

# SEQUENCE LISTING

<110> Novozymes A/S  
 <120> Method for producing a dairy product  
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 <170> PatentIn version 3.5  
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Ala Asp Val Thr Ser Thr Ile Thr Ala Ala Ser Pro Lys Leu Trp Ser  
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Ile Lys Asn Pro Asn Leu Tyr Thr Val Arg Thr Glu Val Leu Asn Gly  
305 310 315 320

Gly Lys Val Leu Asp Thr Tyr Asp Thr Glu Tyr Gly Phe Arg Trp Thr  
325 330 335

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

Leu Lys Gly Val Ser Met His His Asp Gln Gly Ser Leu Gly Ala Val  
355 360 365

Ala Asn Arg Arg Ala Ile Glu Arg Gln Val Glu Ile Leu Gln Lys Met  
370 375 380

Gly Val Asn Ser Ile Arg Thr Thr His Asn Pro Ala Ala Lys Ala Leu  
385 390 395 400



Ile Asp Val Cys Asn Glu Lys Gly Val Leu Val Val Glu Glu Val Phe  
405 410 415

Asp Met Trp Asn Arg Ser Lys Asn Gly Asn Thr Glu Asp Tyr Gly Lys  
420 425 430

Trp Phe Gly Gln Ala Ile Ala Gly Asp Asn Ala Val Leu Gly Gly Asp  
435 440 445

Lys Asp Glu Thr Trp Ala Lys Phe Asp Leu Thr Ser Thr Ile Asn Arg  
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Asp Arg Asn Ala Pro Ser Val Ile Met Trp Ser Leu Gly Asn Glu Met  
465 470 475 480

Met Glu Gly Ile Ser Gly Ser Val Ser Gly Phe Pro Ala Thr Ser Ala  
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Lys Leu Val Ala Trp Thr Lys Ala Ala Asp Ser Thr Arg Pro Met Thr  
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Tyr Gly Asp Asn Lys Ile Lys Ala Asn Trp Asn Glu Ser Asn Thr Met  
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Gly Asp Asn Leu Thr Ala Asn Gly Gly Val Val Gly Thr Asn Tyr Ser  
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Asp Gly Ala Asn Tyr Asp Lys Ile Arg Thr Thr His Pro Ser Trp Ala  
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Ile Tyr Gly Ser Glu Thr Ala Ser Ala Ile Asn Ser Arg Gly Ile Tyr  
565 570 575

Asn Arg Thr Thr Gly Gly Ala Gln Ser Ser Asp Lys Gln Leu Thr Ser  
580 585 590

Tyr Asp Asn Ser Ala Val Gly Trp Gly Ala Val Ala Ser Ser Ala Trp  
595 600 605

Tyr Asp Val Val Gln Arg Asp Phe Val Ala Gly Thr Tyr Val Trp Thr  
610 615 620

Gly Phe Asp Tyr Leu Gly Glu Pro Thr Pro Trp Asn Gly Thr Gly Ser  
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Gly Ala Val Gly Ser Trp Pro Ser Pro Lys Asn Ser Tyr Phe Gly Ile  
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Val Asp Thr Ala Gly Phe Pro Lys Asp Thr Tyr Tyr Phe Tyr Gln Ser  
660 665 670

Gln Trp Asn Asp Asp Val His Thr Leu His Ile Leu Pro Ala Trp Asn  
675 680 685

Glu Asn Val Val Ala Lys Gly Ser Gly Asn Asn Val Pro Val Val Val  
690 695 700

Tyr Thr Asp Ala Ala Lys Val Lys Leu Tyr Phe Thr Pro Lys Gly Ser  
705 710 715 720

Thr Glu Lys Arg Leu Ile Gly Glu Lys Ser Phe Thr Lys Lys Thr Thr  
725 730 735

Ala Ala Gly Tyr Thr Tyr Gln Val Tyr Glu Gly Ser Asp Lys Asp Ser  
740 745 750

Thr Ala His Lys Asn Met Tyr Leu Thr Trp Asn Val Pro Trp Ala Glu  
755 760 765

Gly Thr Ile Ser Ala Glu Ala Tyr Asp Glu Asn Asn Arg Leu Ile Pro  
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Glu Gly Ser Thr Glu Gly Asn Ala Ser Val Thr Thr Thr Gly Lys Ala  
785 790 795 800

Ala Lys Leu Lys Ala Asp Ala Asp Arg Lys Thr Ile Thr Ala Asp Gly  
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Lys Asp Leu Ser Tyr Ile Glu Val Asp Val Thr Asp Ala Asn Gly His  
820 825 830

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

Gly Lys Leu Val Gly Val Asp Asn Gly Ser Ser Pro Asp His Asp Ser  
850 855 860

Tyr Gln Ala Asp Asn Arg Lys Ala Phe Ser Gly Lys Val Leu Ala Ile  
865 870 875 880

Val Gln Ser Thr Lys Glu Ala Gly Glu Ile Thr Val Thr Ala Lys Ala

885

890

895

Asp Gly Leu Gln Ser Ser Thr Val Lys Ile Ala Thr Thr Ala Val Pro  
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Gly Thr Ser Thr Glu Lys Thr Val Arg Ser Phe Tyr Tyr Ser Arg Asn  
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Tyr Tyr Val Lys Thr Gly Asn Lys Pro Ile Leu Pro Ser Asp Val Glu  
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Val Arg Tyr Ser Asp Gly Thr Ser Asp Arg Gln Asn Val Thr Trp Asp  
 945 950 955 960

Ala Val Ser Asp Asp Gln Ile Ala Lys Ala Gly Ser Phe Ser Val Ala  
 965 970 975

Gly Thr Val Ala Gly Gln Lys Ile Ser Val Arg Val Thr Met Ile Asp  
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Glu Ile Gly Ala Leu Leu Asn Tyr Ser Ala Ser Thr Pro Val Gly Thr  
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Pro Ala Val Leu Pro Gly Ser Arg Pro Ala Val Leu Pro Asp Gly  
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Thr Val Thr Ser Ala Asn Phe Ala Val His Trp Thr Lys Pro Ala  
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Asp Thr Val Tyr Asn Thr Ala Gly Thr Val Lys Val Pro Gly Thr  
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Ala Thr Val Phe Gly Lys Glu Phe Lys Val Thr Ala Thr Ile Arg  
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Val Gln Arg Ser Gln Val Thr Ile Gly Ser Ser Val Ser Gly Asn  
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Ala Leu Arg Leu Thr Gln Asn Ile Pro Ala Asp Lys Gln Ser Asp  
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Thr Leu Asp Ala Ile Lys Asp Gly Ser Thr Thr Val Asp Ala Asn  
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Thr Gly Gly Gly Ala Asn Pro Ser Ala Trp Thr Asn Trp Ala Tyr  
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Ser	Lys	Ala	Gly	His	Asn	Thr	Ala	Glu	Ile	Thr	Phe	Glu	Tyr	Ala
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Ile	Ser	Ala	Asp	Gly	Lys	Asn	Trp	Thr	Asp	Leu	Ala	Ala	Thr	Glu
1175						1180					1185			
Thr	Ile	Ala	Ala	Gln	Glu	Ser	Ser	Asp	Arg	Val	Lys	Pro	Tyr	Thr
1190						1195					1200			
Tyr	Asp	Phe	Ala	Pro	Val	Gly	Ala	Thr	Phe	Val	Lys	Val	Thr	Val
1205						1210					1215			
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1220						1225					1230			
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1265						1270					1275			
Ile	Ile	Ala	Asp	Val	Lys	Ala	Glu	Gly	Glu	Gly	Asn	Ala	Ser	Val
1280						1285					1290			
Thr	Val	Leu	Pro	Ala	His	Asp	Asn	Val	Ile	Arg	Val	Ile	Thr	Glu
1295						1300					1305			
Ser	Glu	Asp	His	Val	Thr	Arg	Lys	Thr	Phe	Thr	Ile	Asn	Leu	Gly
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Thr	Ala	Thr	Glu	Gly	Pro	Lys	Lys	Phe	Ala	Val	Asp	Gly	Asn	Thr
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Ser	Thr	Tyr	Trp	His	Ser	Asn	Trp	Thr	Pro	Thr	Thr	Val	Asn	Asp
1370						1375					1380			
Leu	Trp	Ile	Ala	Phe	Glu	Leu	Gln	Lys	Pro	Thr	Lys	Leu	Asp	Ala
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Ala	Ser	Glu	Ile	Arg	Leu	Arg	Lys	Ala	Val	Asp	Thr	Thr	Asp	Ile
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1490						1495					1500			
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1520						1525					1530			
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1535						1540					1545			
Val	Arg	Gly	Ile	Asp	Lys	Tyr	Ser	Gly	Thr	Val	Ala	Lys	Thr	Phe
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Thr	Ile	Glu	Leu	Lys	Asn	Ala	Pro	Ala	Pro	Glu	Pro	Thr	Leu	Thr
1565						1570					1575			

