu Glu Met Ala Arg Phe Gly Ala Lys His Pro Ala  
65 70 75 80

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

Ile Leu Ser Pro Glu Lys Thr Ile Leu Met Pro Thr Leu Gln Ala Glu  
100 105 110

Cys Ser Leu Asp Leu Gly Cys Pro Val Glu Glu Phe Asn Ala Phe Cys  
115 120 125

Asp Ala His Pro Asp Arg Thr Val Val Val Tyr Ala Asn Thr Ser Ala  
130 135 140

Ala Val Lys Ala Arg Ala Asp Trp Val Val Thr Ser Ser Ile Ala Val  
145 150 155 160

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

32028-WO-PCT\_ST25

Pro Asp Lys His Leu Gly Arg Tyr Val Gln Lys Gln Thr Gly Gly Asp  
180 185 190

Ile Leu Cys Trp Gln Gly Ala Cys Ile Val His Asp Glu Phe Lys Thr  
195 200 205

Gln Ala Leu Thr Arg Leu Gln Glu Glu Tyr Pro Asp Ala Ala Ile Leu  
210 215 220

Val His Pro Glu Ser Pro Gln Ala Ile Val Asp Met Ala Asp Ala Val  
225 230 235 240

Gly Ser Thr Ser Gln Leu Ile Ala Ala Ala Lys Thr Leu Pro His Gln  
245 250 255

Arg Leu Ile Val Ala Thr Asp Arg Gly Ile Phe Tyr Lys Met Gln Gln  
260 265 270

Ala Val Pro Asp Lys Glu Leu Leu Glu Ala Pro Thr Ala Gly Glu Gly  
275 280 285

Ala Thr Cys Arg Ser Cys Ala His Cys Pro Trp Met Ala Met Asn Gly  
290 295 300

Leu Gln Ala Ile Ala Glu Ala Leu Glu Gln Glu Gly Ser Asn His Glu  
305 310 315 320

