

SEQUENCE LISTING

<110> DEINOVE

<120> Methods of producing phytoene

<130> B2390PC

<160> 35

<170> PatentIn version 3.5

<210> 1

<211> 296

<212> PRT

<213> Pantoea agglomerans

<400> 1

Met	Glu	Val	Gly	Ser	Lys	Ser	Phe	Ala	Thr	Ala	Ser	Lys	Leu	Phe	Asp
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Ala	Lys	Thr	Arg	Arg	Ser	Val	Leu	Met	Leu	Tyr	Ala	Trp	Cys	Arg	His
			20					25					30		

Cys	Asp	Asp	Val	Ile	Asp	Asp	Gln	Val	Leu	Gly	Phe	Ser	Asn	Asp	Thr
		35					40					45			

Pro	Ser	Leu	Gln	Ser	Ala	Glu	Gln	Arg	Leu	Ala	Gln	Leu	Glu	Met	Lys
	50					55					60				

Thr	Arg	Gln	Ala	Tyr	Ala	Gly	Ser	Gln	Met	His	Glu	Pro	Ala	Phe	Ala
65					70					75					80

Ala	Phe	Gln	Glu	Val	Ala	Met	Ala	His	Asp	Ile	Leu	Pro	Ala	Tyr	Ala
				85					90					95	

Phe	Asp	His	Leu	Ala	Gly	Phe	Ala	Met	Asp	Val	His	Glu	Thr	Arg	Tyr
			100					105					110		

Gln	Thr	Leu	Asp	Asp	Thr	Leu	Arg	Tyr	Cys	Tyr	His	Val	Ala	Gly	Val
		115					120					125			