Ser Val Ser Val Lys Thr Lys Pro Ser Lys Leu Thr Tyr Val Val  
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Gly Asp Ala Phe Asp Pro Ala Gly Leu Val Leu Gln His Asp Arg  
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Gln Ala Asp Arg Pro Pro Gln Pro Leu Val Gly Glu Gln Ala Asp  
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Glu Arg Gly Leu Thr Cys Gly Thr Arg Cys Asp Arg Val Glu Gln  
1625 1630 1635

Leu Arg Lys His Glu Asn Arg Glu Ala His Arg Thr Gly Leu Asp  
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His Leu Glu Phe Val Gly Ala Ala Asp Gly Ala Val Gly Glu Gln  
1655 1660 1665

Ala Thr Phe Lys Val His Val His Ala Asp Gln Gly Asp Gly Arg  
1670 1675 1680

His Asp Asp Ala Asp Glu Arg Asp Ile Asp Pro His Val Pro Val  
1685 1690 1695

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

Val Glu Asp Ala Thr Arg Ser Asp Ser Thr Thr Gln Met Ser Ser Thr  
35 40 45

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

Ser Asp Phe Asp Ala Asn Trp Lys Phe Met Leu Ser Asp Ser Val Gln  
65 70 75 80

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

Pro His Asp Tyr Ser Ile Thr Gln Lys Tyr Ser Gln Ser Asn Glu Ala  
100 105 110

Glu Ser Ala Tyr Leu Pro Gly Gly Thr Gly Trp Tyr Arg Lys Ser Phe  
115 120 125

Thr Ile Asp Arg Asp Leu Ala Gly Lys Arg Ile Ala Ile Asn Phe Asp  
130 135 140

Gly Val Tyr Met Asn Ala Thr Val Trp Phe Asn Gly Val Lys Leu Gly  
145 150 155 160

Thr His Pro Tyr Gly Tyr Ser Pro Phe Ser Phe Asp Leu Thr Gly Asn  
165 170 175

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

Leu Pro Ser Ser Arg Trp Tyr Ser Gly Ser Gly Ile Tyr Arg Asp Val  
195 200 205

Thr Leu Thr Val Thr Asp Gly Val His Val Gly Asn Asn Gly Val Ala  
210 215 220

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

Asn Leu Thr Thr Lys Val Ala Asn Asp Thr Lys Ala Ala Ala Asn Ile  
245 250 255

Thr Leu Lys Gln Thr Val Phe Pro Lys Gly Gly Lys Thr Asp Ala Ala  
260 265 270

Ile Gly Thr Val Thr Thr Ala Ser Lys Ser Ile Ala Ala Gly Ala Ser  
275 280 285

Ala Asp Val Thr Ser Thr Ile Thr Ala Ala Ser Pro Lys Leu Trp Ser  
290 295 300

Ile Lys Asn Pro Asn Leu Tyr Thr Val Arg Thr Glu Val Leu Asn Gly  
305 310 315 320

Gly Lys Val Leu Asp Thr Tyr Asp Thr Glu Tyr Gly Phe Arg Trp Thr  
325 330 335

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

Leu Lys Gly Val Ser Met His His Asp Gln Gly Ser Leu Gly Ala Val  
355 360 365

Ala Asn Arg Arg Ala Ile Glu Arg Gln Val Glu Ile Leu Gln Lys Met  
370 375 380

Gly Val Asn Ser Ile Arg Thr Thr His Asn Pro Ala Ala Lys Ala Leu  
385 390 395 400

Ile Asp Val Cys Asn Glu Lys Gly Val Leu Val Val Glu Glu Val Phe  
405 410 415

Asp Met Trp Asn Arg Ser Lys Asn Gly Asn Thr Glu Asp Tyr Gly Lys  
420 425 430

Trp Phe Gly Gln Ala Ile Ala Gly Asp Asn Ala Val Leu Gly Gly Asp  
435 440 445

Lys Asp Glu Thr Trp Ala Lys Phe Asp Leu Thr Ser Thr Ile Asn Arg  
450 455 460

Asp Arg Asn Ala Pro Ser Val Ile Met Trp Ser Leu Gly Asn Glu Met  
465 470 475 480

Met Glu Gly Ile Ser Gly Ser Val Ser Gly Phe Pro Ala Thr Ser Ala  
485 490 495

Lys Leu Val Ala Trp Thr Lys Ala Ala Asp Ser Thr Arg Pro Met Thr  
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Tyr Gly Asp Asn Lys Ile Lys Ala Asn Trp Asn Glu Ser Asn Thr Met  
515 520 525

Gly Asp Asn Leu Thr Ala Asn Gly Gly Val Val Gly Thr Asn Tyr Ser  
530 535 540

Asp Gly Ala Asn Tyr Asp Lys Ile Arg Thr Thr His Pro Ser Trp Ala  
545 550 555 560

Ile Tyr Gly Ser Glu Thr Ala Ser Ala Ile Asn Ser Arg Gly Ile Tyr  
565 570 575

Asn Arg Thr Thr Gly Gly Ala Gln Ser Ser Asp Lys Gln Leu Thr Ser  
580 585 590

Tyr Asp Asn Ser Ala Val Gly Trp Gly Ala Val Ala Ser Ser Ala Trp  
595 600 605

Tyr Asp Val Val Gln Arg Asp Phe Val Ala Gly Thr Tyr Val Trp Thr  
610 615 620

Gly Phe Asp Tyr Leu Gly Glu Pro Thr Pro Trp Asn Gly Thr Gly Ser  
625 630 635 640

Gly Ala Val Gly Ser Trp Pro Ser Pro Lys Asn Ser Tyr Phe Gly Ile  
645 650 655

Val Asp Thr Ala Gly Phe Pro Lys Asp Thr Tyr Tyr Phe Tyr Gln Ser  
660 665 670

Gln Trp Asn Asp Asp Val His Thr Leu His Ile Leu Pro Ala Trp Asn  
675 680 685

Glu Asn Val Val Ala Lys Gly Ser Gly Asn Asn Val Pro Val Val Val  
690 695 700

Tyr Thr Asp Ala Ala Lys Val Lys Leu Tyr Phe Thr Pro Lys Gly Ser  
705 710 715 720

Thr Glu Lys Arg Leu Ile Gly Glu Lys Ser Phe Thr Lys Lys Thr Thr  
725 730 735

Ala Ala Gly Tyr Thr Tyr Gln Val Tyr Glu Gly Ala Asp Lys Asp Ser  
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Thr Ala His Lys Asn Met Tyr Leu Thr Trp Asn Val Pro Trp Ala Glu