Val His Val Asp Glu Arg Leu Arg Glu Arg Ala Leu Val Pro Leu Asn  
325 330 335

Arg Met Leu Asp Phe Ala Ala Thr Leu Arg Gly  
340 345

<210> 24  
<211> 368  
<212> PRT  
<213> Bacillus subtilis

<400> 24

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

Ser Tyr Lys Glu Leu Ser Arg Lys Asp Met Glu Thr Arg Val Ala Ala  
20 25 30

Ile Lys Lys Lys Phe Gly Ser Arg Leu Phe Ile Pro Gly His His Tyr  
35 40 45

Gln Lys Asp Glu Val Ile Gln Phe Ala Asp Gln Thr Gly Asp Ser Leu  
50 55 60

Gln Leu Ala Gln Val Ala Glu Lys Asn Lys Glu Ala Asp Tyr Ile Val  
65 70 75 80

32028-WO-PCT\_ST25

Phe Cys Gly Val His Phe Met Ala Glu Thr Ala Asp Met Leu Thr Ser  
 85 90 95  
 Glu Gln Gln Thr Val Val Leu Pro Asp Met Arg Ala Gly Cys Ser Met  
 100 105 110  
 Ala Asp Met Ala Asp Met Gln Gln Thr Asn Arg Ala Trp Lys Lys Leu  
 115 120 125  
 Gln His Ile Phe Gly Asp Thr Ile Ile Pro Leu Thr Tyr Val Asn Ser  
 130 135 140  
 Thr Ala Glu Ile Lys Ala Phe Val Gly Lys His Gly Gly Ala Thr Val  
 145 150 155 160  
 Thr Ser Ser Asn Ala Lys Lys Val Leu Glu Trp Ala Phe Thr Gln Lys  
 165 170 175  
 Lys Arg Ile Leu Phe Leu Pro Asp Gln His Leu Gly Arg Asn Thr Ala  
 180 185 190  
 Tyr Asp Leu Gly Ile Ala Leu Glu Asp Met Ala Val Trp Asp Pro Met  
 195 200 205  
 Lys Asp Glu Leu Val Ala Glu Ser Gly His Thr Asn Val Lys Val Ile  
 210 215 220  
 Leu Trp Lys Gly His Cys Ser Val His Glu Lys Phe Thr Thr Lys Asn  
 225 230 235 240  
 Ile His Asp Met Arg Glu Arg Asp Pro Asp Ile Gln Ile Ile Val His  
 245 250 255  
 Pro Glu Cys Ser His Glu Val Val Thr Leu Ser Asp Asp Asn Gly Ser  
 260 265 270  
 Thr Lys Tyr Ile Ile Asp Thr Ile Asn Gln Ala Pro Ala Gly Ser Lys  
 275 280 285  
 Trp Ala Ile Gly Thr Glu Met Asn Leu Val Gln Arg Ile Ile His Glu  
 290 295 300  
 His Pro Asp Lys Gln Ile Glu Ser Leu Asn Pro Asp Met Cys Pro Cys  
 305 310 315 320  
 Leu Thr Met Asn Arg Ile Asp Leu Pro His Leu Leu Trp Ser Leu Glu  
 325 330 335  
 Gln Ile Glu Lys Gly Glu Pro Ser Gly Val Ile Lys Val Pro Lys Ala  
 340 345 350

32028-WO-PCT\_ST25

Ile Gln Glu Asp Ala Leu Leu Ala Leu Asn Arg Met Leu Ser Ile Thr  
355 360 365

<210> 25  
<211> 428  
<212> PRT  
<213> Corynebacterium glutamicum

<400> 25

Met Thr Thr Ser Ile Thr Pro Ser Val Asn Leu Ala Leu Lys Asn Ala  
1 5 10 15

Asn Ser Cys Asn Ser Glu Leu Lys Asp Gly Pro Trp Phe Leu Asp Gln  
20 25 30

Pro Gly Met Pro Asp Val Tyr Gly Pro Gly Ala Ser Gln Asn Asp Pro  
35 40 45

Ile Pro Ala His Ala Pro Arg Gln Gln Val Leu Pro Glu Glu Tyr Gln  
50 55 60

Arg Ala Ser Asp Asp Glu Leu His Arg Arg Ile Arg Glu Ala Lys Asp  
65 70 75 80

Thr Leu Gly Asp Lys Val Val Ile Leu Gly His Phe Tyr Gln Arg Asp  
85 90 95

Glu Val Ile Gln His Ala Asp Phe Val Gly Asp Ser Phe Gln Leu Ala  
100 105 110

Arg Ala Ala Lys Thr Arg Pro Glu Ala Glu Ala Ile Val Phe Cys Gly  
115 120 125

Val His Phe Met Ala Glu Thr Ala Asp Leu Leu Ser Thr Asp Glu Gln  
130 135 140

Ser Val Ile Leu Pro Asn Leu Ala Ala Gly Cys Ser Met Ala Asp Met  
145 150 155 160