Val Gly Leu Met Met Ala Gln Ile Met Gly Val Arg Asp Asn Ala Thr
130 135 140

Leu Asp Arg Ala Cys Asp Leu Gly Leu Ala Phe Gln Leu Thr Asn Ile
145 150 155 160

Ala Arg Asp Ile Val Glu Asp Ala Glu Ala Gly Arg Cys Tyr Leu Pro
165 170 175

Ala Ala Trp Leu Ala Glu Glu Gly Leu Thr Arg Glu Asn Leu Ala Asp
180 185 190

Pro Gln Asn Arg Lys Ala Leu Ser Arg Val Ala Arg Arg Leu Val Glu
195 200 205

Thr Ala Glu Pro Tyr Tyr Arg Ser Ala Ser Ala Gly Leu Pro Gly Leu
210 215 220

Pro Leu Arg Ser Ala Trp Ala Ile Ala Thr Ala Gln Gln Val Tyr Arg
225 230 235 240

Lys Ile Gly Met Lys Val Val Gln Ala Gly Ser Gln Ala Trp Glu Gln
245 250 255

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

Ser Gly Gln Ala Val Thr Ser Arg Val Ala Arg His Ala Pro Arg Ser
275 280 285

Ala Asp Leu Trp Gln Arg Pro Val
290 295

<210> 2

<211> 304

<212> PRT

<213> Paracoccus sp_N81106

<400> 2

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

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

Asp Thr Val Met Leu Tyr Ala Trp Cys Arg His Ala Asp Asp Val Ile
35 40 45

Asp Gly Gln Ala Leu Gly Ser Arg Pro Glu Ala Val Asn Asp Pro Gln
50 55 60

Ala Arg Leu Asp Gly Leu Arg Ala Asp Thr Leu Ala Ala Leu Gln Gly
65 70 75 80

Asp Gly Pro Val Thr Pro Pro Phe Ala Ala Leu Arg Ala Val Ala Arg
85 90 95

Arg His Asp Phe Pro Gln Ala Trp Pro Met Asp Leu Ile Glu Gly Phe
100 105 110

Ala Met Asp Val Glu Ala Arg Asp Tyr Arg Thr Leu Asp Asp Val Leu
115 120 125

Glu Tyr Ser Tyr His Val Ala Gly Ile Val Gly Val Met Met Ala Arg
130 135 140

Val Met Gly Val Arg Asp Asp Pro Val Leu Asp Arg Ala Cys Asp Leu
145 150 155 160

Gly Leu Ala Phe Gln Leu Thr Asn Ile Ala Arg Asp Val Ile Asp Asp
165 170 175

Ala Arg Ile Gly Arg Cys Tyr Leu Pro Gly Asp Trp Leu Asp Gln Ala
180 185 190

Gly Ala Arg Val Asp Gly Pro Val Pro Ser Pro Glu Leu Tyr Thr Val
195 200 205

Ile Leu Arg Leu Leu Asp Ala Ala Glu Leu Tyr Tyr Ala Ser Ala Arg
210 215 220

Val Gly Leu Ala Asp Leu Pro Pro Arg Cys Ala Trp Ser Ile Ala Ala
225 230 235 240

Ala Leu Arg Ile Tyr Arg Ala Ile Gly Leu Arg Ile Arg Lys Gly Gly
245 250 255

Pro Glu Ala Tyr Arg Gln Arg Ile Ser Thr Ser Lys Ala Ala Lys Ile
260 265 270

Gly Leu Leu Gly Ile Gly Gly Trp Asp Val Ala Arg Ser Arg Leu Pro
275 280 285

Gly Ala Gly Val Ser Arg Gln Gly Leu Trp Thr Arg Pro His His Ala
290 295 300

<210> 3
<211> 298
<212> PRT
<213> Deinococcus geothermalis

<400> 3

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

Ala Ala Ala Arg His Cys Trp Glu Val Thr Arg Gln His Ser Arg Thr
20 25 30

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

Trp Ala Val Tyr Ala Ala Cys Arg Ala Gly Asp Asp Ser Val Asp Glu
50 55 60

Cys His Gly Asn Glu Ala Lys Gln Ala Leu Ala Ala Trp Trp Ala Arg
65 70 75 80

Val Gln Ala Ala Phe Ala Gly Arg Pro Gly Pro His Pro Ile Asp Thr
85 90 95

Ala Leu Ala Trp Ala Val Ser His Trp Pro Ile Pro Leu Ala Ala Phe
100 105 110

Glu Glu Leu His Glu Gly Leu Arg Met Asp Leu Glu Gly Tyr His Tyr
115 120 125

Arg Asp Leu Glu Asp Leu Thr Leu Tyr Cys Arg Arg Val Ala Gly Val
130 135 140

Val Gly Phe Met Ile Ala Pro Ile Cys Gly Tyr Ser Gly Gly Glu Asp
145 150 155 160

Thr Leu Arg Arg Ala Leu Arg Leu Gly Gln Ala Met Gln Leu Thr Asn
165 170 175

Ile Leu Arg Asp Val Gly Glu Asp Leu Glu Arg Gly Arg Val Tyr Leu
180 185 190

Pro Glu Asp Leu Leu Arg Glu Tyr Gly Val Thr Arg Ala Ala Leu Glu
195 200 205

Glu Gly Arg Val Thr Pro Gly Tyr Arg Ala Leu Met Arg Asp Leu Ser
210 215 220

Ala Leu Ala Arg Ala Trp Tyr Ala Glu Gly Arg Ala Gly Ile Pro Cys
225 230 235 240

Leu Arg Gly Arg Ala Arg Ile Gly Val Gln Ala Ala Ala Arg Ala Tyr
245 250 255

Glu Gly Ile Leu Asp Asp Leu Ala Arg Gly Asp Phe Asp Asn Phe Arg

260

265

270

Arg Arg Ala His Val Ser Gly Pro Arg Lys Leu Leu Met Leu Pro Gln
 275 280 285

Ala Trp Trp Glu Val Arg Gly Ala Pro Pro
 290 295

<210> 4

<211> 297

<212> PRT

<213> Deinococcus actinosclerus

<400> 4

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

His Cys Gln Asp Val Thr Arg Glu His Ser Lys Thr Phe Tyr Leu Gly
 20 25 30

Ser Arg Phe Phe Pro Ala Ala Gln Arg Arg Ala Val Trp Ala Val Tyr
 35 40 45

Ala Ala Cys Arg Asp Gly Asp Asp Thr Val Asp Glu Leu Ser Gly His
 50 55 60

Ala Ala Gln Leu Gly Leu Asp Gln Trp Trp Thr Arg Val Gln Gly Ala
 65 70 75 80

Phe Ala Gly Arg Pro Gly Asp His Pro Ile Asp Met Ala Leu Ala Trp
 85 90 95

Ala Ala Arg Glu Tyr Pro Ile Pro Leu Ser Ala Phe Ala Glu Leu His
 100 105 110

Glu Gly Leu Arg Met Asp Leu Ser Gly His Glu Tyr His Ser Met Ala
 115 120 125

Asp Leu Ile Leu Tyr Cys Arg Arg Val Ala Gly Val Val Gly Phe Met
130 135 140

Ile Ala Pro Val Ser Gly Tyr Ser Gly Gly Glu Arg Thr Leu His Ala
145 150 155 160

Ala Leu Met Leu Gly Gln Ala Met Gln Leu Thr Asn Ile Leu Arg Asp
165 170 175

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

Leu Ala Glu Phe Arg Val Ser Arg Ala Asp Leu Glu Arg Gly Val Val
195 200 205

Thr Pro Glu Tyr Arg Ala Leu Met Arg His Leu Ser Ala Leu Ala Arg
210 215 220

Glu Trp Tyr Ala Glu Gly Arg Gln Gly Ile Pro Cys Leu His Gly Ser
225 230 235 240

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

Asp Asp Leu Ala Arg Asn Asp Phe Asp Asn Phe Gly Arg Arg Ala His
260 265 270

Val Ser Gly Pro Arg Lys Leu Met Met Leu Pro Gln Ala Trp Trp Glu
275 280 285

Leu Arg Thr Ala Pro Ala Pro Leu Thr
290 295

<210> 5

<211> 313

<212> PRT

<213> Deinococcus deserti

<400> 5

Met Pro Asp Leu Asn Leu Pro Gly Ser Pro Pro Leu Ala Ala Leu Arg
1 5 10 15

Trp Cys Arg Val Met Thr Arg Val His Ser Gln Thr Phe Tyr Leu Gly
20 25 30

Ser Leu Leu Tyr Pro Arg Arg Gln Arg Leu Ala Val Trp Ala Val Tyr
35 40 45

Ala Ala Cys Arg Val Gly Asp Asp Ile Ala Asp Glu Tyr Thr Gly Ala
50 55 60

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

Phe Cys Gly Asn Pro Gly Asp Asp Pro Met Gln Thr Ala Leu Ala Trp
85 90 95

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

Glu Gly Phe Cys Met Asp Leu Thr Gly Gln Ser Tyr Asp Ser Leu Asp
115 120 125

Asp Leu Thr Leu Tyr Cys Arg Arg Val Ala Gly Val Val Gly Phe Met
130 135 140

Val Ala Pro Ile Gly Gly Tyr Arg Gly Gly Ala His Thr Leu Glu Gln
145 150 155 160

Ala Leu Met Leu Gly Gln Ala Met Gln Leu Thr Asn Ile Leu Arg Asp
165 170 175

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

Leu Ser Arg Phe Gly Val Thr His Ala Asp Leu Gln Ala Gly Arg Val

195

200

205

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

Glu Trp Tyr Ala Arg Gly Arg Glu Gly Ile Pro Ala Leu Glu Gly Arg
 225 230 235 240

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

Asp Asp Leu Glu Ala His Gly Tyr Asp Asn Phe Ser Arg Arg Ala His
 260 265 270

Val Pro Pro Arg His Lys Leu Arg Leu Leu Trp Gln Glu Tyr Arg Ala
 275 280 285

His Ser Ser Pro Ala Ser Ala Cys Pro Val Ala Trp Ala Glu Gln Gln
 290 295 300

Tyr Leu Arg Leu Lys Gly Leu Arg Gly
 305 310

<210> 6
 <211> 273
 <212> PRT
 <213> Deinococcus gobiensis

<400> 6

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

Pro Gly Arg Gln Arg Ala Ala Val Trp Ala Val Tyr Ala Ala Cys Arg
 20 25 30

Glu Gly Asp Asp Ile Ala Asp Gly Gly Gly Pro Asp Val Asp Ala Arg
 35 40 45

Leu Gly Asp Trp Trp Ser Arg Val Gln Gly Ala Phe Ala Gly Arg Pro
50 55 60

Gly Glu His Pro Thr Asp Arg Ala Leu Ala Trp Ala Ala Arg Glu Tyr
65 70 75 80

Pro Ile Pro Leu Gly Ala Phe Ala Glu Leu His Glu Gly Leu Arg Met
85 90 95

Asp Leu Arg Gly His Asn Tyr Ala Ser Met Asp Asp Leu Thr Leu Tyr
100 105 110

Cys Arg Arg Val Ala Gly Val Val Gly Phe Met Ile Ala Pro Ile Ser
115 120 125

Gly Tyr Glu Gly Gly Glu Ala Thr Leu Asp Lys Ala Leu Arg Leu Gly
130 135 140

Gln Ala Met Gln Leu Thr Asn Ile Leu Arg Asp Val Gly Glu Asp Leu
145 150 155 160

Ser Leu Gly Arg Val Tyr Leu Pro Ala Glu Val Leu Asp Arg Tyr Gly
165 170 175

Leu Cys Arg Ala Asp Leu Glu Arg Gly Val Val Thr Pro Glu Tyr Cys
180 185 190

Ala Met Leu Arg Asp Leu Thr Ala Gln Ala Arg Ala Trp Tyr Ala Glu
195 200 205

Gly Arg Ala Gly Ile Pro Leu Leu Arg Gly Arg Ala Arg Leu Ala Val
210 215 220

Ala Thr Ala Ala Arg Ala Tyr Glu Gly Ile Leu Asp Asp Leu Glu Ala
225 230 235 240

Ala Gly Tyr Asp Asn Phe Asn Arg Arg Ala Tyr Val Ser Gly Arg Arg
245 250 255

Lys Leu Met Met Leu Pro Gln Ala Trp Trp Glu Leu Arg Ser Phe Ser
260 265 270

Ala

<210> 7
<211> 287
<212> PRT
<213> Deinococcus maricopensis

<400> 7

Met Arg Glu Glu His Leu Pro Ala Arg Ala Ile Glu Arg Cys Arg Asp
1 5 10 15

Gln Thr Arg Ala His Ser Lys Thr Phe Tyr Phe Gly Ser Arg Phe Phe
20 25 30

Pro Arg Ala Gln Arg Gln Ala Val Trp Ala Val Tyr Ala Ala Cys Arg
35 40 45

Glu Gly Asp Asp Ile Ala Asp Glu Ser Pro Ala Trp Asp Arg Ala Ala
50 55 60

His Leu Asp Ala Trp Trp Ala Arg Val Arg Arg Ala Leu Asn Gly Glu
65 70 75 80

Gly Ser Gly Asp His Val Ser Asp Ala Leu Ala Trp Ala Ala Arg Thr
85 90 95

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

Met Asp Leu Ala Gly His Ala Tyr Asp Thr Ala Glu Asp Leu Glu Leu
115 120 125

Tyr Cys Arg Arg Val Ala Gly Val Val Gly Phe Met Ile Ala Pro Ile

130

135

140

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

Gly Gln Ala Met Gln Leu Thr Asn Ile Leu Arg Asp Val Gly Glu Asp
 165 170 175

Trp Ala Arg Glu Arg Val Tyr Leu Pro Gln Thr Leu Leu Glu Gln Tyr
 180 185 190

Gly Val Thr Arg Thr Met Leu Ala Arg Gly Thr Val Thr Pro Glu Tyr
 195 200 205

Arg Ala Leu Met Arg His Leu Cys Ala Gln Ala Arg Thr Trp Tyr Ala
 210 215 220

Gln Gly Arg Ala Gly Ile Pro Arg Leu His Gly Gly Gly Arg Leu Ala
 225 230 235 240

Val Ala Ala Ala Ala Arg Ala Tyr Glu Gly Ile Leu Asp Ala Leu Glu
 245 250 255

Arg Asn Asp Tyr Asp Asn Phe Asn Ala Arg Ala His Val Ser Gly Thr
 260 265 270

Arg Lys Leu Leu Leu Leu Pro Gln Val Trp Trp Glu Cys Arg Ala
 275 280 285

<210> 8

<211> 294

<212> PRT

<213> Deinococcus peraridilitoris

<400> 8

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

His Cys Arg Asp Val Thr Arg Asp His Ser Lys Thr Phe Tyr Phe Gly
20 25 30

Ser Arg Phe Phe Gly Pro Ala Glu Arg Gln Ala Val Trp Ala Val Tyr
35 40 45

Ala Val Cys Arg His Gly Asp Asp Ile Val Asp Glu Gly Asp Pro His
50 55 60

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

Phe Ala Gly Thr Pro Ser Ala Asp Pro Val Phe Gln Ala Leu Cys Trp
85 90 95

Ala Val Ala Arg Phe Pro Ile Pro Arg Gly Ala Phe Glu Glu Leu His
100 105 110

Leu Gly Leu Arg Met Asp Leu Asp Gly His His Tyr Arg Asp Met Thr
115 120 125

Glu Leu Glu Leu Tyr Cys Arg Arg Val Ala Gly Val Val Gly Phe Met
130 135 140

Ile Ala Pro Ile Ala Gly Phe Asp Gly Gly Glu Ala Thr Leu Gln Arg
145 150 155 160

Ala Leu Lys Leu Gly Gln Ala Met Gln Leu Thr Asn Ile Leu Arg Asp
165 170 175

Val Gly Glu Asp Ala Ala Arg Gly Arg Leu Tyr Leu Pro Glu Asp Leu
180 185 190

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

Ser Ser Glu Tyr Gln Ala Leu Met Arg His Leu Val Ala Thr Ala Arg
210 215 220

Thr Trp Tyr Ala Glu Gly Arg Ser Gly Ile Pro Arg Leu Arg Gly Arg