755

760

765

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

Lys Asp Leu Ser Tyr Ile Glu Val Asp Val Thr Asp Ala Asn Gly His  
 820 825 830

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

Gly Lys Leu Val Gly Val Asp Asn Gly Ser Ser Pro Asp His Asp Ser  
 850 855 860

Tyr Gln Ala Asp Asn Arg Lys Ala Phe Ser Gly Lys Val Leu Ala Ile  
 865 870 875 880

Val Gln Ser Thr Lys Glu Ala Gly Glu Ile Thr Val Thr Ala Lys Ala  
 885 890 895

Asp Gly Leu Gln Ser Ser Thr Val Lys Ile Ala Thr Thr Ala Val Pro  
 900 905 910

Gly Thr Ser Thr Glu Lys Thr Val Arg Ser Phe Tyr Tyr Ser Arg Asn  
 915 920 925

Tyr Tyr Val Lys Thr Gly Asn Lys Pro Ile Leu Pro Ser Asp Val Glu  
 930 935 940

Val Arg Tyr Ser Asp Gly Thr Ser Asp Arg Gln Asn Val Thr Trp Asp  
 945 950 955 960

Ala Val Ser Asp Asp Gln Ile Ala Lys Ala Gly Ser Phe Ser Val Ala  
 965 970 975

Gly Thr Val Ala Gly Gln Lys Ile Ser Val Arg Val Thr Met Ile Asp  
 980 985 990

Glu Ile Gly Ala Leu Leu Asn Tyr Ser Ala Ser Thr Pro Val Gly Thr  
 995 1000 1005

Pro	Ala	Val	Leu	Pro	Gly	Ser	Arg	Pro	Ala	Val	Leu	Pro	Asp	Gly
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1025						1030					1035			
Asp	Thr	Val	Tyr	Asn	Thr	Ala	Gly	Thr	Val	Lys	Val	Pro	Gly	Thr
1040						1045					1050			
Ala	Thr	Val	Phe	Gly	Lys	Glu	Phe	Lys	Val	Thr	Ala	Thr	Ile	Arg
1055						1060					1065			
Val	Gln	Arg	Ser	Gln	Val	Thr	Ile	Gly	Ser	Ser	Val	Ser	Gly	Asn
1070						1075					1080			
Ala	Leu	Arg	Leu	Thr	Gln	Asn	Ile	Pro	Ala	Asp	Lys	Gln	Ser	Asp
1085						1090					1095			
Thr	Leu	Asp	Ala	Ile	Lys	Asp	Gly	Ser	Thr	Thr	Val	Asp	Ala	Asn
1100						1105					1110			
Thr	Gly	Gly	Gly	Ala	Asn	Pro	Ser	Ala	Trp	Thr	Asn	Trp	Ala	Tyr
1115						1120					1125			
Ser	Lys	Ala	Gly	His	Asn	Thr	Ala	Glu	Ile	Thr	Phe	Glu	Tyr	Ala
1130						1135					1140			
Thr	Glu	Gln	Gln	Leu	Gly	Gln	Ile	Val	Met	Tyr	Phe	Phe	Arg	Asp
1145						1150					1155			
Ser	Asn	Ala	Val	Arg	Phe	Pro	Asp	Ala	Gly	Lys	Thr	Lys	Ile	Gln
1160						1165					1170			
Ile	Ser	Ala	Asp	Gly	Lys	Asn	Trp	Thr	Asp	Leu	Ala	Ala	Thr	Glu
1175						1180					1185			
Thr	Ile	Ala	Ala	Gln	Glu	Ser	Ser	Asp	Arg	Val	Lys	Pro	Tyr	Thr
1190						1195					1200			
Tyr	Asp	Phe	Ala	Pro	Val	Gly	Ala	Thr	Phe	Val	Lys	Val	Thr	Val
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Leu	Thr	Glu	Ile	Glu	Leu	Lys	Thr	Ala	Thr	Ser	Lys	Phe	Val	Thr
1235						1240					1245			
Asn	Thr	Ser	Ala	Ala	Leu	Ser	Ser	Leu	Thr	Val	Asn	Gly	Thr	Lys
1250						1255					1260			
Val	Ser	Asp	Ser	Val	Leu	Ala	Ala	Gly	Ser	Tyr	Asn	Thr	Pro	Ala
1265						1270					1275			
Ile	Ile	Ala	Asp	Val	Lys	Ala	Glu	Gly	Glu	Gly	Asn	Ala	Ser	Val
1280						1285					1290			
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1295						1300					1305			
Ser	Glu	Asp	His	Val	Thr	Arg	Lys	Thr	Phe	Thr	Ile	Asn	Leu	Gly
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1595						1600					1605			
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1640						1645					1650			
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Trp	Lys	Ala	Phe	Glu	Thr	Ala	Leu	Ala	His	Ala	Lys	Ala	Val	Ile	
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Gly	Asn	Ala	Asn	Ser	Thr	Gln	Phe	Asp	Ile	Asp	Asn	Ala	Leu	Ser	
1865						1870					1875				
Met	Leu	Asn	Asp	Ala	Arg	Ala	Ala	Leu	Lys	Glu	Lys	Pro	Gly	Arg	
1880						1885					1890				
Ile	Ile	Ala	Ile	Ile	Asp	Gly	Gly	Ala	Leu	Ser	Lys	Thr	Gly	Ala	
1895						1900					1905				
Ser	Val	Ala	Ile	Ile	Ala	Ser	Val	Ala	Ala	Ala	Met	Lys	Ala	Val	
1910						1915					1920				

Gly Ala Gly Val Met Ala Leu Arg Pro Pro Lys Trp  
1925 1930 1935

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<213> Ruminococcus torques

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

Ala Leu Ala Gly Ser Met Val Leu Pro Ala Thr Ala Tyr Ala Gln Gly  
20 25 30

Glu Ile Val Gln Leu Glu Gly Gly Thr Ser Thr Gln Thr Asn Thr Ala  
35 40 45

Pro Glu Gln Val Phe Leu Asn Lys Tyr Ser Gly Thr Val Arg Thr Gln  
50 55 60

Asn Phe Asn Asp Asn Trp Lys Phe Tyr Leu Gly Asp Ala Ser Gly Ala  
65 70 75 80

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

His Asp Tyr Ser Ile Asp Gln Lys Tyr Ser Gln Lys Met Glu Ala Glu  
100 105 110

Ser Gly Tyr Leu Pro Gly Gly Thr Gly Trp Tyr Arg Lys Asn Phe Thr  
115 120 125

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

Val Tyr Met Asn Ala Thr Ile Tyr Val Asn Gly Lys Lys Leu Gly Thr  
145 150 155 160

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

Lys Phe Gly Lys Glu Asn Val Ile Ala Val Lys Val Asp His Gln Thr  
180 185 190

Pro Ser Ser Arg Phe Tyr Ser Gly Ser Gly Ile Tyr Arg Asp Val Asp  
195 200 205

Phe Val Val Thr Asp Thr Val His Val Asp Lys Asn Gly Thr Lys Ile  
210 215 220

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

Lys Val Lys Thr Thr Val Val Asn Glu Ser Glu Asn Asn Ala Ser Val  
245 250 255

Lys Val Lys His Thr Ile Tyr Pro Lys Asn Gly Thr Ala Glu Gln Ala  
260 265 270

Val Gly Thr Phe Glu Thr Glu Val Ala Thr Val Asp Lys Gly Lys Ser  
275 280 285

Lys Asp Val Gln Ala Asp Phe Thr Val Ser Gly Val Lys Leu Trp Ser  
290 295 300

Thr Thr Thr Pro Asn Leu Tyr Thr Val Lys Thr Glu Val Leu Met Asp  
305 310 315 320