Ala Asp Leu Asp Ser Val Glu Asp Cys Trp Glu Gln Leu Thr Ser Ile  
165 170 175

Tyr Gly Asp Asp Thr Leu Ile Pro Val Thr Tyr Met Asn Ser Ser Ala  
180 185 190

Ala Leu Lys Gly Phe Val Gly Glu His Gly Gly Ile Val Cys Thr Ser  
195 200 205

Ser Asn Ala Arg Ser Val Leu Glu Trp Ala Phe Glu Arg Gly Gln Arg  
210 215 220

Val Leu Phe Phe Pro Asp Gln His Leu Gly Arg Asn Thr Ala Lys Ala  
Page 36



32028-WO-PCT\_ST25

Ala Gln Gly Gly Ile Ala Ala Val Phe Asp Glu Thr Asp Ser Ile Asp  
50 55 60

Ser His Val Glu Asp Thr Leu Ile Ala Gly Ala Gly Ile Cys Asp Arg  
65 70 75 80

His Ala Val Glu Phe Val Ala Ser Asn Ala Arg Ser Cys Val Gln Trp  
85 90 95

Leu Ile Asp Gln Gly Val Leu Phe Asp Thr His Ile Gln Pro Asn Gly  
100 105 110

Glu Glu Ser Tyr His Leu Thr Arg Glu Gly Gly His Ser His Arg Arg  
115 120 125

Ile Leu His Ala Ala Asp Ala Thr Gly Arg Glu Val Glu Thr Thr Leu  
130 135 140

Val Ser Lys Ala Leu Asn His Pro Asn Ile Arg Val Leu Glu Arg Ser  
145 150 155 160

Asn Ala Val Asp Leu Ile Val Ser Asp Lys Ile Gly Leu Pro Gly Thr  
165 170 175

Arg Arg Val Val Gly Ala Trp Val Trp Asn Arg Asn Lys Glu Thr Val  
180 185 190

Glu Thr Cys His Ala Lys Ala Val Val Leu Ala Thr Gly Gly Ala Ser  
195 200 205

Lys Val Tyr Gln Tyr Thr Thr Asn Pro Asp Ile Ser Ser Gly Asp Gly  
210 215 220

Ile Ala Met Ala Trp Arg Ala Gly Cys Arg Val Ala Asn Leu Glu Phe  
225 230 235 240

Asn Gln Phe His Pro Thr Ala Leu Tyr His Pro Gln Ala Arg Asn Phe  
245 250 255

Leu Leu Thr Glu Ala Leu Arg Gly Glu Gly Ala Tyr Leu Lys Arg Pro  
260 265 270

Asp Gly Thr Arg Phe Met Pro Asp Phe Asp Glu Arg Gly Glu Leu Ala  
275 280 285

Pro Arg Asp Ile Val Ala Arg Ala Ile Asp His Glu Met Lys Arg Leu  
290 295 300

Gly Ala Asp Cys Met Phe Leu Asp Ile Ser His Lys Pro Ala Asp Phe  
305 310 315 320

## 32028-WO-PCT\_ST25

Ile Arg Gln His Phe Pro Met Ile Tyr Glu Lys Leu Leu Gly Leu Gly  
 325 330 335

Ile Asp Leu Thr Gln Glu Pro Val Pro Ile Val Pro Ala Ala His Tyr  
 340 345 350

Thr Cys Gly Gly Val Met Val Asp Asp His Gly Arg Thr Asp Val Glu  
 355 360 365

Gly Leu Tyr Ala Ile Gly Glu Val Ser Tyr Thr Gly Leu His Gly Ala  
 370 375 380

Asn Arg Met Ala Ser Asn Ser Leu Leu Glu Cys Leu Val Tyr Gly Trp  
 385 390 395 400

Ser Ala Ala Glu Asp Ile Thr Arg Arg Met Pro Tyr Ala His Asp Ile  
 405 410 415

Ser Thr Leu Pro Pro Trp Asp Glu Ser Arg Val Glu Asn Pro Asp Glu  
 420 425 430

Arg Val Val Ile Gln His Asn Trp His Glu Leu Arg Leu Phe Met Trp  
 435 440 445

Asp Tyr Val Gly Ile Val Arg Thr Thr Lys Arg Leu Glu Arg Ala Leu  
 450 455 460

Arg Arg Ile Thr Met Leu Gln Gln Glu Ile Asp Glu Tyr Tyr Ala His  
 465 470 475 480