225 230 235 240

Ala Arg Leu Ala Val Gly Ala Ala Ala Ser Ala Tyr Glu Gly Ile Leu
245 250 255

Asp Ala Leu Glu Gln Asn Asp Phe Asp Asn Phe Ser Arg Arg Ala Gln
260 265 270

Val Ser Gly Thr Arg Lys Leu Leu Met Leu Pro Gly Val Leu Trp Arg
275 280 285

Ser Arg Gly Ala Pro Gly
290

<210> 9
<211> 287
<212> PRT
<213> Deinococcus puniceus

<400> 9

Met Ala His Cys Arg Asp Val Thr Arg Leu His Ser Lys Thr Phe Tyr
1 5 10 15

Leu Gly Ser Arg Phe Phe Pro Ala Gln Glu Arg Ala Ala Val Trp Ala
20 25 30

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

Gly His Asp Ala Val Thr Gln Leu Asp Gly Trp Trp Ala Arg Met Gln
50 55 60

Val Ala Phe Ala Gly Leu Pro Asp Pro Gln Pro Asp Gly Thr His Pro
65 70 75 80

Ile Asp Thr Ala Leu Ser Trp Ala Ala Gln Thr Tyr Pro Ile Pro Leu

85

90

95

Ser Ala Phe Gly Glu Leu His Glu Gly Leu Arg Met Asp Leu Asn Gly
 100 105 110

His Ser Tyr Gln Thr Met Asp Asp Leu Thr Leu Tyr Cys Arg Arg Val
 115 120 125

Ala Gly Val Val Gly Phe Met Ile Ala Pro Ile Ser Gly Tyr Ser Gly
 130 135 140

Gly Glu Arg Thr Leu Gln His Ala Leu Met Leu Gly Gln Ala Met Gln
 145 150 155 160

Leu Thr Asn Ile Leu Arg Asp Val Gly Glu Asp Leu Glu Arg Gly Arg
 165 170 175

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

Asp Leu Gln Arg Gly Ile Val Thr Pro Glu Tyr Arg Ala Leu Met Arg
 195 200 205

His Leu Ser Ala Leu Ala Arg Asp Trp Tyr Lys Gln Gly Arg Thr Gly
 210 215 220

Ile Pro Met Leu His Gly Ser Ala Arg Leu Ala Val Gln Thr Ala Ala
 225 230 235 240

Arg Ala Tyr Glu Gly Ile Leu Asp Asp Leu Glu Arg Ala Asp Phe Asp
 245 250 255

Asn Phe Arg Arg Arg Ala Tyr Val Ser Gly Pro Arg Lys Leu Leu Met
 260 265 270

Leu Pro Gln Ala Trp Trp Glu Leu Arg Gly Phe Met Ala Arg Ala
 275 280 285

<210> 10
<211> 325
<212> PRT
<213> Deinococcus radiodurans

<400> 10

Met Arg Ser Arg Ala Gly Leu Ser Leu Arg Leu Pro Thr Arg Thr Leu
1 5 10 15

Thr Val Thr Asp Tyr Ser Pro Ala Leu Pro Cys Thr Glu Leu Arg Arg
20 25 30

Pro Pro Leu Ala Gln Ala Val Arg Tyr Cys Arg Asp Leu Thr Arg Gln
35 40 45

His Ser Lys Thr Phe Tyr Leu Gly Ser Gln Leu Phe Ser Pro Pro Glu
50 55 60

Arg Ala Ala Val Trp Ala Val Tyr Ala Ala Cys Arg Ala Gly Asp Asp
65 70 75 80

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

Trp Arg Ser Arg Ile Asp Ala Ala Phe Ala Gly Gln Pro Ala Asp Asp
100 105 110

Pro Ile Ser Thr Ala Leu Ala Trp Ala Ala Gly Arg Tyr Ala Ile Pro
115 120 125

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

Gly His Glu Tyr Arg Asp Met Asp Asp Leu Leu Leu Tyr Cys Arg Arg
145 150 155 160

Val Ala Gly Val Val Gly Phe Met Val Ala Pro Ile Ser Gly Tyr Arg
165 170 175

Gly Gly Ala Ala Thr Leu Asn Asp Ala Leu Gln Leu Gly Gln Ala Met
180 185 190

Gln Leu Thr Asn Ile Leu Arg Asp Val Gly Glu Asp Leu Thr Arg Gly
195 200 205

Arg Val Tyr Leu Pro Gln Ser Leu Leu Asp Glu Tyr Gly Leu Ser Arg
210 215 220

Ala Ala Leu Glu Arg Trp Gly Gln Gly Glu Pro Leu Ser Pro Ala Tyr
225 230 235 240

Arg Ala Leu Met Thr His Leu Gly Gly Leu Ala Arg Glu Trp Tyr Ala
245 250 255

Ala Gly Arg Ala Gly Ile Pro Gln Leu Asp Gly Arg Gly Pro Leu Ala
260 265 270

Val Leu Thr Ala Ala Arg Ala Tyr Glu Gly Ile Leu Asp Asp Leu Glu
275 280 285

Arg Ala Gly Tyr Asp Asn Phe Gly Arg Arg Ala Tyr Val Ser Gly Arg
290 295 300

Arg Lys Leu Leu Met Leu Pro Gln Ala Trp Trp Glu Leu Arg Ser Leu
305 310 315 320

Gly Ala Val His Gly
325

<210> 11

<211> 283

<212> PRT

<213> Deinococcus soli

<400> 11

Met Ala His Cys Gln Asp Val Thr Arg Glu His Ser Lys Thr Phe Tyr

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

Ala Arg Glu Trp Tyr Ala Glu Gly Arg Gln Gly Ile Pro Cys Leu His
210 215 220

Gly Ser Ala Arg Leu Ala Val Ala Thr Ala Ala Arg Ala Tyr Glu Gly
225 230 235 240

Ile Leu Asp Asp Leu Ala Arg Asn Asp Phe Asp Asn Phe Gly Arg Arg
245 250 255

Ala His Val Ser Gly Pro Arg Lys Leu Leu Met Leu Pro Gln Ala Trp
260 265 270

Trp Glu Leu Arg Thr Ala Ala Ala Ser Leu Ser
275 280

<210> 12
<211> 299
<212> PRT
<213> Deinococcus swuensis

<400> 12

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

Gln Ala Val Ala His Cys Arg Asp Val Thr Arg Asp His Ser Lys Thr
20 25 30

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

Trp Ala Val Tyr Ala Ala Cys Arg Thr Gly Asp Asp Ile Ala Asp Glu
50 55 60

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

Ile Gln Gly Ala Phe Ala Gly Arg Pro Gly Pro Asp Pro Val Asp Thr
85 90 95

Ala Leu Ala Trp Ala Ala Arg Thr Tyr Pro Ile Pro Leu Ser Ala Phe
100 105 110

Ala Glu Leu His Glu Gly Leu Arg Met Asp Leu Asn Gly His Val Tyr
115 120 125

His Asp Met Glu Asp Leu Ala Leu Tyr Cys Arg Arg Val Ala Gly Val
130 135 140

Ile Gly Phe Met Ile Ala Pro Val Ser Gly Tyr Ser Gly Gly Glu Arg
145 150 155 160

Thr Leu His His Ala Leu Met Leu Gly Gln Ala Met Gln Leu Thr Asn
165 170 175

Ile Leu Arg Asp Val Gly Glu Asp Leu Thr Arg Gly Arg Val Tyr Leu
180 185 190

Pro Gln Thr Leu Leu Gly Glu Tyr Gly Val Ser Arg Ala Asp Leu Glu
195 200 205

Arg Gly Val Val Thr Pro Glu Tyr Arg Ala Leu Met Val His Leu Cys
210 215 220

Ala Leu Ala Arg Asp Trp Tyr Ala Glu Gly Arg Ala Gly Ile Pro Cys
225 230 235 240

Leu His Gly Ser Ala Arg Leu Ala Val Ala Thr Ala Ala Arg Ala Tyr
245 250 255

Glu Gly Ile Leu Asp Asp Leu Glu Arg Ala Asp Tyr Asp Asn Phe Asn
260 265 270

Arg Arg Ala Tyr Val Ser Gly Thr Arg Lys Leu Leu Met Leu Pro Arg
275 280 285

Ala Trp Trp Glu Leu Arg Gly Ala Val Ser Gly
290 295

<210> 13
<211> 556
<212> PRT
<213> Deinococcus geothermalis

<400> 13

Met Thr Asp Phe Ser Thr Leu His Arg Arg Lys Gln Ala Leu Ile Ile
1 5 10 15

Gly Ser Gly Ile Gly Gly Leu Ser Leu Gly Ile Arg Leu Gln Ser Leu
20 25 30

Gly Phe Glu Thr Thr Ile Leu Glu Lys Leu Asp Gly Pro Gly Gly Arg
35 40 45

Ala Tyr Gln Lys Arg Thr Pro Asp Gly Tyr Val Phe Asp Met Gly Pro
50 55 60

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

Arg Asp Gly Gly Trp Pro Gly Gln Pro Asp Tyr Pro Ala Glu Val Leu
85 90 95

Asn Gly Glu Arg Val Arg Val Gly Glu Ser Gly Gly Pro Arg Thr Arg
100 105 110

Glu Tyr Val Arg Leu Val Pro Ile Leu Pro Phe Tyr Arg Ile Tyr Phe
115 120 125

Asp Asp Gly Thr Phe Phe Asp Tyr Asp Gly Asp Pro Ala Ser Thr Arg
130 135 140

Arg Gln Ile Ala Glu Leu Ala Pro Gly Asp Leu Ala Gly Tyr Glu Arg
145 150 155 160

Phe His Ala Asp Ala Glu Ala Ile Phe Arg Arg Gly Phe Leu Glu Leu
165 170 175

Gly Tyr Thr His Phe Gly Asp Val Gly Thr Met Leu Arg Val Val Pro
180 185 190

Asp Leu Leu Lys Leu Asp Ala Val Arg Thr Leu Phe Ser Phe Thr Ser
195 200 205

Arg Tyr Phe Gln Ser Pro Lys Leu Arg Gln Val Phe Ser Phe Glu Thr
210 215 220

Leu Leu Ile Gly Gly Asn Pro Leu Ser Val Pro Ala Ile Tyr Ala Met
225 230 235 240

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

Thr Gly Ala Leu Val Arg Ala Leu Val Arg Lys Phe Glu Glu Leu Gly
260 265 270

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

Glu Trp Gly Lys Pro Val Arg Arg Pro Leu Gly Pro Arg Val Ala Arg
290 295 300

Gly Val Arg Leu Lys Gly Gly Glu Gln Arg Pro Ala Asp Leu Val Ile
305 310 315 320

Ser Asn Gly Asp Trp Ala Asn Thr Tyr Leu Lys Arg Val Pro Arg Gln
325 330 335

Ala Arg Leu Val Asn Asn Asp Leu Arg Val Lys Ala Ala Arg Gln Ser
340 345 350

Met Ser Leu Leu Val Ile Tyr Phe Gly Phe Arg Glu Asp Gly Arg Ser

355

360

365

Leu Asp Leu Arg His His Asn Ile Ile Leu Gly Pro Arg Tyr Glu Ala
 370 375 380

Leu Leu Gln Glu Ile Phe Gly Gln Lys Val Leu Gly Ala Asp Phe Ser
 385 390 395 400

Gln Tyr Leu His Val Pro Thr Leu Thr Asp Pro Ser Leu Ala Pro Pro
 405 410 415

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

Gly Leu Asp Trp Thr Val Glu Gly Pro Arg Leu Val Asp Arg Val Leu
 435 440 445

Ala Phe Leu Asp Glu Arg Gly Tyr Ile Pro Gly Leu Arg Glu Arg Leu
 450 455 460

Thr Tyr Leu Asp Phe Ile Thr Pro Asp Tyr Phe Glu Gly Thr Leu Asp
 465 470 475 480

Ser Tyr Leu Gly Asn Ala Phe Gly Pro Glu Pro Ile Leu Ala Gln Ser
 485 490 495

Ala Tyr Phe Arg Pro His Asn Arg Ser Glu Asp Val Gln Asn Leu Tyr
 500 505 510

Leu Val Gly Ala Gly Val Gln Pro Gly Ala Gly Thr Pro Ser Val Met
 515 520 525

Met Ser Ala Lys Met Thr Ala Arg Leu Ile Ala Glu Asp Phe Gly Leu
 530 535 540

Gln Gly Ala Val Arg Pro Val Asp Ser Val Arg Arg
 545 550 555

<210> 14
<211> 568
<212> PRT
<213> Deinococcus actinosclerus

<400> 14

Met Thr Pro Asp Arg Thr Thr Thr Pro Ala Ala Ala Arg Arg Lys Thr
1 5 10 15

Ala Leu Ile Val Gly Ala Gly Ile Gly Gly Leu Ser Leu Gly Ile Arg
20 25 30

Leu Gln Ser Leu Gly Phe Asp Thr Thr Ile Val Glu Arg Leu Asp Gln
35 40 45

Pro Gly Gly Arg Ala Tyr Gln Lys Arg Thr Ala Asp Gly Tyr Val Phe
50 55 60

Asp Met Gly Pro Thr Val Ile Thr Val Pro His Phe Ile Glu Glu Leu
65 70 75 80

Phe Ala Leu Glu Arg Asp Lys Gly Met Leu Gly Glu Ala Asp Tyr Pro
85 90 95

Ala Gln Val Leu Ala Pro Asp Ala Arg Val Arg Glu Gly Glu Ser Gly
100 105 110

Gly Glu Arg Thr Arg Asp Tyr Val Lys Leu Val Pro Ile Leu Pro Phe
115 120 125

Tyr Arg Ile Tyr Phe Asp Asp Gly Thr Phe Phe Asp Tyr Asp Gly Asp
130 135 140

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

Ala Gly Tyr Glu Arg Phe His Ala Asp Ala Gln Ala Ile Phe Glu Arg
165 170 175

Gly Phe Leu Glu Leu Gly Tyr Thr His Phe Gly Asp Met Pro Thr Met
180 185 190

Leu Arg Val Val Pro Asp Leu Met Arg Leu Asp Ala Val Arg Thr Leu
195 200 205

Phe Ser Phe Thr Ser Lys Tyr Phe Ser Asn Pro Lys Met Arg Gln Val
210 215 220

Phe Ser Phe Glu Thr Leu Leu Val Gly Gly Asn Pro Leu Ser Val Pro
225 230 235 240

Ala Ile Tyr Ala Met Ile His Phe Val Glu Lys Thr Trp Gly Ile His
245 250 255

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

Phe Glu Glu Leu Gly Gly Thr Leu Arg Leu Asn Ala Gly Val Gln Glu
275 280 285

Ile Leu Val Thr Asp Asp Arg Gly Arg Pro Val Arg Arg Pro Gly Gly
290 295 300

Lys Arg Val Ala Arg Gly Leu Arg Leu Glu Ser Gly Glu Glu Leu His
305 310 315 320

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

Arg Val Pro Ala Ala Ala Arg Leu Val Asn Ser Asp Val Arg Val Lys
340 345 350

Ala Ala Arg Gln Ser Met Ser Leu Leu Val Ile Tyr Phe Gly Phe Arg
355 360 365

Gln Glu Gly Pro Ala Leu Asn Leu Arg His His Asn Ile Ile Leu Gly
370 375 380

Pro Arg Tyr Glu Glu Leu Leu Thr Glu Ile Phe Gly Lys Lys Val Leu
385 390 395 400

Gly Arg Asp Phe Ser Gln Tyr Leu His Val Pro Thr Leu Thr Asp Pro
405 410 415

Thr Leu Ala Pro Glu Gly His His Ala Ala Tyr Thr Leu Val Pro Val
420 425 430

Pro His Asn Ala Ser Gly Leu Asp Trp Asn Val Glu Gly Pro Lys Leu
435 440 445

Val Glu Arg Val Tyr Asp Phe Leu Glu Glu Arg Gly Tyr Ile Pro Asn
450 455 460

Leu Arg Ala Arg Leu Thr His Ser Glu Phe Ile Thr Pro Asp Tyr Phe
465 470 475 480

Glu Gly Thr Leu Asp Ser Tyr Leu Gly Asn Ala Phe Gly Pro Glu Pro
485 490 495

Leu Leu Ala Gln Ser Ala Tyr Phe Arg Pro His Asn Arg Ser Glu Asp
500 505 510

Val Arg Asn Leu Tyr Met Val Gly Ala Gly Ala Gln Pro Gly Gly Gly
515 520 525