Gly Thr Thr Val Asp Thr Tyr Glu Thr Asp Tyr Gly Phe Arg Tyr Phe  
325 330 335

Asp Phe Asn Asn Asn Thr Gly Phe Ser Leu Asn Gly Gln Lys Met Lys  
340 345 350

Leu Gln Gly Val Cys Met His His Asp Gln Gly Ala Leu Gly Ser Val  
355 360 365

Ala Asn Asp Arg Ser Thr Glu Arg Gln Val Glu Ile Leu Lys Met Met  
370 375 380

Gly Cys Asn Ser Ile Arg Val Thr His Asn Pro Ala Ser Asp Glu Leu  
385 390 395 400

Ile Asp Ala Cys Asn Lys His Gly Ile Leu Val Ile Asp Glu Ala Phe  
405 410 415

Asp Gly Trp Val Ala Pro Lys Asn Ser Asn Ser Asn Asp Tyr Ser Lys  
420 425 430

Trp Phe Asn Lys Lys Ile Glu Asp Gly Asn Glu Ile Met Gly Ala Ala



435																	
Glu	Asn	Met	Thr	Trp	Ala	Gln	Phe	Asp	Leu	Thr	Ala	Met	Ile	Glu	Arg		
450						455					460						
Gly	Gln	Asn	Asp	Pro	Ala	Ile	Ile	Met	Trp	Ser	Leu	Gly	Asn	Glu	Met		
465					470					475				480			
Trp	Glu	Gly	Thr	Gly	Gly	Tyr	Ser	Asp	Asp	Tyr	Lys	Thr	Ala	Gln	Asp		
				485					490					495			
Asn	Leu	Val	Lys	Trp	Ala	Lys	Ala	Ala	Asp	Thr	Thr	Arg	Pro	Val	Thr		
			500					505					510				
Thr	Gly	Asp	Asn	Lys	Leu	Lys	Ser	Asn	Glu	Thr	Gly	Ala	Ile	Thr	Leu		
		515					520					525					
Gly	Gln	Glu	Leu	Gln	Lys	Ala	Gly	Gly	Ile	His	Gly	Met	Asn	Tyr	Ser		
530						535					540						
Gln	Glu	Trp	Lys	Asn	His	Ala	Gly	Lys	Thr	His	Tyr	Asp	Met	Ile	His		
545					550					555					560		
Glu	Ala	Tyr	Pro	Glu	Trp	Cys	Met	Tyr	Gly	Ser	Glu	Thr	Ala	Ser	Ala		
				565					570					575			
Val	Asn	Ser	Arg	Gly	Ile	Tyr	Lys	Gly	Met	Gly	Ser	Gln	Thr	Asp	Tyr		
			580					585					590				
Gly	Asp	Tyr	Asp	Leu	Thr	Ser	Tyr	Asp	Thr	Ser	Ala	Val	Gly	Trp	Gly		
		595					600					605					
Ala	Thr	Ala	Ser	Ser	Ala	Trp	Tyr	Glu	Val	Ile	Lys	Arg	Asp	Phe	Ile		
610						615					620						
Ala	Gly	Glu	Tyr	Val	Trp	Thr	Gly	Phe	Asp	Tyr	Ile	Gly	Glu	Pro	Thr		
625					630					635					640		
Pro	Trp	Asn	Gly	Thr	Gly	Gln	Gly	Lys	Pro	Gly	Asn	Ala	Ser	Arg	Trp		
				645					650					655			
Pro	Ala	Pro	Lys	Ser	Ser	Tyr	Phe	Gly	Ile	Val	Asp	Thr	Ala	Gly	Leu		
			660					665					670				
Pro	Lys	Asp	Ser	Tyr	Tyr	Phe	Tyr	Gln	Ser	Gln	Trp	Asn	Asp	Ser	Val		
		675					680					685					

Asn Thr Leu His Ile Leu Pro Ala Trp Asn Glu Glu Val Val Tyr Lys  
690 695 700

Lys Ser Gly Asn Asp Val Pro Val Val Val Tyr Ser Asp Ala Lys Lys  
705 710 715 720

Val Glu Leu Phe Phe Thr Pro Ala Ser Gly Gly Glu Gln Arg Ser Leu  
725 730 735

Gly Ala Lys Glu Phe Thr Glu Lys Lys Thr Thr Ala Gly Tyr Thr Tyr  
740 745 750

Gln Met Tyr Glu Gly Thr Gly Lys Ser Asn Thr Glu His Glu Asn Leu  
755 760 765

Tyr Met Thr Trp Met Val Pro Tyr Glu Ala Gly Thr Ile Thr Ala Lys  
770 775 780

Ala Trp Asp Lys Asp Gly Lys Glu Ile Thr Glu Asn Leu Gln Gly Arg  
785 790 795 800

Thr Ser Val Thr Thr Ala Gly Glu Ala Lys Lys Leu Lys Val Asp Val  
805 810 815

Asp Arg Thr Lys Ile Thr Ala Asn Gly Glu Asp Leu Ser Tyr Leu Thr  
820 825 830

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

Lys Val Thr Phe Glu Val Ser Gly Asp Gly Val Leu Ala Gly Val Asp  
850 855 860

Asn Gly Arg Pro Val Asp His Gln Ser Tyr Arg Asp Asp Asn Arg Lys  
865 870 875 880

Ala Phe Ser Gly Gln Leu Val Gly Ile Val Gln Ser Thr Lys Ser Ala  
885 890 895

Gly Thr Ile Thr Val Lys Val Lys Ala Glu Gly Met Glu Asp Gln Thr  
900 905 910

Val Thr Ile Thr Thr Thr Pro Ser Ser Asp Ser Ser Glu Ser Lys Lys  
915 920 925

Ala Ile Ser Ser Val Lys Met Ser Lys Ser Tyr Tyr Val Lys Val Gly  
930 935 940

Asn Gln Pro Gln Leu Pro Gly Gln Val Glu Val Val Leu Thr Asp Lys  
945 950 955 960