Phe Arg Val Ser Asn Asn Leu Leu Glu Leu Arg Asn Leu Val Gln Val  
 485 490 495

Ala Glu Leu Ile Val Arg Cys Ala Met Met Arg Lys Glu Ser Arg Gly  
 500 505 510

Leu His Phe Thr Leu Asp Tyr Pro Glu Leu Leu Thr His Ser Gly Pro  
 515 520 525

Ser Ile Leu Ser Pro Gly Asn His Tyr Ile Asn Arg  
 530 535 540

<210> 27  
 <211> 531  
 <212> PRT  
 <213> Bacillus subtilis

<400> 27

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

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

32028-WO-PCT\_ST25

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

32028-WO-PCT\_ST25

Thr Ile Thr Ala Ile Cys Glu Lys Ala Gly Ile Asp Ile His Ser Gly  
305 310 315 320

Lys Ile Pro Val Ala Pro Gly Met His Phe Leu Met Gly Gly Val Ser  
325 330 335

Val Asn Arg Trp Gly Glu Thr Thr Val Pro Gly Leu Tyr Ala Ile Gly  
340 345 350

Glu Thr Ala Cys Ser Gly Leu His Gly Ala Asn Arg Leu Ala Ser Asn  
355 360 365

Ser Leu Leu Glu Ala Leu Val Phe Gly Lys Arg Ala Ala Glu His Ile  
370 375 380

Ile Gln Lys Pro Val Tyr Asn Arg Gln Tyr Gln Ser Gly Leu Glu Thr  
385 390 395 400

Ser Val Phe Tyr Glu Val Pro Asp Ile Glu Gly His Glu Leu Gln Ser  
405 410 415

Lys Met Thr Ser His Met Ser Ile Leu Arg Glu Gln Ser Ser Leu Ile  
420 425 430

Glu Leu Ser Ile Trp Leu His Thr Leu Pro Phe Gln Glu Val Asn Val  
435 440 445

Lys Asp Ile Thr Ile Arg Gln Met Glu Leu Ser His Leu Trp Gln Thr  
450 455 460

Ala Lys Leu Met Thr Phe Ser Ala Leu Leu Arg Glu Glu Ser Arg Gly  
465 470 475 480

Ala His Phe Arg Thr Asp Phe Pro His Ala Glu Val Ser Trp Gln Gly  
485 490 495

Arg Gln Ile Val His Thr Lys Lys Gly Thr Lys Ile Arg Lys Asn Glu  
500 505 510

Gly Ile Trp Asn Asn Glu Ser Phe Thr Ala Glu Lys Ile Thr Glu Ser  
515 520 525

Leu Phe Ser  
530

<210> 28  
<211> 297  
<212> PRT  
<213> Escherichia coli

<400> 28

Met Pro Pro Arg Arg Tyr Asn Pro Asp Thr Arg Arg Asp Glu Leu Leu  
Page 41



Ala Leu Asp Leu Ser Met Arg Phe Arg  
290 295

<210> 29  
<211> 289  
<212> PRT  
<213> Bacillus subtilis

<400> 29

Met Asn His Leu Gln Leu Lys Lys Leu Leu Asn His Phe Phe Leu Glu  
1 5 10 15

Asp Ile Gly Thr Gly Asp Leu Thr Ser Gln Ser Ile Phe Gly Glu Gln  
20 25 30

Ser Cys Glu Ala Glu Ile Val Ala Lys Ser Glu Gly Ile Phe Ala Gly  
35 40 45

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

Ser Ile Leu His Lys Lys Asp Gly Asp Met Leu His Lys Gly Glu Val  
65 70 75 80

Ile Ala Glu Leu His Gly Pro Ala Ala Ala Leu Leu Ser Gly Glu Arg  
85 90 95

Val Val Leu Asn Leu Ile Gln Arg Leu Ser Gly Ile Ala Thr Met Thr  
100 105 110

Arg Glu Ala Val Arg Cys Leu Asp Asp Glu Gln Ile Lys Ile Cys Asp  
115 120 125

Thr Arg Lys Thr Thr Pro Gly Leu Arg Met Leu Glu Lys Tyr Ala Val  
130 135 140

Arg Ala Gly Gly Gly Tyr Asn His Arg Phe Gly Leu Tyr Asp Gly Ile  
145 150 155 160