Thr Pro Ser Val Met Met Ser Ala Lys Met Thr Ala Arg Leu Ile Ala
530 535 540

Gln Asp Phe Gly Ile His Pro Ser Val Arg Asp Gly Val Pro Glu Arg
545 550 555 560

Asn Thr Ala Glu Leu Ala Ala Asp
565

<210> 15
<211> 550
<212> PRT
<213> Deinococcus deserti

<400> 15

Met Ala Arg Pro Pro Glu Leu Thr Arg Arg Lys Val Ala Val Ile Ile
1 5 10 15

Gly Ala Gly Ile Gly Gly Leu Ser Leu Gly Ile Arg Leu Gln Ser Leu
20 25 30

Gly Phe Asp Thr Thr Ile Leu Glu Arg Leu Asp Gly Pro Gly Gly Arg
35 40 45

Gly Tyr Gln Lys Arg Thr Pro Asp Gly Tyr Val Phe Asp Met Gly Pro
50 55 60

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

Arg Asp Arg Ala Ala Leu Gly Ala Glu Asp Phe Pro Pro Ala Val Arg
85 90 95

Gln Ala Pro Arg Val Thr Ser Gly Glu Ser Gly Gly Pro Arg Thr Arg
100 105 110

Asp Tyr Val Lys Leu Val Pro Ile Leu Pro Phe Tyr Arg Ile Val Phe
115 120 125

Asp Asp Gly Ser Tyr Phe Asp Tyr Asp Gly Asp Pro Glu Gly Thr Arg
130 135 140

Arg Gln Ile Ala Ala Leu Ala Pro Glu Asp Leu Glu Gly Tyr Glu Arg
145 150 155 160

Phe His Arg Asp Ala Gln Ala Ile Phe Glu Arg Gly Phe Leu Glu Leu

165

170

175

Gly Tyr Thr His Phe Gly Asp Val Pro Thr Met Leu Gly Ala Val Pro
 180 185 190

Asp Leu Leu Arg Leu Asp Ala Val Arg Thr Leu Phe Ser Phe Thr Ser
 195 200 205

Lys Tyr Phe Arg Ser Asp Lys Met Arg Gln Val Phe Ser Phe Glu Thr
 210 215 220

Leu Leu Val Gly Gly Asn Pro Leu Ser Val Pro Ala Ile Tyr Ala Met
 225 230 235 240

Ile His Phe Val Glu Lys Thr Trp Gly Ile His Tyr Ala Met Gly Gly
 245 250 255

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

Gly Thr Val Arg Tyr Asp Ala Gly Val Glu Glu Ile Leu Val Thr Asp
 275 280 285

Glu Trp Gly Gln Leu Val Arg Thr Pro Leu Gly Arg Arg Gln Ala Arg
 290 295 300

Gly Val Arg Leu Glu Ser Gly Glu Thr Val Pro Ala Asp Leu Val Val
 305 310 315 320

Ser Asn Gly Asp Trp Ala Asn Thr Tyr Leu Arg Arg Val Pro Arg Ala
 325 330 335

Ala Arg Leu Val Asn Ser Asp Leu Arg Val Arg Ala Ala Arg Gln Ser
 340 345 350

Met Ser Leu Leu Val Ile Tyr Phe Gly Phe Arg Asp Asn Gly Arg Pro
 355 360 365

Leu Gly Leu Arg His His Asn Ile Leu Leu Gly Pro Arg Tyr Glu Ala
370 375 380

Leu Leu Arg Glu Ile Phe Gly Gln Lys Val Leu Gly Ala Asp Phe Ser
385 390 395 400

Gln Tyr Leu His Val Pro Thr Leu Thr Asp Pro Ser Leu Ala Pro Glu
405 410 415

Gly His His Ala Ala Tyr Thr Leu Val Pro Val Pro His Asn Gly Ser
420 425 430

Gly Leu Asp Trp Thr Val Gln Gly Pro Leu Leu Val Asp Arg Val Leu
435 440 445

Asn Tyr Leu Glu Glu Arg Gly Val Ile Pro Asp Leu Arg Ala Arg Leu
450 455 460

Thr His Leu Glu Tyr Val Thr Pro Asp Tyr Phe Glu Thr Thr Leu Asp
465 470 475 480

Ser Tyr Leu Gly Asn Ala Phe Gly Pro Glu Pro Val Leu Thr Gln Ser
485 490 495

Ala Phe Phe Arg Pro His Asn Arg Ser Glu Asp Val Ser Asn Leu Tyr
500 505 510

Leu Val Gly Ala Gly Ala Gln Pro Gly Ala Gly Thr Pro Ser Val Met
515 520 525

Met Ser Ala Lys Met Thr Ala Arg Leu Ile Ala Gln Asp Phe Gly Val
530 535 540

Pro Ala Glu Ile Thr Gly
545 550

<211> 497
<212> PRT
<213> Deinococcus gobiensis

<400> 16

Met Phe Asp Met Gly Pro Thr Val Ile Thr Val Pro His Phe Ile Glu
1 5 10 15

Glu Leu Phe Ser Leu Glu Arg Asp His Ala Ala Leu Asn Thr Pro Asp
20 25 30

Tyr Pro Pro His Thr Leu Ser Gly Glu Arg Val Lys Ala Gly Asp Ser
35 40 45

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

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

Asp Pro Val Ser Thr Arg Glu Gln Ile Ala Arg Leu Ala Pro Glu Asp
85 90 95

Leu Glu Gly Tyr Glu Arg Phe His Arg Asp Ala Gln Ala Ile Phe Glu
100 105 110

Arg Gly Phe Leu Glu Leu Gly Tyr Thr His Phe Gly Asp Leu Pro Thr
115 120 125

Met Leu Arg Val Val Pro Asp Leu Met Lys Leu Asp Ala Val Arg Thr
130 135 140

Leu Phe Ser Phe Thr Ser Arg Tyr Phe Ser Ser Asp Lys Met Arg Gln
145 150 155 160

Val Phe Ser Phe Glu Thr Leu Leu Ile Gly Gly Asn Pro Leu Ser Val
165 170 175

Pro Ala Ile Tyr Ala Met Ile His Phe Val Glu Lys Thr Trp Gly Val
180 185 190

His Tyr Ala Met Gly Gly Thr Gly Ala Leu Val Gln Gly Phe Val Arg
195 200 205

Lys Phe Arg Glu Leu Gly Gly Thr Val Arg Tyr Gly Thr Gly Val Glu
210 215 220

Glu Ile Leu Val Glu Ser Gly Arg Gly Gly Pro Val Arg Ala Pro Val
225 230 235 240

Gly Pro Arg Val Ala Arg Gly Val Arg Leu Glu Ser Gly Glu Glu Leu
245 250 255

Arg Ala Asp Ile Val Val Ser Asn Gly Asp Trp Ala Asn Thr Tyr Leu
260 265 270

Lys Arg Val Pro Ala Ala Ala Arg Leu Val Asn Asn Asp Leu Arg Ile
275 280 285

Lys Ala Ala Pro Gln Ser Met Gly Leu Leu Val Ile Tyr Phe Gly Phe
290 295 300

Arg Asp Asp Gly Gln Pro Leu Asn Leu Arg His His Asn Ile Leu Leu
305 310 315 320

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

Leu Gly Gln Asp Phe Ser Gln Tyr Leu His Val Pro Thr Leu Thr Asp
340 345 350

Pro Ala Leu Ala Pro Ala Gly His His Ala Ala Tyr Thr Leu Val Pro
355 360 365

Val Pro His Asn Gly Ser Gly Ile Asp Trp Ser Val Glu Gly Pro Arg
370 375 380

Leu Thr Glu Arg Val Leu Asp Tyr Leu Glu Glu Arg Gly Phe Ile Pro
385 390 395 400

Asp Leu Arg Ala Arg Leu Thr His Phe Glu Tyr Val Thr Pro Asp Tyr
405 410 415

Phe Glu Gly Thr Leu Asp Ser Tyr Leu Gly Asn Ala Phe Gly Pro Glu
420 425 430

Pro Val Leu Ala Gln Ser Ala Phe Phe Arg Pro His Asn Arg Ser Glu
435 440 445

Asp Val Arg Gly Leu Tyr Leu Val Gly Ala Gly Ala Gln Pro Gly Ala
450 455 460

Gly Thr Pro Ser Val Met Met Ser Ala Lys Met Thr Ala Arg Leu Ile
465 470 475 480

Ala Glu Asp Phe Gly Ile His Pro Asp Leu Leu Gly Ala Ala Ala Asp
485 490 495

Asp

<210> 17
<211> 555
<212> PRT
<213> Deinococcus maricopensis

<400> 17

Met Arg Arg Lys Thr Ala Ile Ile Ile Gly Ala Gly Phe Gly Gly Leu
1 5 10 15

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

Glu Ala Leu Asp Gln Pro Gly Gly Arg Ala Tyr Gln Lys Arg Thr Pro

35

40

45

Asp Gly Tyr Val Phe Asp Met Gly Pro Thr Val Ile Thr Val Pro His
 50 55 60

Phe Ile Glu Glu Leu Phe Ala Leu Glu Arg Asp Gly Gly Arg Leu His
 65 70 75 80

Asp Pro Asp Phe Pro Glu His Val Arg His Ala Glu Arg Val Arg Glu
 85 90 95

Gly Asp Ser Gly Gly Pro Arg Thr Arg Asp Tyr Val Arg Leu Val Pro
 100 105 110

Ile Leu Pro Phe Tyr Arg Ile Ile Phe Asp Asp Gly Thr His Phe Asp
 115 120 125

Tyr Asp Gly Asp Pro Asp Ser Thr Arg Ala Gln Ile Arg Ala Leu Ala
 130 135 140

Pro Glu Asp Leu Glu Ala Tyr Glu Arg Phe His Ala Asp Ala Arg Ala
 145 150 155 160

Ile Phe Glu Arg Gly Phe Leu Glu Leu Gly Tyr Thr His Phe Gly Asp
 165 170 175

Leu Pro Ser Met Leu Arg Val Val Pro Asp Leu Leu Arg Leu Asp Ala
 180 185 190

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

Met Gln Gln Val Phe Ser Phe Glu Thr Leu Leu Val Gly Gly Asn Pro
 210 215 220

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

Trp Gly Ile His Tyr Ala Met Gly Gly Thr Gly Ala Leu Val Asp Ala
245 250 255

Phe Val Arg Lys Tyr Arg Glu Leu Gly Gly Thr Leu Arg Leu Ala Ala
260 265 270

Pro Val Glu Arg Ile Leu Val Thr Asp Asp Arg Gly Arg Pro Val Arg
275 280 285

Ala Pro Leu Gly Ala Arg Val Ala Arg Gly Val Arg Leu Gln Gly Gly
290 295 300

Glu Glu Leu His Ala Asp Val Val Val Ser Asn Gly Asp Trp Ala Asn
305 310 315 320

Thr Tyr Met Lys Leu Val Glu Pro Arg Ala Arg Leu Val Asn Ser Asp
325 330 335

Ala Arg Val Arg Leu Ala Arg Gln Ser Met Ser Leu Leu Val Val Tyr
340 345 350

Phe Gly Phe Arg Asp Asp Gly Arg Pro Leu Asp Leu Arg His His Asn
355 360 365

Ile Ile Leu Gly Pro Arg Tyr Glu Gly Leu Leu Thr Asp Ile Phe Arg
370 375 380

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

Leu Thr Asp Pro Ser Leu Ala Pro Ala Gly His His Ala Ala Tyr Thr
405 410 415

Leu Val Pro Val Pro His Asn Gly Ser Gly Leu Asn Trp Ala Glu Val
420 425 430

Gly Pro Ala Leu Val Asp Arg Val Leu Thr Phe Leu Asp Glu Arg Gly

435

440

445

His Ile Pro Asn Leu Arg Ala Arg Leu Thr His Val Ser His Ile Thr
 450 455 460

Pro Asp Tyr Phe Glu Gly Thr Leu Gly Ala His Leu Gly Asn Ala Phe
 465 470 475 480

Gly Pro Glu Pro Leu Leu Ala Gln Ser Ala Phe Met Arg Pro His Asn
 485 490 495

Arg Ser Glu Asp Val Arg Asn Leu Tyr Leu Val Gly Ala Gly Ala Gln
 500 505 510

Pro Gly Ala Gly Thr Pro Ser Val Met Met Ser Ala Lys Met Thr Ala
 515 520 525

Arg Leu Ile Ala Gln Asp Phe Gly Val His Ala Asp Leu Val His Gly
 530 535 540

Ser Ala Ala Val Ala Val Gly Ala Glu Pro Arg
 545 550 555

<210> 18
 <211> 573
 <212> PRT
 <213> Deinococcus peraridilitoris

<400> 18

Met Thr Pro Gln Gln Gln Thr Pro Gln Ala Gln Ser Arg Ser Ala Ser
 1 5 10 15

Arg Ser Gly Arg Ser Lys Thr Ala Val Ile Ile Gly Ala Gly Phe Gly
 20 25 30

Gly Leu Ala Leu Gly Ile Arg Leu Gln Ser Leu Gly Phe Asp Thr Thr
 35 40 45

Ile Met Glu Arg Arg Asp Ala Pro Gly Gly Arg Ala Tyr Gln Phe Gln
50 55 60

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

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

Leu Ala Pro Asp Phe Pro Pro Ala Val Val Ser Ala Pro Arg Val Met
100 105 110

Ser Gly Leu Ser Gly Gly Pro Ala Thr Arg Arg Tyr Val Asp Ile Val
115 120 125

Pro Ile Leu Pro Phe Tyr Arg Ile Tyr Phe Asp Asp Gly Ser Phe Phe
130 135 140

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

Ala Pro Glu Asp Leu Pro Gly Tyr Glu Arg Phe His Glu Asp Ala Arg
165 170 175

Ala Ile Phe Glu Arg Gly Phe Leu Glu Leu Gly Tyr Thr His Phe Gly
180 185 190

Asp Leu Gly Ser Met Leu Arg Val Val Pro Asp Leu Leu Lys Leu Asp
195 200 205

Ala Val Arg Thr Leu Phe Ser Phe Ala Arg Lys Tyr Phe Arg Asn Pro
210 215 220

Lys Met Gln Gln Val Phe Ser Phe Glu Thr Leu Leu Val Gly Gly Asn
225 230 235 240

Pro Leu Lys Val Pro Ala Ile Tyr Ala Met Ile His Phe Val Glu Lys
245 250 255

Thr Trp Gly Val His Tyr Val Met Gly Gly Thr Gly Ala Leu Val Arg
260 265 270

Ala Phe Val Arg Lys Phe Glu Glu Leu Gly Gly Thr Met Arg Tyr Asn
275 280 285

Ala Pro Val Ala Arg Ile Glu Val Thr Asp Ala Arg Gly Gly Met Gly
290 295 300

Gly Leu Phe Ser Arg Arg Phe Ala Arg Gly Val Thr Leu Gln Cys Gly
305 310 315 320

Glu His Leu Ala Ala Asp Val Val Val Ser Asn Gly Asp Trp Ala Asn
325 330 335

Thr Tyr Leu Lys Leu Ile Glu Arg Arg His Arg Arg Val Asn Ser Asp
340 345 350

Ala Arg Val Lys Leu Ala Arg Gln Ser Met Ser Leu Leu Val Val Tyr
355 360 365

Phe Gly Phe Arg Ala Asp Ser Leu Pro Leu Asp Leu Arg His His Asn
370 375 380

Ile Ile Leu Gly Pro Arg Tyr Glu Glu Leu Leu Thr Asp Ile Phe Asp
385 390 395 400

Arg Lys Val Leu Ala Glu Asp Phe Ser Gln Tyr Leu His Leu Pro Thr
405 410 415

Leu Thr Asp Pro Ser Leu Ala Pro Pro Gly Tyr His Ala Ala Tyr Thr
420 425 430

Leu Val Pro Val Pro His Asn Gly Ser Gly Leu Asp Trp Thr Glu Val
435 440 445

Gly Pro Lys Leu Thr Glu Arg Val Leu Arg Phe Leu Glu Glu Arg Gly
450 455 460

Phe Ile Pro Gly Leu Arg Glu Arg Leu Val Tyr Gln His Phe Val Thr
465 470 475 480

Pro Asp Tyr Phe Glu Gln Glu Leu Asp Ser Tyr Gln Gly Asn Ala Phe
485 490 495

Gly Val Glu Pro Val Leu Met Gln Ser Ala Tyr Phe Arg Pro His Asn
500 505 510

Arg Ser Glu Asp Ile Gly Asn Leu Tyr Leu Val Gly Ala Ser Ala Gln
515 520 525