Thr Lys Thr Thr Gly Thr Val Thr Trp Glu Lys Ala Thr Ala Glu Gln  
965 970 975

Ile Gly Gln Ala Gly Thr Phe Ser Leu Thr Gly Thr Val Ser Val Glu  
980 985 990

Gly Val Glu Lys Ala Glu Thr Val Ser Val Asn Val Asn Met Ile Asp  
995 1000 1005

Thr Val Ala Ala Leu Leu Asn Tyr Ser Thr Thr Thr Ser Val Gly  
1010 1015 1020

Val Ala Pro Ser Leu Pro Thr Ser Arg Pro Ala Val Met Glu Asp  
1025 1030 1035

Gly Thr Val Leu Thr Ala Ala Phe Pro Val Lys Trp Glu Ala Pro  
1040 1045 1050

Glu Lys Gly Tyr Asp Ala Glu Gly Ile Val Asn Val Thr Gly Thr  
1055 1060 1065

Ala Asp Val Phe Gly Glu Ser Met Pro Val Thr Ala Thr Val Arg  
1070 1075 1080

Val Gln Glu Ala Glu Tyr Thr Val Gly Asn Asn Val Ala Lys Glu  
1085 1090 1095

Ala Met Thr Leu Ser Gln Asp Ile Pro Gln Glu Met Gln Ser Asp  
1100 1105 1110

Asp Leu Glu Ala Ile Arg Asp Gly Asn Arg Thr Val Asp Gly Asn  
1115 1120 1125

Gln Gly Gly Asn Thr Asn Ser Thr Met Trp Ser Asn Tyr Lys Asn  
1130 1135 1140

Ser Lys Asp Ala Lys Asp Asn Asp Ala Asp Ile Thr Phe Gln Tyr  
1145 1150 1155

Ala	Thr	Gln	Gln	Ile	Phe	Asn	Gln	Ile	Lys	Ile	Phe	Phe	Arg	Ser
1160						1165					1170			
Asp	Ser	His	Ala	Ala	Ser	Tyr	Pro	Ala	Asp	Asn	Thr	Thr	Lys	Ile
1175						1180					1185			
Tyr	Val	Ser	Glu	Thr	Gly	Glu	Glu	Gly	Thr	Trp	Thr	Glu	Val	Thr
1190						1195					1200			
Ala	Thr	Glu	Ser	His	Pro	Glu	Glu	Leu	Pro	Ala	Ile	Gly	Val	Val
1205						1210					1215			
Glu	Tyr	Thr	Tyr	Asp	Phe	Val	Pro	Thr	Lys	Ala	Val	Phe	Val	Lys
1220						1225					1230			
Ile	His	Val	Val	Asn	Asn	Pro	Asp	Ala	Ser	Gly	Lys	Gly	Gly	Gly
1235						1240					1245			
Phe	Thr	Cys	Thr	Gly	Ile	Val	Glu	Ala	Glu	Leu	Tyr	Leu	Ala	Asn
1250						1255					1260			
Gln	Ala	Asp	Phe	Thr	Thr	Asn	Thr	Thr	Ala	Lys	Leu	Glu	Ser	Leu
1265						1270					1275			
Lys	Ile	Asn	Glu	Thr	Ser	Ala	Pro	Ala	Glu	Val	Leu	Ala	Ala	Gly
1280						1285					1290			
Ala	Gly	Ser	Trp	Gly	Thr	Lys	Glu	Val	Glu	Ala	Lys	Thr	Val	Glu
1295						1300					1305			
Ala	Val	Gly	Ala	Asp	Asn	Ala	Ala	Val	Thr	Val	Leu	Pro	Thr	Tyr
1310						1315					1320			
Glu	Asn	Ala	Val	Arg	Ile	Ile	Ile	Glu	Ser	Glu	Asp	His	Lys	Thr
1325						1330					1335			
Thr	Asn	Thr	Phe	Val	Val	Asn	Leu	Asp	Ala	Asp	Ala	Thr	Asp	Asp
1340						1345					1350			
Ser	Lys	Asp	Tyr	Asp	Lys	Ala	Lys	Ile	Thr	Ser	Thr	Val	Gly	Ser
1355						1360					1365			
Ala	Gln	Ser	Gly	Asn	Glu	Lys	Glu	Lys	Ala	Phe	Asp	Gly	Asp	Thr
1370						1375					1380			
Asn	Thr	Leu	Trp	His	Thr	Gln	Trp	Asn	Asn	Thr	Asn	Pro	Ala	Glu

1385		1390		1395
Arg Trp Ile Glu Met Glu Leu Glu Asp Val Gln Asn Val Ile Gly				
1400		1405		1410
Leu Arg Tyr Leu Pro Arg Gln Asn Gly Gly Gln Asn Gly Ile Val				
1415		1420		1425
Lys Thr Tyr Lys Ile Glu Val Lys Ala Ala Glu Gly Asp Glu Trp				
1430		1435		1440
Lys Glu Val Ala Val Thr Glu Gly Thr Lys Val Trp Ala Val Asp				
1445		1450		1455
Asn Thr Trp Lys Met Ala Lys Phe Glu Thr Pro Val Gln Ala Lys				
1460		1465		1470
Tyr Ile Arg Phe Ser Gly Val Glu Thr His Asp Asp Gln Gly Gly				
1475		1480		1485
Asn Lys Trp Met Ser Ala Ala Glu Ile Arg Val Lys Val Thr Lys				
1490		1495		1500
Glu Glu Val Val Pro Pro Thr Ala Thr Glu Leu Ser Leu Lys Ala				
1505		1510		1515
Gln Pro Thr Lys Thr Ala Tyr Ala Val Gly Glu Lys Phe Asp Pro				
1520		1525		1530
Ala Gly Leu Val Ile Gly Val Lys Tyr Ser Asp Gly Thr Glu Lys				
1535		1540		1545
Glu Val Ala Tyr Gly Gln Asp Asn Ala Gly Glu Phe Thr Phe Asn				
1550		1555		1560
Pro Thr Leu Ser Thr Ala Leu Thr Lys Asp Tyr Thr Lys Val Glu				
1565		1570		1575
Val Gly Tyr Ala Gly Leu Lys Leu Asp Val Asn Ile Thr Val Ser				
1580		1585		1590
Glu Ser Glu Pro Val Ile Pro Glu Ala Leu Glu Val Val Ser Ala				
1595		1600		1605
Pro Ala Lys Thr Glu Tyr Glu Glu Gly Glu Met Phe Asn Pro Ala				
1610		1615		1620

Gly	Leu	Ser	Val	Lys	Ile	Lys	Tyr	Ser	Asp	Gly	Ser	Tyr	Gly	Asp
1625						1630					1635			
Glu	Val	Ala	Tyr	Gly	Thr	Ala	Asn	Ala	Asp	Gln	Phe	Thr	Phe	Asn
1640						1645					1650			
Pro	Thr	Leu	Asp	Thr	Ala	Leu	Lys	Thr	Ser	Asp	Glu	Lys	Val	Thr
1655						1660					1665			
Val	Thr	Tyr	Ala	Glu	Lys	Thr	Ala	Asp	Ile	Lys	Ile	Lys	Val	Asn
1670						1675					1680			
Lys	Lys	Thr	Pro	Val	Val	Pro	Glu	Asn	Pro	Thr	Val	Glu	Lys	Val
1685						1690					1695			
Glu	Ile	Lys	Ala	Asn	Pro	Ala	Lys	Thr	Glu	Tyr	Lys	Glu	Gly	Asp
1700						1705					1710			
Lys	Phe	Asp	Pro	Thr	Gly	Leu	Val	Leu	Thr	Val	Lys	Tyr	Asp	Lys
1715						1720					1725			
Gly	Glu	Asp	Lys	Glu	Val	Ala	Tyr	Gly	Asp	Ala	Thr	Lys	Ala	Asp
1730						1735					1740			
Phe	Thr	Phe	Ile	Pro	Ser	Leu	Asp	Thr	Ala	Leu	Lys	Thr	Ser	Asp
1745						1750					1755			
Glu	Lys	Val	Thr	Val	Thr	Tyr	Ala	Gly	Lys	Thr	Ala	Glu	Ile	Gly
1760						1765					1770			
Ile	Glu	Val	Lys	Ala	Asp	Thr	Pro	Val	Glu	Pro	Glu	Lys	Pro	Thr
1775						1780					1785			
Val	Asp	Lys	Ile	Ala	Val	Lys	Lys	Val	Pro	Ala	Lys	Thr	Thr	Tyr
1790						1795					1800			
Lys	Ala	Gly	Glu	Thr	Phe	Asp	Pro	Ser	Gly	Leu	Val	Leu	Thr	Val
1805						1810					1815			
Thr	Met	Ser	Asp	Lys	Thr	Thr	Lys	Glu	Val	Ala	Tyr	Gly	Asn	Glu
1820						1825					1830			
Thr	Ala	Lys	Asp	Phe	Val	Phe	Asn	Pro	Thr	Leu	Asp	Thr	Ala	Leu
1835						1840					1845			