Met Ile Lys Asp Asn His Ile Ala Ala Cys Gly Ser Ile Leu Glu Ala  
165 170 175

Cys Lys Lys Ala Arg Gln Ala Ala Gly His Met Val Asn Ile Glu Val  
180 185 190

Glu Ile Glu Thr Glu Glu Gln Leu Arg Glu Ala Ile Ala Ala Gly Ala  
195 200 205

Asp Val Ile Met Phe Asp Asn Cys Pro Pro Asp Thr Val Arg His Phe  
210 215 220

32028-WO-PCT\_ST25

Ala Lys Leu Thr Pro Ala Asn Ile Lys Thr Glu Ala Ser Gly Gly Ile  
225 230 235 240

Thr Leu Glu Ser Leu Pro Ala Phe Lys Gly Thr Gly Val Asn Tyr Ile  
245 250 255

Ser Leu Gly Phe Leu Thr His Ser Val Lys Ser Leu Asp Ile Ser Met  
260 265 270

Asp Val Thr Leu Ser Asn Glu Ser Val Glu Glu Cys Cys Tyr Val Asn  
275 280 285

Ser

<210> 30

<211> 279

<212> PRT

<213> Corynebacterium glutamicum

<400> 30

Met Thr Thr His Ile Asp Arg Ile Val Gly Ala Ala Leu Ser Glu Asp  
1 5 10 15

Ala Pro Trp Gly Asp Ile Thr Ser Asp Thr Phe Ile Pro Gly Ser Ala  
20 25 30

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

Gln Ala Leu Phe Asp Ala Ser Phe Arg Leu Val Asp Pro Arg Ile Asn  
50 55 60

Ala Ser Leu Lys Val Ala Asp Gly Asp Ser Phe Glu Thr Gly Asp Ile  
65 70 75 80

Leu Gly Thr Ile Thr Gly Ser Ala Arg Ser Ile Leu Arg Ser Glu Arg  
85 90 95

Ile Ala Leu Asn Phe Ile Gln Arg Thr Ser Gly Ile Ala Thr Leu Thr  
100 105 110

Ser Cys Tyr Val Ala Glu Val Lys Gly Thr Lys Ala Arg Ile Val Asp  
115 120 125

Thr Arg Lys Thr Thr Pro Gly Leu Arg Ile Ile Glu Arg Gln Ala Val  
130 135 140

Arg Asp Gly Gly Gly Phe Asn His Arg Ala Thr Leu Ser Asp Ala Val  
145 150 155 160

Met Val Lys Asp Asn His Leu Ala Ala Ile Ala Ser Gln Gly Leu Ser  
165 170 175

32028-WO-PCT\_ST25

Ile	Thr	Glu	Ala	Leu	Ser	Asn	Met	Lys	Ala	Lys	Leu	Pro	His	Thr	Thr
			180					185					190		
His	Val	Glu	Val	Glu	Val	Asp	His	Ile	Glu	Gln	Ile	Glu	Pro	Val	Leu
		195					200					205			
Ala	Ala	Gly	Val	Asp	Thr	Ile	Met	Leu	Asp	Asn	Phe	Thr	Ile	Asp	Gln
	210					215					220				
Leu	Ile	Glu	Gly	Val	Asp	Leu	Ile	Gly	Gly	Arg	Ala	Leu	Val	Glu	Ala
225					230					235					240
Ser	Gly	Gly	Val	Asn	Leu	Asn	Thr	Ala	Gly	Lys	Ile	Ala	Ser	Thr	Gly
				245					250					255	
Val	Asp	Val	Ile	Ser	Val	Gly	Ala	Leu	Thr	His	Ser	Val	His	Ala	Leu
			260					265					270		
Asp	Leu	Gly	Leu	Asp	Ile	Phe									
		275													