Pro Gly Ala Gly Thr Pro Ser Val Met Met Ser Ala Lys Met Thr Ala
530 535 540

Arg Glu Ile Ala Arg Asp Phe Gly Val His Ser Ser Ile Leu Gln Ser
545 550 555 560

Ala Phe Pro Gln Glu Asp Pro Glu Val Pro Val Arg Gly
565 570

<210> 19
<211> 562
<212> PRT
<213> Deinococcus proteolyticus

<400> 19

Met Thr Ser Ser His Ile Ser Ser Arg Thr Ala Pro Leu Arg Lys Thr
1 5 10 15

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

Leu Gln Ser Leu Gly Phe Asp Thr Arg Ile Leu Glu Arg Leu Asp Ala
35 40 45

Pro Gly Gly Arg Ala Tyr Gln Lys Arg Thr Pro Asp Gly Tyr Val Phe
50 55 60

Asp Met Gly Pro Thr Val Leu Thr Val Pro His Phe Ile Glu Glu Leu
65 70 75 80

Phe Ala Leu Glu Arg Asp Gln Ala Ala Leu Asp Ala Ala Asp Tyr Pro
85 90 95

Pro Ser Thr Leu Ser Gly Glu Arg Val Arg Glu Gly Val Ser Gly Gly
100 105 110

Pro Arg Thr Ser Asp Tyr Val Gln Leu Val Pro Ile Leu Pro Phe Tyr
115 120 125

Arg Ile Tyr Phe Asp Asp Gly Thr Tyr Phe Asp Tyr Asp Gly Asp Pro
130 135 140

Glu His Thr Arg Gln Gln Ile Ala Glu Leu Ala Pro Glu Asp Leu Glu
145 150 155 160

Gly Tyr Glu Glu Phe Asn Arg Asp Ala Arg Ala Ile Phe Glu Arg Gly
165 170 175

Phe Leu Glu Leu Gly Tyr Thr His Phe Gly Asp Pro Gln Thr Met Leu
180 185 190

Ala Val Val Pro Asp Leu Leu Arg Leu Asp Ala Val Arg Thr Leu Phe
195 200 205

Gly Phe Thr Ser Lys Tyr Phe Ala Ser Asp Lys Met Arg Gln Val Phe
210 215 220

Ser Phe Glu Thr Leu Leu Val Gly Gly Asn Pro Leu Ser Val Pro Ala
225 230 235 240

Ile Tyr Ala Met Ile His Phe Val Glu Lys Thr Trp Gly Ile His Tyr

245

250

255

Ala Met Gly Gly Thr Gly Ala Leu Val Arg Ala Leu Val Arg Lys Tyr
 260 265 270

Glu Glu Leu Gly Gly Gln Ile Arg Tyr Gly Ala Gly Val Glu Glu Ile
 275 280 285

Leu Thr Met Pro Arg Pro Gly Leu Leu Gly Arg Pro Ala Ala Gln Gly
 290 295 300

Val Arg Leu Glu Gly Gly Glu Glu Leu His Ala Asp Ile Val Val Ser
 305 310 315 320

Asn Gly Asp Trp Ala Asn Thr Tyr Leu Lys Arg Leu Pro Ala Ala Ala
 325 330 335

Arg Arg Val Asn Ser Asp Leu Arg Val Arg Ala Ala Ala Gln Ser Met
 340 345 350

Gly Leu Val Val Val Tyr Phe Gly Phe Arg Asp Glu Gly Tyr Ala Pro
 355 360 365

Leu Asp Leu Arg His His Asn Ile Ile Leu Gly Pro Arg Tyr Glu Glu
 370 375 380

Leu Leu Gly Glu Ile Phe Ser Gly Gly Val Leu Gly Glu Asp Phe Ser
 385 390 395 400

Gln Tyr Leu His Ile Pro Thr Leu Thr Asp Pro Ser Leu Ala Pro Ala
 405 410 415

Gly His His Ala Ala Tyr Thr Leu Ile Pro Val Pro Asn Lys Ser Gly
 420 425 430

Arg Gly Ala Ala Leu Asn Trp Glu Asn Glu Gly Pro Glu Leu Val Lys
 435 440 445

Arg Val Met Glu Phe Leu Glu Glu Arg Gly Tyr Ile Pro His Leu Ala
450 455 460

Glu Arg Leu Thr His Leu Glu Trp Ile Thr Pro Asp Tyr Phe Asp Gln
465 470 475 480

Thr Leu Asp Ser Phe Val Gly Asn Ala Phe Gly Pro Glu Pro Lys Leu
485 490 495

Ile Gln Ser Ala Tyr Phe Arg Pro His Asn Arg Ser Glu Asp Val Ala
500 505 510

Gly Leu Tyr Met Val Gly Ala Ser Ala Gln Pro Gly Gly Gly Thr Pro
515 520 525

Ser Val Met Met Ser Ala Lys Met Thr Ala Arg Leu Ile Ala Glu Asp
530 535 540

Phe Gly Ile His Pro Glu Ile Ala Ala Gly Val Pro Ala Gly Tyr Pro
545 550 555 560

Thr Glu

<210> 20

<211> 578

<212> PRT

<213> Deinococcus puniceus

<400> 20

Met Thr His Thr Pro Pro Ser Asn Pro Thr Gln Ser Asn Ser Thr Gln
1 5 10 15

Arg Lys Thr Ala Leu Ile Ile Gly Ser Gly Ile Gly Gly Leu Ser Leu
20 25 30

Gly Ile Arg Leu Gln Ser Leu Gly Phe Asn Thr Thr Ile Leu Glu Lys
35 40 45

Leu Asp Ala Pro Gly Gly Arg Ala Tyr Gln Lys Arg Thr Glu Asp Gly
50 55 60

Tyr Val Phe Asp Met Gly Pro Thr Val Ile Thr Val Pro His Phe Ile
65 70 75 80

Glu Glu Leu Phe Ala Leu Glu Arg Asp Arg Ala Ala Leu Thr Thr Pro
85 90 95

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

Ser Gly Gly Pro Arg Thr Arg Asp Tyr Val Lys Leu Val Pro Ile Leu
115 120 125

Pro Phe Tyr Arg Ile Tyr Phe Asp Asp Gly Thr Tyr Phe Asp Tyr Asp
130 135 140

Gly Asp Pro Asp Ser Thr Arg Arg Gln Ile Leu Glu Leu Ala Pro Asp
145 150 155 160

Asp Leu Ala Gly Tyr Glu Arg Phe His Lys Asp Ala Gly Ala Ile Phe
165 170 175

Glu Arg Gly Phe Leu Glu Leu Gly Tyr Thr His Phe Gly Asp Met Pro
180 185 190

Thr Met Leu Arg Val Val Pro Asp Leu Met Lys Leu Asp Ala Val Arg
195 200 205

Thr Leu Phe Ser Phe Thr Ser Lys Tyr Phe Gln Ser Pro Lys Leu Arg
210 215 220

Gln Val Phe Ser Phe Glu Thr Leu Leu Val Gly Gly Asn Pro Leu Ser
225 230 235 240

Val Pro Ala Ile Tyr Ala Met Ile His Phe Val Glu Lys Thr Trp Gly
245 250 255

Ile His Tyr Ala Met Gly Gly Thr Gly Ala Leu Val Arg Ala Phe Val
260 265 270

Gln Lys Phe Glu Glu Leu Gly Gly Gln Ile Arg Tyr Gly Ala Glu Val
275 280 285

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

Thr Gly Ala Arg Val Ala Arg Gly Val Ala Leu Ala Gly Gly Glu Glu
305 310 315 320

Leu His Ala Asp Ile Thr Val Ser Asn Gly Asp Trp Ala Asn Leu Tyr
325 330 335

Leu Lys Leu Val Pro Pro Gln Ala Arg Leu Val Asn Ser Asp Val Arg
340 345 350

Val Arg Ala Ala Arg Gln Ser Met Ser Leu Leu Val Ile Tyr Phe Gly
355 360 365

Phe Arg Arg Asp Gly Pro Asn Asp Arg Pro Leu Asp Leu Arg His His
370 375 380

Asn Ile Ile Leu Gly Pro Arg Tyr Glu Glu Leu Leu Thr Glu Ile Phe
385 390 395 400

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

Thr Leu Thr Asp Pro Thr Leu Ala Pro Glu Gly His His Ala Ala Tyr
420 425 430

Thr Leu Val Pro Val Pro His Asn Ala Ser Gly Leu Asp Trp Ser Val
435 440 445

Glu Gly Pro Lys Leu Val Glu Arg Val Tyr Asp Phe Leu Glu Glu Arg
450 455 460

Gly Tyr Ile Pro Asn Leu Arg Glu Arg Leu Thr His Ser Glu Tyr Ile
465 470 475 480

Thr Pro Asp Tyr Phe Glu Gly Thr Leu Asp Ala Tyr Met Gly Asn Ala
485 490 495

Phe Gly Pro Glu Pro Thr Leu Ile Gln Ser Ala Tyr Phe Arg Pro His
500 505 510

Asn Arg Ser Glu Asp Val Arg Asn Leu Tyr Leu Val Gly Ala Gly Ala
515 520 525

Gln Pro Gly Ala Gly Thr Pro Ser Val Met Met Ser Ala Lys Met Thr
530 535 540

Ala Arg Leu Ile Ala Gln Asp Phe Gly Ile His Pro Asp Ile Leu Gly
545 550 555 560

Gly Pro Asp Glu Val Ala Ala Gln Ala Glu Pro Asp Ala Val Gly Ala
565 570 575

Ala Asp

<210> 21
<211> 548
<212> PRT
<213> Deinococcus radiodurans

<400> 21

Met Thr Ser Ala Leu Pro Arg Pro Ala Pro Ser Pro Tyr Ala Arg Arg
1 5 10 15

Lys Thr Ala Leu Val Ile Gly Ala Gly Phe Gly Gly Leu Ala Leu Gly

20

25

30

Ile Arg Leu Gln Ser Leu Gly Phe Asp Thr Thr Ile Leu Glu Arg Leu
 35 40 45

Asp Gly Pro Gly Gly Arg Ala Tyr Gln Lys Arg Thr Pro Asp Gly Tyr
 50 55 60

Val Phe Asp Met Gly Pro Thr Val Leu Thr Val Pro His Phe Ile Glu
 65 70 75 80

Glu Leu Phe Ala Leu Glu Arg Asp Arg Ala Gly Leu Asp Ala Pro Asp
 85 90 95

Tyr Pro Pro Glu Val Leu Ser Gly Glu Arg Val Lys Glu Gly Val Ser
 100 105 110

Gly Gly Pro His Thr Ser Arg Tyr Val Thr Leu Val Pro Ile Leu Pro
 115 120 125

Phe Tyr Arg Ile Val Phe His Asp Gly Thr Tyr Phe Asp Tyr Asp Gly
 130 135 140

Asp Pro Glu Ser Thr Arg Arg Gln Ile Ala Glu Leu Ala Pro Gly Asp
 145 150 155 160

Leu Ala Gly Tyr Glu Arg Phe His Ala Asp Ala Glu Ala Ile Phe Arg
 165 170 175

Arg Gly Phe Leu Glu Leu Gly Tyr Thr His Phe Gly Asp Val Pro Thr
 180 185 190

Met Leu Arg Val Val Pro Asp Leu Leu Lys Leu Asp Ala Val Arg Thr
 195 200 205

Leu Phe Ser Phe Thr Ser Lys Tyr Phe Gln Ser Asp Lys Leu Arg Gln
 210 215 220

Val Phe Ser Phe Glu Thr Leu Leu Val Gly Gly Asn Pro Leu Ser Val
225 230 235 240

Pro Ala Ile Tyr Ala Met Ile His Phe Val Glu Lys Thr Trp Gly Ile
245 250 255

His Tyr Ala Met Gly Gly Thr Gly Ala Leu Val Arg Gly Leu Val Gln
260 265 270

Lys Phe Glu Glu Leu Gly Gly Ala Ile Arg Tyr Gly Ala Gly Val Asp
275 280 285

Glu Val Leu Val Asp Gly Asn Leu Pro Gly Lys Arg Thr Ala Arg Gly
290 295 300

Val Arg Leu Glu Ser Gly Glu Glu Leu Arg Ala Asp Leu Val Ala Ser
305 310 315 320

Asn Gly Asp Trp Ala Asn Thr Tyr Leu Lys Arg Val Arg Pro Ser Ala
325 330 335

Arg Leu Val Asn Ser Asp Leu Arg Val Lys Ala Ala Ser Glu Ser Met
340 345 350

Ser Leu Leu Val Val Tyr Phe Gly Phe Arg Gly Gly Asp Asp Leu Pro
355 360 365

Leu Lys His His Asn Ile Leu Leu Gly Pro Arg Tyr Glu Ala Leu Leu
370 375 380

Ser Glu Ile Phe Gly Thr Lys Arg Leu Gly Glu Asp Phe Ser Gln Tyr
385 390 395 400

Leu His Val Pro Thr Leu Thr Asp Pro Ala Leu Ala Pro Ala Gly His
405 410 415

His Ala Ala Tyr Thr Leu Val Pro Val Pro His Asn Gly Ser Gly Ile

420

425

430

Asp Trp Asp Val Glu Gly Pro Lys Leu Ala Glu Ala Ala Leu Ala Asp
 435 440 445

Ile Glu Arg Arg Gly Leu Ile Pro Gly Leu Arg Glu Arg Leu Thr His
 450 455 460

Phe Glu Phe Ile Thr Pro Asp Tyr Phe Ala Gly Thr Leu Asp Ser Tyr
 465 470 475 480

Leu Gly Asn Ala Phe Gly Pro Glu Pro Arg Leu Val Gln Ser Ala Phe
 485 490 495

Phe Arg Pro His Asn Arg Ser Glu Asp Leu His Asn Phe Tyr Leu Val
 500 505 510

Gly Ala Gly Ala Gln Pro Gly Ala Gly Thr Pro Ser Val Met Met Ser
 515 520 525

Ala Lys Met Thr Ala Arg Leu Ile Ala Glu Asp Phe Gly Ile His Ala
 530 535 540

Asp Ile Arg Arg
 545

<210> 22
 <211> 567
 <212> PRT
 <213> Deinococcus soli

<400> 22

Met Thr Pro Asp Leu Thr Ala Thr Pro Ala Ala Thr Arg Lys Thr Ala
 1 5 10 15

Leu Ile Val Gly Ala Gly Ile Gly Gly Leu Ser Leu Gly Ile Arg Leu
 20 25 30

Gln Ser Leu Gly Phe Asp Thr Thr Ile Val Glu Arg Leu Asp Gln Pro
35 40 45

Gly Gly Arg Ala Tyr Gln Lys Arg Thr Ala Asp Gly Tyr Val Phe Asp
50 55 60

Met Gly Pro Thr Val Ile Thr Val Pro His Phe Ile Glu Glu Leu Phe
65 70 75 80

Ala Leu Glu Arg Asp Lys Gly Met Leu Gly Glu Ala Asp Tyr Pro Ala
85 90 95

Gln Val Leu Ala Pro Asp Ala Arg Val Arg Glu Gly Glu Ser Gly Gly
100 105 110

Glu Arg Thr Arg Asp Tyr Val Lys Leu Val Pro Ile Leu Pro Phe Tyr
115 120 125

Arg Ile Tyr Phe Asp Asp Gly Thr Phe Phe Asp Tyr Asp Gly Asp Pro
130 135 140

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

Gly Tyr Glu Arg Phe His Ala Asp Ala Gln Ala Ile Phe Glu Arg Gly
165 170 175

Phe Leu Glu Leu Gly Tyr Thr His Phe Gly Asp Met Pro Thr Met Leu
180 185 190

Arg Val Val Pro Asp Leu Met Arg Leu Asp Ala Val Arg Thr Leu Phe
195 200 205

Ser Phe Thr Ser Lys Tyr Phe Arg Asn Pro Lys Met Arg Gln Val Phe
210 215 220

Ser Phe Glu Thr Leu Leu Val Gly Gly Asn Pro Leu Ser Val Pro Ala
225 230 235 240

Ile Tyr Ala Met Ile His Phe Val Glu Lys Thr Trp Gly Ile His Tyr
245 250 255

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

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

Leu Val Thr Asp Asp Gln Gly Arg Pro Val Arg Arg Pro Gly Gly Lys
290 295 300

Arg Val Ala Arg Gly Leu Arg Leu Glu Ser Gly Glu Glu Leu His Ala
305 310 315 320

Asp Ile Val Val Ser Asn Gly Asp Trp Ala Asn Thr Tyr Leu Lys Arg
325 330 335

Val Pro Ala Ala Ala Arg Leu Val Asn Ser Asp Val Arg Val Lys Ala
340 345 350

Ala Arg Gln Ser Met Ser Leu Leu Val Ile Tyr Phe Gly Phe Arg Arg
355 360 365

Glu Gly Pro Glu Leu Asn Leu Arg His His Asn Ile Ile Leu Gly Pro
370 375 380

Arg Tyr Glu Glu Leu Leu Thr Glu Ile Phe Gly Lys Lys Val Leu Gly
385 390 395 400

Arg Asp Phe Ser Gln Tyr Leu His Val Pro Thr Leu Thr Asp Pro Thr
405 410 415