Thr Glu Gly Met Asn Lys Val Asp Val Thr Tyr Ala Gly Lys Thr  
1850 1855 1860

Val Asp Ile Gly Ile Glu Val Lys Ala Asp Thr Pro Val Glu Pro  
1865 1870 1875

Glu Lys Pro Thr Val Glu Lys Val Glu Ile Lys Ala Asn Pro Ala  
1880 1885 1890

Lys Thr Glu Tyr Lys Ala Gly Glu Thr Phe Asp Pro Thr Gly Met  
1895 1900 1905

Ser Leu Thr Val Thr Met Ser Asp Gly Thr Thr Lys Val Val Ala  
1910 1915 1920

Tyr Gly Pro Glu Thr Ala Lys Asp Phe Ser Phe Asn Pro Ser Leu  
1925 1930 1935

Asn Thr Lys Leu Thr Ala Asp Thr Lys Lys Val Thr Val Thr Tyr  
1940 1945 1950

Gly Gly Gln Ser Ala Asp Val Ala Val Ser Val Lys Ala Asp Pro  
1955 1960 1965

Ser Glu Asp Lys Lys Pro Asn Thr Glu Lys Pro Asp Lys Gly Gly  
1970 1975 1980

Ala Val Gln Thr Gly Asp Asn Phe Asn Val Thr Leu Leu Ile Gly  
1985 1990 1995

Leu Val Val Leu Ala Gly Ala Val Ala Gly Gly Ala Ala Leu Thr  
2000 2005 2010

Ile Phe Lys Arg Asn Lys Arg Lys  
2015 2020

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Phe Ala Leu Thr Leu Ala Pro Thr Leu Val Met Ala Glu Thr Arg Gln

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



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

Ser Val Asp Asn Pro Asn Met Tyr Lys Val Lys Ser Glu Val Leu Leu  
290 295 300

Asp Gly Lys Val Ile Asp Thr Tyr Phe Thr Asp Phe Gly Phe Arg Tyr  
305 310 315 320

Tyr Asn Phe Asp Lys Asp Thr Gly Phe Ser Leu Asn Gly Glu Asn Met  
325 330 335

Lys Leu Lys Gly Val Cys Met His His Asp Gln Gly Ala Leu Gly Ala  
340 345 350

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

Met Gly Val Asn Ala Ile Arg Val Ser His Asn Pro Ala Ser Glu Met  
370 375 380

Leu Leu Glu Ile Cys Asn Arg Leu Gly Leu Leu Val Ile Asn Glu Ala  
385 390 395 400

Phe Asp Thr Trp Thr Asn Pro Lys Asn Gly Asn Val Asn Asp Phe Ser  
405 410 415

Lys Tyr Phe Asn Glu Val Ile Gly Glu Asp Asn Glu Ile Leu Asn Gly  
420 425 430

Ser Pro Glu Met Thr Trp Gly Glu Phe Glu Ala Arg Ser Met Val Lys  
435 440 445

Asn Ser Lys Asn Asn Pro Ser Ile Ile Met Trp Ser Ile Gly Asn Glu  
450 455 460

Val Leu Glu Gly Ile Ser Gly Ser Ala Ser Asn Tyr Thr Asn Val Ala  
465 470 475 480

Gln Asn Ile Ile Asp Trp Ile Lys Asp Glu Asp Glu Thr Arg His Val  
485 490 495

Thr Ile Gly Asp Asn Arg Thr Lys Asn Gly Asp Arg Thr Ala Glu Ala  
500 505 510

Ile Ser Glu Val Val Asp Asp Asn Gly Gly Leu Val Gly Phe Asn Tyr  
515 520 525

Ala Asn Glu Thr Gln Val Ala Gln Gln Arg Ala Asn His Pro Asp Trp  
530 535 540

Thr Leu Tyr Ala Ser Glu Thr Ser Ser Ala Ile His Thr Arg Gly Tyr  
545 550 555 560

Tyr Lys Thr Lys Gly Ile Asp Tyr Gly Asn His Arg Ile Ser Glu Tyr  
565 570 575

Asp Asn Asn Gln Thr Lys Val Gly Trp Gly His Ser Ala Ser Asp Ala  
580 585 590

Trp Lys Phe Val Ile Lys Asn Asp Tyr Asn Ala Gly Glu Leu Val Trp  
595 600 605

Thr Gly Phe Asp Tyr Ile Gly Glu Pro Thr Pro Trp Asn Gly Thr Gly  
610 615 620

Thr Gly Thr Val Gly Gly Gly Asn Gly Ala Ala Pro Lys Ser Ser Tyr  
625 630 635 640

Phe Gly Ile Val Asp Thr Ala Gly Phe Glu Lys Asp Ile Tyr Tyr Leu  
645 650 655

Tyr Gln Ser Gln Trp Asn Asp Asp Val Asn Thr Leu His Val Leu Pro  
660 665 670

Thr Trp Asn Arg Glu Asp Ile Val Ile Glu Asn Gly Asn Val Glu Val  
675 680 685

Asn Val Phe Thr Asp Ala His Lys Val Glu Leu Tyr Leu Asn Asp Lys  
690 695 700

Lys Val Gly Glu Gln Thr Ser Thr Glu His Thr Thr Asp Ala Gly Tyr  
705 710 715 720

Lys Tyr Tyr Thr Phe Gly Asn Asp Ser Leu Tyr Pro Val Phe Asn Val  
725 730 735

Pro Tyr Glu Glu Gly Thr Leu Thr Ala Lys Ala Tyr Asp Lys Glu Gly  
740 745 750

Asn Glu Ile Thr Asn Thr Glu Gly Arg Asn Thr Val Lys Thr Thr Gly  
 755 760 765

Glu Ala Ser Thr Val Arg Leu Ser Ala Asp Arg Asp Thr Ile Asp Ser  
 770 775 780

Asp Gly Tyr Asp Leu Ser Tyr Ile Thr Val Asp Ile Val Asp Glu Asp  
 785 790 795 800

Gly Asn Ile Val Gln Asn Ala Asp Asn Arg Leu Asn Phe Gln Leu Glu  
 805 810 815

Gly Asp Gly Lys Ile Val Gly Val Asp Asn Gly Asp Gln Thr Asp Thr  
 820 825 830

Asp Ser Tyr Lys Pro Thr Ser Asp Thr Glu Ala Ser Arg Lys Ala Leu  
 835 840 845

Ser Gly Lys Ala Leu Val Ile Val Gln Ser Thr Lys Asp Ala Gly Asn  
 850 855 860

Ile Arg Leu Asn Val Ser Gly Glu Gly Leu Gln Ser Gln Ser Ile Glu  
 865 870 875 880

Ile Asn Thr Val Asn Asn Ala Gly Glu Asp Lys Phe Leu Glu Ser Tyr  
 885 890 895

Glu Ile Val Lys Asp Tyr Tyr Val Asn Leu Asn Glu Lys Pro Glu Leu  
 900 905 910

Pro Ser Thr Val Glu Gly Arg Tyr Ser Asp Gly Thr Thr Glu Thr Phe  
 915 920 925

Asn Ile Ser Trp Asn Asp Tyr Asp Glu Ser Gln Leu Asn Thr Pro Gln  
 930 935 940

Val Phe Lys Ile Asn Gly Lys Leu Glu Gly Thr Asp Val Ala Val Asn  
 945 950 955 960