Leu Ala Pro Glu Gly His His Ala Ala Tyr Thr Leu Val Pro Val Pro
420 425 430

His Asn Ala Ser Gly Leu Asp Trp Asn Val Glu Gly Pro Lys Leu Val
435 440 445

Glu Arg Val Tyr Asp Phe Leu Glu Glu Arg Gly Tyr Ile Pro Asn Leu
450 455 460

Arg Ala Arg Leu Thr His Ser Glu Phe Ile Thr Pro Asp Tyr Phe Glu
465 470 475 480

Gly Thr Leu Asp Ser Tyr Leu Gly Asn Ala Phe Gly Pro Glu Pro Ile
485 490 495

Leu Ala Gln Ser Ala Tyr Phe Arg Pro His Asn Arg Ser Glu Asp Val
500 505 510

Arg Asn Leu Tyr Met Val Gly Ala Gly Ala Gln Pro Gly Gly Gly Thr
515 520 525

Pro Ser Val Met Met Ser Ala Lys Met Thr Ala Arg Leu Ile Ala Gln
530 535 540

Asp Phe Gly Ile His Pro Ser Val Arg Asp Gly Val Pro Glu Ser Arg
545 550 555 560

Pro Ala Glu Leu Ala Ala Asp
565

<210> 23
<211> 571
<212> PRT
<213> Deinococcus swuensis

<400> 23

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

Ile Gly Ser Gly Ile Gly Gly Leu Ser Leu Gly Ile Arg Leu Gln Ser
20 25 30

Leu Gly Phe Asp Thr Thr Ile Leu Glu Arg Leu Asp Ala Pro Gly Gly
35 40 45

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

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

Glu Arg Asp Lys Gly Met Leu Gly Glu Pro Asp Tyr Pro Pro His Thr
85 90 95

Leu Thr Glu Asp Ala Arg Val Lys Ser Gly Glu Ser Gly Gly Pro Arg
100 105 110

Thr Arg Glu Tyr Val Lys Leu Val Pro Ile Leu Pro Phe Tyr Arg Ile
115 120 125

Tyr Phe Asp Asp Gly Ser Phe Phe Asp Tyr Asp Gly Asp Pro Glu Ser
130 135 140

Thr Arg Arg Gln Ile Gly Glu Leu Ala Pro Glu Asp Leu Ala Gly Tyr
145 150 155 160

Glu His Phe His Ala Asp Ala Arg Ala Ile Phe Glu Arg Gly Phe Leu
165 170 175

Glu Leu Gly Tyr Thr His Phe Gly Asp Met Thr Ser Met Leu Arg Val
180 185 190

Val Pro Asp Leu Met Arg Leu Asp Ala Val Arg Thr Leu Phe Ser Phe
195 200 205

Thr Ser Lys Tyr Phe Gln Asn Pro Lys Met Arg Gln Val Phe Ser Phe
210 215 220

Glu Thr Leu Leu Val Gly Gly Asn Pro Leu Ser Val Pro Ala Ile Tyr

225		230		235		240
Ala Met Ile His Phe Val Glu Lys Thr Trp Gly Ile His Tyr Ala Met						
		245		250		255
Gly Gly Thr Gly Ala Leu Val Arg Ala Phe Val Arg Lys Phe Glu Glu						
		260		265		270
Leu Gly Gly Thr Leu Arg Leu Asn Ala Gly Val Asp Glu Ile Leu Val						
		275		280		285
Thr Asp Gly Arg Gly Gln Pro Val Lys Arg Pro Leu Gly Lys Arg Thr						
		290		295		300
Ala Arg Gly Val Arg Leu Glu Ser Gly Glu Glu Leu His Ala Asp Ile						
305		310		315		320
Val Val Ser Asn Gly Asp Trp Ala Asn Thr Asn Leu Lys Arg Ile Pro						
		325		330		335
Ala Ala Ala Arg Leu Val Asn Ser Asp Val Arg Val Lys Ala Ala Arg						
		340		345		350
Gln Ser Met Ser Leu Leu Val Ile Tyr Phe Gly Phe Arg Asp Asp Pro						
		355		360		365
Ala Arg Pro Leu Gln Leu Arg His His Asn Ile Ile Leu Gly Pro Arg						
		370		375		380
Tyr Glu Glu Leu Leu Thr Glu Ile Phe Gly Gln Lys Val Leu Gly Gln						
385		390		395		400
Asp Phe Ser Gln Tyr Leu His Val Pro Thr Leu Thr Asp Pro Ser Leu						
		405		410		415
Ala Pro Ala Gly His His Ala Ala Tyr Thr Leu Val Pro Val Pro His						
		420		425		430

Asn Ala Ser Gly Leu Asp Trp Ala Val Glu Gly Pro Lys Leu Val Asp
 435 440 445

Arg Val Tyr Ser Phe Leu Glu Glu Arg Gly Tyr Ile Pro Asn Leu Arg
 450 455 460

Glu Arg Leu Thr His Ser Glu Tyr Ile Thr Pro Asp Tyr Phe Ala Gln
 465 470 475 480

Thr Leu Asp Ser Tyr Leu Gly Asn Ala Phe Gly Pro Glu Pro Val Leu
 485 490 495

Ile Gln Ser Ala Tyr Phe Arg Pro His Asn Arg Ser Glu Asp Ile Gly
 500 505 510

Asn Leu Tyr Leu Val Gly Ala Gly Ala Gln Pro Gly Gly Gly Thr Pro
 515 520 525

Ser Val Met Met Ser Ala Lys Met Thr Ala Arg Leu Ile Ala Asp Asp
 530 535 540

Phe Gly Ile His Lys Asp Val Arg Asp Gly Val Pro Ala Ala Ala Glu
 545 550 555 560

Ala Leu Ala Arg Glu Val Ala Gly Ala Thr Asp
 565 570

<210> 24
 <211> 1902
 <212> DNA
 <213> Deinococcus geothermalis

<400> 24
 atgagtgagc caactgccaa cctccagcct gccagccgca ccccgctgct ggaccgggtg 60
 aatggcccgg aagacctcaa acggctcggg cgcgaccagc taccacagct cgctgccgaa 120
 ctgcgcgagg agatcgtgcg ggtctgctcg gtaggggggt tacatctcgc cagctctctg 180
 ggcgcgaccg acctaatcgt ggcgtacat tacgtgctgc attcgccgcg cgaccgcatt 240

ctgttcgacg tggggcatca ggcctacgcc cacaagatgc tcacgggccg ccgccacctg	300
atgcacaccg tcaagaagga gggcgggctg tcgggcttca ccaaggtgag cgagtccgaa	360
cacgacgcca tcacggtggg ccatgccagc acctccctcg ccaatgcgct gggcatggcg	420
cttgacggg acgctttggg acaggattac aaggtggctg ccgtgatcgg ggacggctcg	480
ctgacgggcg gcatggcgct ggcggcgctg aataccatcg gggacctggg gcggcgaatg	540
ctcattgtgc ttaacgacaa cgagatgagc atcagcgaga acgtgggggc catcaaccgc	600
ttcatgcggg gtctccaggt gcagaagtgg ttccaggagg gcgaggaagc cgggaaaaag	660
gccgtgcagg cggtcagcaa gccgctcgcc aacttgatga gccgcgcaa gagttccacg	720
cggcactttt tcgatcccg cagtgtcaat ccctttgccg cgatgggctg gcgctatgtg	780
ggaccggtgg acggccacaa cgtgcaggaa ttggtgtggc tgatcgagcg gctggtcgac	840
ctcgatgggc cgaccattct gcacgtcgtc accaaaaagg gcaagggcct gagctacgcc	900
gaggccgacc cgatcaaatg gcatggcccc ggcaagtttg acccggcgac gggtgagtcg	960
gtgcccagca atgcctactc gtggagcagc gcctttggag acgcggtgac cgagcttgca	1020
cggctggacc cccgtacctt tgtgatcacg cccgcgatgc gcgagggcag cggcctggtg	1080
cgctacagcc aggttcaccc ccaccgttac ctggatgtcg gtatcgcgga ggacgtggcc	1140
gtcaccacgg ccgccggaat ggcgcttcag gggatgcggc ccatcgtggc gatctactcc	1200
actttcctgc aacgcgccta cgatcaggtg ctgcacgacg tcgccatcga gaatctgaac	1260
gtgaccttcg ccatcgaccg tgggggcatc gtgggcgag acggagccac ccacaacggc	1320
gtcttcgacc tgagttacct gcgctcgatt ccgaatgtcg gcattggcct gccgaaggac	1380
gccgccgagc tgcgcgggat gctgaagtat gcccaggagc atgctggccc cttcgccatc	1440
cgctatccgc gcggcaacgt ggaacgcgtg ccggaaggca cctggccgga gctgaggtgg	1500
ggcacctggg aacgcttgca agacggcgac gacgtggtga ttctggcggg aggcaaggcg	1560
ctggagtacg cgctgaaggc cgcccgcgac ctccccggcg tgggcgtggt gaatgcccgt	1620
ttcgtgaagc cgctcgacca agggatgctg cgcgaggtgg cgaccaaagc ccgcgcactg	1680
gtcacggtgg aggacaacac ggtcgtcggg gggttcggaa gtgccgtcct ggaagccctc	1740

agcgcgctgg ggctgagaac cccggtgcgg gttctcggca tccccgacgc gtttcaggat	1800
cacgcgaccg tagagagcgt gcatgcccgt gcggggattg acgcgcctgc catccgcacg	1860
gtcctggccg aacttggcgt ggacgtgccg ctggagggtct ag	1902

<210> 25
 <211> 1893
 <212> DNA
 <213> *Deinococcus yunweiensis*

<400> 25	
atgacatcca gcgacctcgt ccccgttccg cagcgcctgc tcgacgcggt gaactcgccg	60
gacgacctca agacctgaa gcgcgagcag ctgccgcagg tggcgcagga actccgcgac	120
gagatcgtgc ggggtgtgctc ggtgggtggc ctgcacctgg cgtcctcgct gggcgcgacc	180
gacgtgatcg tggcgctgca ctacgtcctg aactcgccgc gtgaccggat tctgttcgat	240
gtgggtcacc aggcctacgc gcacaagatg ctcaccggcc gccgcgagca gatggtcagc	300
gtgaagaagg agggcgggct ctcgggcttc accaagggtca gcgagtcgcc gcacgacgcg	360
atcacggtgg ggcacgccag taccagcctg gcaaacgcgc tgggcatggc gatggcacgg	420
gacgccctgg ggcaggatta ccacgtggcc gccgtgatcg gtgacggcag cctgaccggc	480
ggcatggccc tggccgccct aaacaccatc ggggacacgc agcgcaagat gctgatcgtc	540
ctgaacgaca acgagatgag catctccgag aacgtggggg ccatgaacaa gttcatgcgt	600
ggcctccagg tgcagaagtg gttccaggag ggcgagggcg cgggcaagaa ggccatgcag	660
gcggtcagcc gcccgtcgc caacttcatg agccgcgcca agagcagcac ccggcatttc	720
ttcgaccccc ccagcgtgaa tccctttgcc accatgggcg tgcgttatgt ggggccagtc	780
gacggacaca acgtgcagga actcgtgtgg ctgctcgaac gcctcgtgga actcgacggg	840
ccgacgatcc tgcattgtgt gaccaagaag ggcaagggcc tgagctacgc cgaggccgat	900
ccgatctact ggcacggccc cggcaagttc gaccgggaga ccggggactt cgtgcccagc	960
aatgcgtact cgtggagcaa cgccttcgga gacgccgtca cggagctggc gaaagccgat	1020
ccccgcacct tcgtgatcac ccccgccatg cgcgagggca gcgggctggc cggctacagc	1080

aaggcccatc cgcaccgcta tctggacgtc ggcatcgccg aggaggctgc tgtgacggcc	1140
gccgccggca tggccctcca ggggctgcgg cccgtcgtgg cgatctactc caccttcctg	1200
caacgcgcct acgaccaggt gctgcacgac gtcgccattg agcacttgaa cgtcaccttc	1260
gctattgacc gggccgggat cgtcggcgcg gacggggcca cccacaacgg cgtcttcgac	1320
ctgagcttcc tgcgctcgat cccagggtgtg cggatcggcc tgcccaagga cgcgaccgag	1380
ctgcgtggca tgctgaagta cgcccaggag caccgccggc ctttcgcat ccgctatccg	1440
cgtggcacca ccgagcgcgt gccagagggc acctggccca ccctggcgtg gggcacgtgg	1500
gagcgcgtga agtccggcga cgacgtggtc atcctggcgg gtggcaaggg cctggagtat	1560
gcccagaagg ccgccgccga cctgcccggc gtgggtgtcg tgaacgccc tttcgtcaag	1620
ccgcttgacg acgccatgct gcgagagggt gccggcagtg ctgcgctat cgtcaccgtc	1680
gaggacaaca ccgtcgtcgg gggatttggc agcgcctgtc tggaggccct gaacgcctgg	1740
ggcctgaccg tgcccgtgcg cgtgctgggc atcccggacg aattccagga acacgccacc	1800
gtggacagcg tgcattgccc cgccggcatc gacgctccc ctatccgcac ggtgctggcc	1860
gagcttgggg tggacgtgcc gctgggcgtg taa	1893

<210> 26

<211> 1911

<212> DNA

<213> *Deinococcus radiopugnans*

<400> 26

ttgaccgaca tcaaaaaggc tgatgggctg cacctcgggc acaagggcac gccgctgctg	60
gaccgcattg ccggcccggc tgacctcaag aagctctcgc gcgatcagtt gcccagctg	120
agccaggaac tgcgcgacga gatcgtgcgg gtctgctcgg tgggtgggct gcatctggcg	180
tcctcgttgg gggccaccga cctgatcgtg gcgctgcatt acgtgctgaa cagtccgcgt	240
gaccggattc tcttcgacgt gggtcaccag gcctacgccc acaagatgct gaccgggcgg	300
cgggagcaga tgcacaccgt caagaaggaa ggtgggctga gcggctttac caaggtcagc	360
gagtcggaac acgacgcat taccgtgggc cacgccagca ccagcctggc gaacgcgtg	420
ggcatggcga tggcgagaga cgcgctgggc caggactatc aggtggccgc cgtgatcggc	480

gacggctcgc tgaccggcgg gatggcgctg gccgccctga acaccatcgg tgacctgcgc	540
cgcaagatgc tgatcgtcct gaacgacaac gagatgagca tttccgagaa cgtgggcgcg	600
atcaacaagt tcatgcgcgg cctgcaggtc cagaagtggc ttcaggaggg cgagggagcc	660
gggaaaaagg cggcgcagtc cctgagcaag ccgctggccg atttcatgag ccgtgccaaag	720
agcagcaccc gccacttctt cgatccggcc agcgtcaatc ctttcgcat gatgggcgtg	780
cgttatgtcg gcccggcga cggccacaac gtccaggaac tgggtgtggc gatggaacgg	840
ctggtggacc tggacggccc cacgatcctg catgtcgtga cccgcaaggg caagggcctg	900
agctacgccg agggccagcc gatctactgg cacgggtccc gtcaatttga cccggacacc	960
ggggatttca agggccagcag cgcgtactcg tggagcgccg cgcttcggcga cgccgtgacc	1020
gaactggcca aacgcgatcc gcgtactttc gtgatcacc cggccatgcg cgagggcagc	1080
gggctgggtg gctacagccg ggcgcaaccg caccgttacc tggacgtggg catcgccgag	1140
gacgtggccg tgaccactgc cgccggcatg gcgttgagg gcctgcggcc catcgtggcg	1200
atctactcca ctttcctgca acgcgcctac gatcagggtg tgacacgacg cgccatcgag	1260
aacctgaacg tcaccttcgc catcgaccgc gccgggatcg tgggggcccga cggctcgacg	1320
cacaacggcg tgctcgacct gagctacctg cgcagcattc ccaacgtgcg gatcggcctg	1380
ccgaaggacg cccacgagat gcgcggcatg ctgaagtacg cgcaggagca cgacggtccc	1440
ttcgccatcc gttacccgcg cggcaacacg gtcaagggtg cggaaggcac gtggcccacg	1500
ctggaatggg gcacgtggga gcgcgtcaag gaaggctccg acgccgtgat cctggccggc	1560
ggcaaggcgc tggaatacgc gcaggcggcg gcggcggacc tgcccggcgt cgggtgtggg	1620
aacgcccgtt tcgtcaagcc gctggacctg aacatgctgc gcgagctggc cggcagcgcc	1680
cgcacaatca tcaccgtgga ggacaacacg ctggtgggcg gcttcggcag cgccgtgttg	1740
gaggccctga acagcatggg cttaaagggtg cccgtgcgga cgctgggcat tccggacgag	1800
ttccaggacc acgccaccgc cgagagcgtc cacgcccgcg ccggcatcga tgcccaggcg	1860
atccgcaccg tgctggccga gcttgggggtg gatgtgcctc tgggcgtctg a	1911

<210> 27
<211> 1041
<212> DNA
<213> *Deinococcus geothermalis*

<400> 27
gtgaccgacc ccgacccgaa cgctgccgcg cccacaggcc tcccggcacg caagctgcgg 60
catcttgaag cctgtctgcg cccggaaagt cagtacatgg gcgtgactac cgggctggag 120
cgggtgccct ggccttaccg ggcgctccca gagctggacc tggaggcggg ggacctcacg 180
acgaccttcc tgggtcggag actgcgtgcc ccggtgttga ttggagcgat gacgggaggc 240
gcgcagcggg cggaggatcat caatcgcaac ctcgccaccg ccgcggagcg gttgggcatc 300
gggatgatgt tggggtcaca gcgagtgatg ctggagcgcc ctgaagcagc ggtcagcttt 360
cgctgctgcg acgtggcccc cgggtgtactg ctgctgggaa atctcggagc ggcacagttt 420
ctgctggggg acggcgtgtc cgaggccgag cgggcgggtgc gggcgggtgga ggcagacggc 480
ctcgccatcc atctcaaccc gctgcaagaa gccatgcagg ccggtgggga cacgcgctgg 540
cgagggtctcg cggcgcggtt ggccgaggtg gtgcccgtc tgccttttcc ggtgattctc 600
aaggagggtg ggcatggcct ggatccggcc actgtgcaga ccgtggccac ggcgggggtt 660
gcggcgctgg acgtggcggg cgcgggcggt acgagttggg cgcggggttga gcaactgggtg 720
cgctacggcg ccgttctcgc gccggacctg tgcgaagtgg gactgcccac cgcaccggcc 780
atcgtggagg cgcgccgggc agctcccgga acaccctga tcgcctccgg gggcatccgc 840
accggttttg acgcagcgcg tgccctggcc ctcggcgcg aggtgggtggc ggtggctcgg 900
cctctcctcg ctcccgcgct ggagagtgcg gcggcggtag aggcgtggct tgcgcggttc 960
attcacgagc tgcgggtggc gctgtttgtg ggcggttca ggagtgtgga ggcggtgcgg 1020
ggccggctcg agctggtttg a 1041

<210> 28
<211> 1053
<212> DNA
<213> *Deinococcus yunweiensis*

<400> 28
gtggacgact cgacgagcgg catccaggca cgcaagatgc accatctcca agcgtgtctg 60

gagccgcaca gccagtagca gacggtcacg accggcctgg acgcgggtgcc ctggccgtac	120
cgggctgctgc ccgaggtcga tctgccggcc gtacagctcc agacaagctt cctgggtcgc	180
cggctggccg ccccccgtgct gatcgggtgcc atgaccggcg gggccgagcg ggcacggatc	240
atcaaccgca atctggcgat ggctgcgcag cgcctgggca tcggcatgat gctcggctcg	300
cagcgcgtca tgctggagcg cccggaggtg accgagacct tccgcgtgcg cgatgtggcc	360
ccggacatcc tgctcgtcgg gaatctgggg gcggcgcagt tcggcctggg ctacggcgcg	420
gccgaggcgc tccgcgccgt acagcagatc gacgccgacg ccctggcgat tcatgccaat	480
cccccttcagg aagccatgca ggctgggggg gacacgcgct ggccggggcct gctggaacgc	540
ctgtcggacg tgggtaccagc gctgccgttc ccgacgatcc tgaaggaaagt cggacatggg	600
ctggatgtcc acaccgccc cgcggcggcc gacctgggct tcacggcgct ggatgtggcc	660
ggggccggtg gcacgagctg ggcgcggggtg gagcagctcg tccgctacgg cacggtgcgc	720
tcgccggccc tgtgtgagct gggcatcccc accgcgcggg ccctgcggga cgtgcggggc	780
gccctgcccc gcatgccgct ggtcgcgtcc gggggcatcc gcaccggcct ggacgccgcc	840
cgtgccctgg cgctgggggg gcaggtgggt gccattgccc ggcccctgct ggaaccggca	900
ttggacggcc cggacgcggc cgaggcgtgg ctcgcggcct tcatccacga cctgcggatc	960
gcgctgtttg tcggtggcta cgacagtgtg gacgaggtgc gcccggcgct ggactggccg	1020
ctggtgtcgg gggctgtcag ctctgggctg tga	1053

<210> 29

<211> 504

<212> DNA

<213> *Deinococcus radiopugnans*

<400> 29

atggtgcagg ctctggaatg gctcgatctg gtagacgaga atgatcaggt ggtcggccag	60
atcaccctgt acgacgcctg ggcacagcgg cgggcagtcg ggatgggtcaa cgcctttctg	120
gtcaaccggc gcggtgagct gtggattccg cgccgcaccg cctccaaacg gatgtttccc	180
aactgtctga atatgagcgt gggaggccac gtcgaacgcg gcgaaaccta tctcagcgcc	240

ttcaagcgcg agacgcacga ggaactgaat ctgaacgtgg acgcgctgga ctggcggaaa	300
atcgccgcct tttcgccgtt cgagacggga ctgagcagct tcatgcgcgt ctatgagatc	360
aggactgacg ccgcgcacga cttcaattcc gccgacttca gcgaggcgtg gtggctgacg	420
cccgccgaac tgctggactg gattgaggcg ggcgaaaccgg ccaaggggtga tctggccgag	480
ctggtgcggc ggtgctttcc atga	504

<210> 30
 <211> 636
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> R244C mutant of the DXP synthase from D. radiopugnans