Val Asn Val His Val Ile Gly Asp Val Val Ser Met Glu Asn Tyr Ser  
 965 970 975

Thr Phe Thr Tyr Ala Gly Gln Thr Pro Thr Leu Pro Lys Thr Val Lys  
 980 985 990

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

995					1000					1005				
Asn	Leu	Glu	Gly	Val	Asp	Phe	Ser	Glu	Pro	Asn	Thr	Thr	Val	Glu
1010						1015					1020			
Val	Leu	Gly	Glu	Val	Ser	Leu	Leu	Gly	Lys	Thr	Tyr	Thr	Val	Thr
1025						1030					1035			
Ser	Thr	Val	Arg	Val	Val	Glu	Ala	Leu	Lys	Ala	Ala	Ala	Asn	Leu
1040						1045					1050			
Ala	Ile	Asn	Asn	Ser	Ser	Asn	Lys	Asp	Val	Pro	Ala	Leu	Ser	Gln
1055						1060					1065			
Ser	Cys	Val	Ser	Thr	Ala	Asp	Asn	Leu	Asn	Ser	Ile	Asn	Asn	Gly
1070						1075					1080			
Ile	Thr	Asn	Asn	Ser	Ser	Asn	Thr	Gly	Glu	Arg	Trp	Thr	Asn	Trp
1085						1090					1095			
Asn	Glu	Arg	Asn	Leu	Thr	Glu	Asn	Gly	Glu	Pro	Lys	Gly	Ala	Tyr
1100						1105					1110			
Val	Gln	Leu	Asp	Trp	Lys	Asn	Lys	Tyr	Asn	Ile	Asp	Arg	Leu	Asp
1115						1120					1125			
Leu	Trp	Leu	Phe	Thr	Asp	Asn	Ile	Tyr	Gly	Arg	Ile	Pro	Lys	Lys
1130						1135					1140			
Val	Glu	Ile	Ser	Tyr	Lys	Asn	Glu	Ala	Gly	Glu	Tyr	Glu	Val	Val
1145						1150					1155			
Thr	His	Ser	Asn	Thr	Thr	Glu	Val	Ser	Tyr	Leu	Ala	Gly	Glu	Thr
1160						1165					1170			
Thr	Tyr	Phe	Leu	Asp	Lys	Val	Ile	Asn	Thr	Asp	Ser	Ile	Arg	Val
1175						1180					1185			
Tyr	Met	Gln	Gln	Pro	Glu	Val	Gly	Lys	Cys	Ile	Gly	Leu	Ser	Glu
1190						1195					1200			
Val	Ala	Val	Tyr	Glu	Tyr	Val	Pro	Gln	Val	Ser	Ala	Asn	Glu	Gly
1205						1210					1215			
Asn	Lys	Leu	Ser	Glu	Ile	Lys	Leu	Asp	Gly	Glu	Ala	Leu	Glu	Gly
1220						1225					1230			

Phe Asn Pro Asp Thr Asn Glu Tyr Thr Val Asn Leu Lys Glu Leu  
1235 1240 1245

Pro Lys Thr Val Glu Ala Ser Gly Glu Glu Asn Val Ala Ile Thr  
1250 1255 1260

Ile Leu Pro Val His Asn Asn Lys Ser Ile Ile Ile Ala Arg Ser  
1265 1270 1275

Glu Ser Gly Ala Lys Asn Ile Tyr Thr Val Asn Tyr Val Leu Glu  
1280 1285 1290

Glu Ser Glu Gly Ser Ala Asp Ile Asn Glu Asp Gly Ser Ile Asn  
1295 1300 1305

Val Gly Asp Leu Ser Ile Val Ser Lys Tyr Gln Gly Glu Val Ile  
1310 1315 1320

Ser Gly Asn Ala Leu Ser Glu Lys Ser Asp Ile Asn Lys Asp Gly  
1325 1330 1335

Val Val Asp Lys Ala Asp Ile Gln Ile Val Met Gly Lys Ile Leu  
1340 1345 1350

Gly Glu  
1355

<210> 7

<211> 1355

<212> PRT

<213> Clostridium perfringens

<400> 7

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

Phe Ala Leu Thr Leu Ala Pro Thr Leu Val Met Ala Glu Thr Arg Gln  
20 25 30

Ile Pro Glu Ser Glu Thr Val Asn Val Gly Phe Ile Lys Asp Gly Glu  
35 40 45

Arg Ser Thr Ile Phe Asn Gln Asn Trp Lys Phe Phe Lys Gly Asp Pro  
50 55 60

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

Asn Leu Pro His Asp Trp Ser Ile Glu Gly Asp Phe Thr Val Glu Gly  
85 90 95

Glu Ala Glu Ser Gly Phe Leu Leu Gly Gly Thr Gly Trp Tyr Arg Lys  
100 105 110

Ala Phe Val Val Pro Glu Lys Tyr Asn Gly Lys Asp Phe Thr Leu Asn  
115 120 125

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

Val Gly Glu His Asn Tyr Gly Tyr Thr Ser Phe Ala Phe Asp Ile Thr  
145 150 155 160

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

Val Ser Asn Pro Val Pro Thr Ser Arg Trp Tyr Ser Gly Ser Gly Ile  
180 185 190

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

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

Asp Val Asp Val Ala Ile Glu Thr Ile Val Glu Asn Glu Ser Lys Asp  
225 230 235 240

Asn Ser Met Val Thr Val Lys Ser Thr Val Val Asn Ser Lys Gly Glu  
245 250 255

Glu Val Ser Glu Ser Val Ile Asn Glu Lys Ser Ile Gly Ala Asn Glu  
260 265 270

Ser Tyr Thr Phe Asn Gln Thr Ala Ile Val Asn Asn Pro Gly Leu Trp  
275 280 285

Ser Val Asp Asn Pro Asn Met Tyr Lys Val Lys Ser Glu Val Leu Val  
290 295 300

Asp Gly Asn Val Ile Asp Thr Tyr Phe Thr Asp Phe Gly Phe Arg Tyr

305					310					315				320	
Tyr	Asn	Phe	Asp	Lys	Asp	Thr	Gly	Phe	Ser	Leu	Asn	Gly	Glu	Asn	Ile
				325					330					335	
Lys	Leu	Lys	Gly	Val	Cys	Met	His	His	Asp	Gln	Gly	Ala	Leu	Gly	Ala
			340					345					350		
Ala	Ser	Tyr	Tyr	Arg	Ala	Val	Glu	Arg	Gln	Met	Glu	Lys	Met	Lys	Glu
		355					360					365			
Met	Gly	Val	Asn	Ala	Ile	Arg	Val	Ser	His	Asn	Pro	Ala	Ser	Glu	Met
	370					375					380				
Leu	Leu	Glu	Ile	Cys	Asn	Arg	Leu	Gly	Leu	Leu	Val	Ile	Asn	Glu	Ala
385					390					395					400
Phe	Asp	Thr	Trp	Thr	Asn	Pro	Lys	Asn	Gly	Asn	Val	Asn	Asp	Phe	Ser
				405					410					415	
Lys	Tyr	Phe	Asn	Glu	Val	Ile	Gly	Glu	Asp	Asn	Glu	Ile	Leu	Asn	Gly
			420					425					430		
Ser	Pro	Glu	Met	Thr	Trp	Gly	Glu	Phe	Glu	Ala	Arg	Ser	Met	Val	Lys
		435					440					445			
Asn	Ser	Lys	Asn	Asn	Pro	Ser	Ile	Ile	Met	Trp	Ser	Ile	Gly	Asn	Glu
	450					455					460				
Val	Leu	Glu	Gly	Ile	Ser	Gly	Ser	Ala	Ser	Asn	Tyr	Thr	Asn	Val	Ala
465					470					475					480
Gln	Asn	Ile	Ile	Asp	Trp	Ile	Lys	Asp	Glu	Asp	Glu	Thr	Arg	His	Val
				485					490					495	
Thr	Ile	Gly	Asp	Asn	Arg	Thr	Lys	Asn	Gly	Asp	Arg	Thr	Ala	Glu	Ala
			500						505				510		
Ile	Ser	Glu	Val	Val	Asp	Asp	Asn	Asp	Gly	Leu	Val	Gly	Phe	Asn	Tyr
		515					520					525			
Ala	Asn	Glu	Ala	Gln	Val	Ala	Gln	Gln	Arg	Ala	Asn	His	Pro	Asp	Trp
	530					535					540				
Thr	Leu	Tyr	Ala	Ser	Glu	Thr	Ser	Ser	Ala	Ile	His	Thr	Arg	Gly	Tyr
545					550					555					560