<400> 30

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

Thr Pro Leu Leu Asp Arg Ile Ala Gly Pro Ala Asp Leu Lys Lys Leu
20 25 30

Ser Arg Asp Gln Leu Pro Glu Leu Ser Gln Glu Leu Arg Asp Glu Ile
35 40 45

Val Arg Val Cys Ser Val Gly Gly Leu His Leu Ala Ser Ser Leu Gly
50 55 60

Ala Thr Asp Leu Ile Val Ala Leu His Tyr Val Leu Asn Ser Pro Arg
65 70 75 80

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

Leu Thr Gly Arg Arg Glu Gln Met His Thr Val Lys Lys Glu Gly Gly
100 105 110

Leu Ser Gly Phe Thr Lys Val Ser Glu Ser Glu His Asp Ala Ile Thr

115

120

125

Val Gly His Ala Ser Thr Ser Leu Ala Asn Ala Leu Gly Met Ala Met
 130 135 140

Ala Arg Asp Ala Leu Gly Gln Asp Tyr Gln Val Ala Ala Val Ile Gly
 145 150 155 160

Asp Gly Ser Leu Thr Gly Gly Met Ala Leu Ala Ala Leu Asn Thr Ile
 165 170 175

Gly Asp Leu Arg Arg Lys Met Leu Ile Val Leu Asn Asp Asn Glu Met
 180 185 190

Ser Ile Ser Glu Asn Val Gly Ala Ile Asn Lys Phe Met Arg Gly Leu
 195 200 205

Gln Val Gln Lys Trp Phe Gln Glu Gly Glu Gly Ala Gly Lys Lys Ala
 210 215 220

Val Gln Ser Leu Ser Lys Pro Leu Ala Asp Phe Met Ser Arg Ala Lys
 225 230 235 240

Ser Ser Thr Cys His Phe Phe Asp Pro Ala Ser Val Asn Pro Phe Ala
 245 250 255

Met Met Gly Val Arg Tyr Val Gly Pro Val Asp Gly His Asn Val Gln
 260 265 270

Glu Leu Val Trp Leu Met Glu Arg Leu Val Asp Leu Asp Gly Pro Thr
 275 280 285

Ile Leu His Val Val Thr Arg Lys Gly Lys Gly Leu Ser Tyr Ala Glu
 290 295 300

Ala Asp Pro Ile Tyr Trp His Gly Pro Gly Gln Phe Asp Pro Asp Thr
 305 310 315 320

Gly Asp Phe Lys Ala Ser Ser Ala Tyr Ser Trp Ser Ala Ala Phe Gly
325 330 335

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

Thr Pro Ala Met Arg Glu Gly Ser Gly Leu Val Gly Tyr Ser Arg Ala
355 360 365

His Pro His Arg Tyr Leu Asp Val Gly Ile Ala Glu Asp Val Ala Val
370 375 380

Thr Thr Ala Ala Gly Met Ala Leu Gln Gly Leu Arg Pro Ile Val Ala
385 390 395 400

Ile Tyr Ser Thr Phe Leu Gln Arg Ala Tyr Asp Gln Val Leu His Asp
405 410 415

Val Ala Ile Glu Asn Leu Asn Val Thr Phe Ala Ile Asp Arg Ala Gly
420 425 430

Ile Val Gly Ala Asp Gly Ser Thr His Asn Gly Val Phe Asp Leu Ser
435 440 445

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

His Glu Met Arg Gly Met Leu Lys Tyr Ala Gln Glu His Asp Gly Pro
465 470 475 480

Phe Ala Ile Arg Tyr Pro Arg Gly Asn Thr Val Lys Val Pro Glu Gly
485 490 495

Thr Trp Pro Thr Leu Glu Trp Gly Thr Trp Glu Arg Val Lys Glu Gly
500 505 510

Ser Asp Ala Val Ile Leu Ala Gly Gly Lys Ala Leu Glu Tyr Ala Gln

515

520

525

Ala Ala Ala Ala Asp Leu Pro Gly Val Gly Val Val Asn Ala Arg Phe
 530 535 540

Val Lys Pro Leu Asp Leu Asn Met Leu Arg Glu Leu Ala Gly Ser Ala
 545 550 555 560

Arg Thr Ile Ile Thr Val Glu Asp Asn Thr Leu Val Gly Gly Phe Gly
 565 570 575

Ser Ala Val Leu Glu Ala Leu Asn Ser Met Gly Leu Lys Val Pro Val
 580 585 590

Arg Thr Leu Gly Ile Pro Asp Glu Phe Gln Asp His Ala Thr Ala Glu
 595 600 605

Ser Val His Ala Arg Ala Gly Ile Asp Ala Gln Ala Ile Arg Thr Val
 610 615 620

Leu Ala Glu Leu Gly Val Asp Val Pro Leu Gly Val
 625 630 635

<210> 31

<211> 630

<212> PRT

<213> Artificial Sequence

<220>

<223> R238C mutant of the DXP synthase from D. yunweiensis

<400> 31

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

Val Asn Ser Pro Asp Asp Leu Lys Thr Leu Lys Arg Glu Gln Leu Pro
 20 25 30

Gln Val Ala Gln Glu Leu Arg Asp Glu Ile Val Arg Val Cys Ser Val

35

40

45

Gly Gly Leu His Leu Ala Ser Ser Leu Gly Ala Thr Asp Val Ile Val
 50 55 60

Ala Leu His Tyr Val Leu Asn Ser Pro Arg Asp Arg Ile Leu Phe Asp
 65 70 75 80

Val Gly His Gln Ala Tyr Ala His Lys Met Leu Thr Gly Arg Arg Glu
 85 90 95

Gln Met Val Ser Val Lys Lys Glu Gly Gly Leu Ser Gly Phe Thr Lys
 100 105 110

Val Ser Glu Ser Pro His Asp Ala Ile Thr Val Gly His Ala Ser Thr
 115 120 125

Ser Leu Ala Asn Ala Leu Gly Met Ala Met Ala Arg Asp Ala Leu Gly
 130 135 140

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

Gly Met Ala Leu Ala Ala Leu Asn Thr Ile Gly Asp Thr Gln Arg Lys
 165 170 175

Met Leu Ile Val Leu Asn Asp Asn Glu Met Ser Ile Ser Glu Asn Val
 180 185 190

Gly Ala Met Asn Lys Phe Met Arg Gly Leu Gln Val Gln Lys Trp Phe
 195 200 205

Gln Glu Gly Glu Gly Ala Gly Lys Lys Ala Met Gln Ala Val Ser Arg
 210 215 220

Pro Leu Ala Asn Phe Met Ser Arg Ala Lys Ser Ser Thr Cys His Phe
 225 230 235 240

Phe Asp Pro Ala Ser Val Asn Pro Phe Ala Thr Met Gly Val Arg Tyr
245 250 255

Val Gly Pro Val Asp Gly His Asn Val Gln Glu Leu Val Trp Leu Leu
260 265 270

Glu Arg Leu Val Glu Leu Asp Gly Pro Thr Ile Leu His Val Val Thr
275 280 285

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

His Gly Pro Gly Lys Phe Asp Pro Glu Thr Gly Asp Phe Val Pro Ser
305 310 315 320

Asn Ala Tyr Ser Trp Ser Asn Ala Phe Gly Asp Ala Val Thr Glu Leu
325 330 335

Ala Lys Ala Asp Pro Arg Thr Phe Val Ile Thr Pro Ala Met Arg Glu
340 345 350

Gly Ser Gly Leu Val Gly Tyr Ser Lys Ala His Pro His Arg Tyr Leu
355 360 365

Asp Val Gly Ile Ala Glu Glu Val Ala Val Thr Ala Ala Ala Gly Met
370 375 380

Ala Leu Gln Gly Leu Arg Pro Val Val Ala Ile Tyr Ser Thr Phe Leu
385 390 395 400

Gln Arg Ala Tyr Asp Gln Val Leu His Asp Val Ala Ile Glu His Leu
405 410 415

Asn Val Thr Phe Ala Ile Asp Arg Ala Gly Ile Val Gly Ala Asp Gly
420 425 430

Ala Thr His Asn Gly Val Phe Asp Leu Ser Phe Leu Arg Ser Ile Pro

435

440

445

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

Leu Lys Tyr Ala Gln Glu His Pro Gly Pro Phe Ala Ile Arg Tyr Pro
 465 470 475 480

Arg Gly Thr Thr Glu Arg Val Pro Glu Gly Thr Trp Pro Thr Leu Ala
 485 490 495

Trp Gly Thr Trp Glu Arg Val Lys Ser Gly Asp Asp Val Val Ile Leu
 500 505 510

Ala Gly Gly Lys Gly Leu Glu Tyr Ala Gln Lys Ala Ala Ala Asp Leu
 515 520 525

Pro Gly Val Gly Val Val Asn Ala Arg Phe Val Lys Pro Leu Asp Asp
 530 535 540

Ala Met Leu Arg Glu Val Ala Gly Ser Ala Arg Ala Ile Val Thr Val
 545 550 555 560

Glu Asp Asn Thr Val Val Gly Gly Phe Gly Ser Ala Val Leu Glu Ala
 565 570 575

Leu Asn Ala Trp Gly Leu Thr Val Pro Val Arg Val Leu Gly Ile Pro
 580 585 590

Asp Glu Phe Gln Glu His Ala Thr Val Asp Ser Val His Ala Arg Ala
 595 600 605

Gly Ile Asp Ala Pro Ala Ile Arg Thr Val Leu Ala Glu Leu Gly Val
 610 615 620

Asp Val Pro Leu Gly Val
 625 630

<210> 32
<211> 633
<212> PRT
<213> Artificial Sequence

<220>
<223> R241C mutant of the DXP synthase from *D. geothermalis*

<400> 32

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

Leu Asp Arg Val Asn Gly Pro Glu Asp Leu Lys Arg Leu Gly Arg Asp
20 25 30

Gln Leu Pro Gln Leu Ala Ala Glu Leu Arg Glu Glu Ile Val Arg Val
35 40 45

Cys Ser Val Gly Gly Leu His Leu Ala Ser Ser Leu Gly Ala Thr Asp
50 55 60

Leu Ile Val Ala Leu His Tyr Val Leu His Ser Pro Arg Asp Arg Ile
65 70 75 80

Leu Phe Asp Val Gly His Gln Ala Tyr Ala His Lys Met Leu Thr Gly
85 90 95

Arg Arg His Leu Met His Thr Val Lys Lys Glu Gly Gly Leu Ser Gly
100 105 110

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

Ala Ser Thr Ser Leu Ala Asn Ala Leu Gly Met Ala Leu Ala Arg Asp
130 135 140

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

Leu Thr Gly Gly Met Ala Leu Ala Ala Leu Asn Thr Ile Gly Asp Leu
165 170 175

Gly Arg Arg Met Leu Ile Val Leu Asn Asp Asn Glu Met Ser Ile Ser
180 185 190

Glu Asn Val Gly Ala Ile Asn Arg Phe Met Arg Gly Leu Gln Val Gln
195 200 205

Lys Trp Phe Gln Glu Gly Glu Glu Ala Gly Lys Lys Ala Val Gln Ala
210 215 220

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

Cys His Phe Phe Asp Pro Ala Ser Val Asn Pro Phe Ala Ala Met Gly
245 250 255

Val Arg Tyr Val Gly Pro Val Asp Gly His Asn Val Gln Glu Leu Val
260 265 270

Trp Leu Ile Glu Arg Leu Val Asp Leu Asp Gly Pro Thr Ile Leu His
275 280 285

Val Val Thr Lys Lys Gly Lys Gly Leu Ser Tyr Ala Glu Ala Asp Pro
290 295 300

Ile Lys Trp His Gly Pro Gly Lys Phe Asp Pro Ala Thr Gly Glu Ser
305 310 315 320

Val Pro Ser Asn Ala Tyr Ser Trp Ser Ser Ala Phe Gly Asp Ala Val
325 330 335

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

Met Arg Glu Gly Ser Gly Leu Val Arg Tyr Ser Gln Val His Pro His

355

360

365

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

Ala Gly Met Ala Leu Gln Gly Met Arg Pro Ile Val Ala Ile Tyr Ser
 385 390 395 400

Thr Phe Leu Gln Arg Ala Tyr Asp Gln Val Leu His Asp Val Ala Ile
 405 410 415

Glu Asn Leu Asn Val Thr Phe Ala Ile Asp Arg Gly Gly Ile Val Gly
 420 425 430

Ala Asp Gly Ala Thr His Asn Gly Val Phe Asp Leu Ser Tyr Leu Arg
 435 440 445

Ser Ile Pro Asn Val Gly Ile Gly Leu Pro Lys Asp Ala Ala Glu Leu
 450 455 460

Arg Gly Met Leu Lys Tyr Ala Gln Glu His Ala Gly Pro Phe Ala Ile
 465 470 475 480

Arg Tyr Pro Arg Gly Asn Val Glu Arg Val Pro Glu Gly Thr Trp Pro
 485 490 495

Glu Leu Arg Trp Gly Thr Trp Glu Arg Leu Gln Asp Gly Asp Asp Val
 500 505 510

Val Ile Leu Ala Gly Gly Lys Ala Leu Glu Tyr Ala Leu Lys Ala Ala
 515 520 525

Arg Asp Leu Pro Gly Val Gly Val Val Asn Ala Arg Phe Val Lys Pro
 530 535 540

Leu Asp Gln Gly Met Leu Arg Glu Val Ala Thr Lys Ala Arg Ala Leu
 545 550 555 560

Val Thr Val Glu Asp Asn Thr Val Val Gly Gly Phe Gly Ser Ala Val
565 570 575

Leu Glu Ala Leu Ser Ala Leu Gly Leu Arg Thr Pro Val Arg Val Leu
580 585 590

Gly Ile Pro Asp Ala Phe Gln Asp His Ala Thr Val Glu Ser Val His
595 600 605

Ala Arg Ala Gly Ile Asp Ala Pro Ala Ile Arg Thr Val Leu Ala Glu
610 615 620

Leu Gly Val Asp Val Pro Leu Glu Val
625 630

<210> 33
<211> 329
<212> PRT
<213> Deinococcus geothermalis

<400> 33

Met His Pro Asp Leu Leu Pro Arg Val Leu Ser Leu Leu Pro Asn Arg
1 5 10 15

Gly Asp Arg Pro Glu Leu Arg Ala Phe Ser Ala Met Leu Arg Asp Tyr
20 25 30

Pro Glu Arg Gly Gly Lys Gly Ile Arg Ser Glu Leu Leu Leu Ala Ser
35 40 45

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

Leu Trp Leu Ala Ala Gly Leu Glu Leu Phe Gln Asn Trp Val Leu Ile
65 70 75 80

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

Leu His Arg Leu Tyr Gly Val Pro Val Ala Ile Asn Val Gly Asp Ala
100 105 110

Leu His Ala Ser Met Trp Ala Ala Val His Arg Ala Gly Val Pro Gly
115 120 125

Gly Leu Glu Glu Phe Leu Asn Met Val Trp Arg Thr Ala Glu Gly Gln
130 135 140

His Leu Asp Leu Thr Trp Val Gln Glu Arg Ser Trp Asn Leu Gly Glu
145 150 155 160

Ala Asp Tyr Leu Ala Met Val Arg Leu Lys Thr Ala Leu Tyr Thr Val
165 170 175

Val Val Pro Leu Arg Leu Gly Ala Leu Ala Ala Gly Val Leu Pro Asp
180 185 190

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

Arg Asp Asp Val Leu Asn Leu Ala Gly Asp Pro Ala Lys Tyr Gly Lys
210 215 220

Glu Ile Gly Gly Asp Leu Trp Glu Gly Lys Arg Thr Leu Ile Val Leu
225 230 235 240

His Trp Leu Ala His Ala Pro Glu Glu Gln Arg Gln Val Phe Leu Glu
245 250 255

Gln Met Arg Arg Asp Arg Ala Asp Lys Asp Ala Ala Ala Ile Ala Ala
260 265 270

Ile His Arg Trp Leu Leu Glu Ser Gly Ser Val Gln Tyr Ala Gln Ala
275 280 285

Tyr Ala Asp Thr Gln Ala Arg Glu Gly Leu Ala Arg Leu Thr Glu Ala
290 295 300

Leu Glu Asn Ala Pro Asp Pro Gln Ala Ala Arg Ala Leu Leu Ala Gln
305 310 315 320

Leu Arg Gly Leu Ala Thr Arg Glu Ala
325

<210> 34
<211> 329
<212> PRT
<213> Deinococcus radiodurans

<400> 34

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

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

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

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

Leu Trp Leu Ala Ala Ala Leu Glu Leu Phe Gln Asn Trp Val Leu Val
65 70 75 80

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

Leu His His Leu Cys Gly Met Pro Val Ala Leu Asn Val Gly Asp Ala
100 105 110

Leu His Ala Tyr Met Trp Ala Ala Val Gly Lys Ala Asn Val Pro Gly
115 120 125

Ala Phe Glu Glu Phe Leu Gln Met Val Tyr Arg Thr Ala Glu Gly Gln
130 135 140

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

Ala Asp Tyr Leu Gln Met Val Gly Leu Lys Thr Ala His Tyr Thr Val
165 170 175

Ile Val Pro Leu Arg Leu Gly Ala Leu Ala Ala Gly Met Ala Pro Gln
180 185 190

Asp Ala Phe Thr Pro Ala Gly Leu Ala Leu Gly Thr Ala Phe Gln Ile
195 200 205

Arg Asp Asp Val Leu Asn Leu Ala Gly Asp Pro Val Lys Tyr Gly Lys
210 215 220

Glu Ile Gly Gly Asp Leu Leu Glu Gly Lys Arg Thr Leu Ile Val Leu
225 230 235 240

Asp Trp Leu Thr Thr Ala Pro Asp Asp Arg Lys Ala Ile Phe Leu Asp
245 250 255

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

Ile His Arg Trp Leu Leu Glu Ser Gly Ser Val Glu Ala Ala Gln Asp
275 280 285

Tyr Ala Gln Ala Gln Ala Ala Glu Gly Leu Asp Leu Leu Glu Lys Ala
290 295 300

Leu Ala Asp Ala Pro Asp Ala Gln Ala Ala Ala Ala Leu Leu Ala Ser
305 310 315 320

Val Arg Glu Leu Ala Thr Arg Glu Lys

<210> 35
 <211> 329
 <212> PRT
 <213> Deinococcus deserti

<400> 35

Met Arg Pro Asp Leu Leu Ser Arg Val Leu Ser Leu Leu Pro Asp Gly
 1 5 10 15

Gly Thr Arg Pro Glu Leu Arg Gln Phe Ser Glu Met Leu Arg Asp Tyr
 20 25 30

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

Ala Gln Ala His Gly Val Ala His Asp Thr Asp Ala Trp Asp Gln Ala
 50 55 60

Gln Trp Leu Ala Ala Gly Leu Glu Leu Phe Gln Asn Trp Val Leu Ile
 65 70 75 80

His Asp Asp Ile Gln Asp Asp Ser Glu Glu Arg Arg Gly Gln Pro Ala
 85 90 95

Leu His Arg Leu Tyr Gly Val Pro Leu Ala Ile Asn Val Gly Asp Ala
 100 105 110

Leu His Ala Tyr Met Trp Ala Ala Val His Arg Ala Gly Val Pro Gly
 115 120 125

Ala Met Glu Glu Phe Leu Thr Met Ile His Arg Thr Ala Glu Gly Gln
 130 135 140

His Leu Asp Leu Ser Trp Val Glu His Arg Glu Trp Lys Leu Arg Glu
 145 150 155 160

Ala Asp Tyr Leu Glu Met Val Gln Leu Lys Thr Ala His Tyr Thr Val
165 170 175

Ile Val Pro Leu Arg Leu Gly Ala Leu Ala Ala Gly Val Gln Pro Ala
180 185 190

Ser Ala Phe Thr Asn Ala Gly Leu Ala Leu Gly Ser Ala Phe Gln Ile
195 200 205

Arg Asp Asp Val Leu Asn Leu Leu Gly Asp Pro Leu Lys Tyr Gly Lys
210 215 220

Glu Ile Gly Gly Asp Leu Leu Glu Gly Lys Arg Thr Leu Ile Val Leu
225 230 235 240

Arg Trp Leu Ala Gln Ala Pro Ala Glu Gln Arg Glu Val Phe Leu Asp
245 250 255

Gln Met Arg Arg Asp Arg Ala Ala Lys Asp Pro Ala Val Ile Ala Gln
260 265 270

Ile His Arg Trp Leu Leu Asp Ser Gly Cys Val Thr Ala Ala Gln Asp
275 280 285

Tyr Ala Ala Ala Arg Ala Glu Glu Gly Leu Ser Leu Leu Ser Ser Ala
290 295 300

Leu Ser Gly Ala Pro Gly Gln Ala Ala Val Gln Gln Ile Leu Gly Ala
305 310 315 320

Met Arg Ala Leu Ala Thr Arg Asp Ala
325