Tyr Lys Thr Lys Gly Ile Asp Tyr Ser Asn His Arg Ile Ser Glu Tyr  
565 570 575

Asp Asn Asn Gln Thr Arg Val Gly Trp Gly His Ser Ala Ser Asp Ala  
580 585 590

Trp Lys Phe Val Ile Lys Asn Asp Tyr Asn Ala Gly Glu Phe Val Trp  
595 600 605

Thr Gly Phe Asp Tyr Ile Gly Glu Pro Thr Pro Trp Asn Gly Thr Gly  
610 615 620

Thr Gly Thr Val Gly Gly Gly Asn Gly Ala Ala Pro Lys Ser Ser Tyr  
625 630 635 640

Phe Gly Ile Val Asp Thr Ala Gly Phe Glu Lys Asp Ile Tyr Tyr Leu  
645 650 655

Tyr Gln Ser Gln Trp Asn Asp Asp Val Asn Thr Leu His Val Leu Pro  
660 665 670

Thr Trp Asn Arg Glu Asp Ile Val Ile Glu Asn Gly Asn Val Glu Val  
675 680 685

Asn Val Phe Thr Asp Ala His Lys Val Glu Leu Tyr Leu Asn Asp Glu  
690 695 700

Lys Ile Gly Glu Gln Thr Ser Thr Glu His Thr Thr Asp Ala Gly Tyr  
705 710 715 720

Lys Tyr Tyr Thr Phe Gly Asn Asp Ser Leu Tyr Pro Val Phe Asn Val  
725 730 735

Pro Tyr Lys Glu Gly Thr Leu Thr Ala Arg Ala Tyr Asp Lys Glu Gly  
740 745 750

Asn Glu Ile Thr Asn Thr Glu Gly Arg Asn Thr Val Lys Thr Thr Gly  
755 760 765

Glu Ala Ser Thr Val Arg Leu Ser Ala Asp Arg Asp Thr Ile Asp Ser  
770 775 780

Asp Gly Tyr Asp Leu Ser Tyr Ile Thr Val Asp Ile Val Asp Glu Asn  
785 790 795 800



Gly Asn Ile Val Gln Asn Ala Asp Asn Arg Leu Asn Phe Glu Leu Glu  
805 810 815

Gly Asn Gly Lys Ile Val Gly Val Asp Asn Gly Asp Gln Thr Asp Thr  
820 825 830

Asp Ser Tyr Lys Pro Thr Ser Asp Thr Glu Ala Ser Arg Lys Ala Leu  
835 840 845

Ser Gly Lys Ala Leu Val Ile Val Gln Ser Thr Lys Asp Ala Gly Asn  
850 855 860

Ile Arg Leu Asn Val Ser Gly Glu Gly Leu Gln Ser Gln Ser Ile Glu  
865 870 875 880

Ile Asn Thr Val Asn Asn Ala Gly Glu Asp Lys Phe Leu Glu Ser Tyr  
885 890 895

Glu Ile Val Lys Asp Tyr Tyr Val Asn Leu Asn Glu Lys Pro Glu Leu  
900 905 910

Pro Ser Thr Val Glu Gly Arg Tyr Ser Asp Gly Thr Thr Glu Thr Phe  
915 920 925

Asn Ile Ser Trp Asn Asp Tyr Asp Glu Ser Gln Leu Asn Thr Pro Gln  
930 935 940

Val Phe Lys Ile Asn Gly Lys Leu Glu Gly Thr Asp Val Ala Val Asn  
945 950 955 960

Val Asn Val His Val Ile Gly Asp Val Val Ser Met Glu Asn Tyr Ser  
965 970 975

Thr Phe Thr Tyr Ala Gly Gln Thr Pro Thr Leu Pro Lys Thr Val Lys  
980 985 990

Gly Tyr Leu Ala Asp Gly Asn Glu Ser Glu Glu Phe Lys Val Asp Trp  
995 1000 1005

Asn Leu Glu Gly Val Asp Phe Ser Glu Pro Asn Thr Thr Val Glu  
1010 1015 1020

Val Leu Gly Glu Val Ser Leu Leu Gly Lys Thr Tyr Thr Val Thr  
1025 1030 1035

Ser	Thr	Val	Arg	Val	Val	Glu	Ala	Leu	Lys	Ala	Ala	Ala	Asn	Leu
1040						1045					1050			
Ala	Ile	Asn	Lys	Asp	Thr	Asn	Lys	Asp	Val	Pro	Ala	Leu	Ser	Gln
1055						1060					1065			
Ser	Cys	Val	Ser	Gln	Ala	Asp	Asn	Leu	Asn	Ser	Ile	Asn	Asn	Gly
1070						1075					1080			
Ile	Thr	Asn	Asn	Gly	Thr	Asp	Thr	Arg	Glu	Arg	Trp	Thr	Asn	Trp
1085						1090					1095			
Asn	Glu	Arg	Asp	Leu	Thr	Val	Asn	Gly	Glu	Pro	Lys	Gly	Ala	Tyr
1100						1105					1110			
Val	Gln	Leu	Asp	Trp	Glu	Asn	Lys	Tyr	Asn	Ile	Asp	Arg	Leu	Asp
1115						1120					1125			
Leu	Trp	Leu	Phe	Thr	Asp	Asn	Ile	Tyr	Gly	Arg	Ile	Pro	Lys	Lys
1130						1135					1140			
Val	Glu	Ile	Ser	Tyr	Lys	Asn	Glu	Ala	Gly	Glu	Tyr	Glu	Val	Val
1145						1150					1155			
Thr	His	Ser	Asn	Thr	Thr	Glu	Val	Ser	Tyr	Leu	Ala	Gly	Glu	Thr
1160						1165					1170			
Thr	Tyr	Phe	Leu	Asp	Lys	Val	Ile	Asn	Thr	Asp	Ser	Ile	Arg	Val
1175						1180					1185			
Tyr	Met	Gln	Gln	Pro	Glu	Val	Gly	Lys	Cys	Ile	Gly	Leu	Ser	Glu
1190						1195					1200			
Val	Ala	Val	Tyr	Glu	Tyr	Val	Pro	Gln	Val	Ser	Ala	Asn	Glu	Gly
1205						1210					1215			
Asn	Lys	Leu	Ser	Glu	Ile	Lys	Leu	Asp	Gly	Glu	Ala	Leu	Glu	Gly
1220						1225					1230			
Phe	Asn	Pro	Asp	Thr	Asn	Glu	Tyr	Thr	Val	Asn	Leu	Lys	Glu	Leu
1235						1240					1245			
Pro	Lys	Thr	Val	Glu	Ala	Ser	Gly	Glu	Glu	Asn	Val	Ala	Ile	Thr
1250						1255					1260			
Ile	Leu	Pro	Val	His	Asn	Asn	Lys	Ser	Ile	Ile	Ile	Ala	Arg	Ser

1265

1270

1275

Glu Ser Gly Ala Lys Asn Ile Tyr Thr Val Asn Tyr Val Leu Glu  
1280 1285 1290

Glu Ser Glu Gly Ser Ala Asp Ile Asn Glu Asp Gly Ser Ile Asn  
1295 1300 1305

Val Gly Asp Leu Ser Ile Val Ser Lys Tyr Gln Gly Glu Ile Ile  
1310 1315 1320

Ser Gly Asn Ala Leu Ser Glu Lys Ser Asp Ile Asn Lys Asp Gly  
1325 1330 1335

Val Val Asp Lys Ala Asp Ile Gln Ile Val Met Gly Lys Ile Leu  
1340 1345 1350

Gly Glu  
1355