

SEQUENCE LISTING

<110> HAV VACCINES LIMITED

<120> VACCINE

<130> N413293WO

<150> GB1811382.9

<151> 2018-07-11

<160> 146

<170> PatentIn version 3.5

<210> 1

<211> 213

<212> DNA

<213> Mycobacterium avium paratuberculosis

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<211> 71

<212> PRT

<213> Mycobacterium avium paratuberculosis

<400> 2

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Asp Ala Gly Lys Ala Asp His Tyr Cys Met Val Ile Asn Asp Asp Ala
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Gln Arg Leu Leu Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu
35 40 45

Glu Leu Ile Ala Ala Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
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Trp Ala Ile Asp Leu Asn Ala
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<213> Mycobacterium avium paratuberculosis

<400> 3

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<212> PRT
<213> Mycobacterium avium paratuberculosis

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<220>
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<220>
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<222> (12)..(12)
<223> PHOSPHORYLATION

<400> 5

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<222> (12)..(12)
<223> PHOSPHORYLATION

<400> 6

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg Val Ala
1 5 10 15

Asn Asp Glu Ala Ala Leu Leu Glu Leu Ile
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<210> 7
<211> 15
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 7

Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr Trp Ala Ile Asp
1 5 10 15

<210> 8
<211> 18
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 8

Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr Trp Ala Ile Asp Leu
1 5 10 15

Asn Ala

<210> 9
<211> 20
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 9

Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val Asp Ala Gly Lys
1 5 10 15

Ala Asp His Tyr

<210> 10
 <211> 24
 <212> PRT
 <213> Mycobacterium avium paratuberculosis

<400> 10

Met Thr Val Thr Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val
 1 5 10 15

Asp Ala Gly Lys Ala Asp His Tyr
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<210> 11
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 <223> Synthetic Peptide

<220>
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 <222> (15)..(15)
 <223> X is a peptide linker, A, or AA

<400> 11

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Thr Thr Leu Ala Asp Gly Gly Glu Val Thr Trp Ala Ile Asp
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<210> 12
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 <213> Artificial Sequence

<220>
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 <223> X is a peptide linker, A, or AA

<400> 12

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Thr Thr Leu Ala Asp Gly Gly Glu Val Thr Trp Ala Ile Asp Leu Asn
20 25 30

Ala

<210> 13

<211> 42

<212> PRT

<213> Artificial Sequence

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<223> Synthetic Peptide

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<221> MISC_FEATURE

<222> (27)..(27)

<223> X is a peptide linker, A, or AA

<400> 13

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Asn Asp Glu Ala Ala Leu Leu Glu Leu Ile Xaa Val Thr Thr Leu Ala
20 25 30

Asp Gly Gly Glu Val Thr Trp Ala Ile Asp
35 40

<210> 14

<211> 45

<212> PRT

<213> Artificial Sequence

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<220>

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<222> (27)..(27)

<223> X is a peptide linker, A, or AA

<400> 14

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1 5 10 15

Asn Asp Glu Ala Ala Leu Leu Glu Leu Ile Xaa Val Thr Thr Leu Ala
20 25 30

Asp Gly Gly Glu Val Thr Trp Ala Ile Asp Leu Asn Ala
35 40 45

<210> 15

<211> 35

<212> PRT

<213> Artificial Sequence

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<223> Synthetic Peptide

<220>

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<222> (21)..(21)

<223> X is a peptide linker or C

<400> 15

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Ala Asp His Tyr Xaa Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu
20 25 30

Ser Gln Arg
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<210> 16

<211> 47

<212> PRT

<213> Artificial Sequence

<220>

<223> Synthetic Peptide

<220>

<221> MISC_FEATURE

<222> (21)..(21)

<223> X is a peptide linker or C

<400> 16

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1 5 10 15

Ala Asp His Tyr Xaa Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu
20 25 30

Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu Glu Leu Ile
35 40 45

<210> 17

<211> 39

<212> PRT

<213> Artificial Sequence

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<221> MISC_FEATURE

<222> (25)..(25)

<223> X is a peptide linker or C

<400> 17

Met Thr Val Thr Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val
1 5 10 15

Asp Ala Gly Lys Ala Asp His Tyr Xaa Met Val Ile Asn Asp Asp Ala
20 25 30

Gln Arg Leu Leu Ser Gln Arg
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<210> 18

<211> 51

<212> PRT

<213> Artificial Sequence

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<223> Synthetic Peptide

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<221> MISC_FEATURE
<222> (25)..(25)
<223> X is a peptide linker or C

<400> 18

Met Thr Val Thr Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val
1 5 10 15

Asp Ala Gly Lys Ala Asp His Tyr Xaa Met Val Ile Asn Asp Asp Ala
20 25 30

Gln Arg Leu Leu Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu
35 40 45

Glu Leu Ile
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<210> 19
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<212> PRT
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<220>
<223> Synthetic Peptide

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<222> (21)..(21)
<223> X is a peptide linker or C

<220>
<221> MISC_FEATURE
<222> (48)..(48)
<223> X is a peptide linker, A, or AA

<400> 19

Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val Asp Ala Gly Lys
1 5 10 15

Ala Asp His Tyr Xaa Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu
20 25 30

Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu Glu Leu Ile Xaa
35 40 45

Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr Trp Ala Ile Asp Leu
50 55 60

Asn Ala
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<210> 20
<211> 70
<212> PRT
<213> Artificial Sequence

<220>
<223> Synthetic Peptide

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<222> (25)..(25)
<223> X is a peptide linker or C

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<223> X is a peptide linker, A, or AA

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Asp Ala Gly Lys Ala Asp His Tyr Xaa Met Val Ile Asn Asp Asp Ala
20 25 30

Gln Arg Leu Leu Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu
35 40 45

Glu Leu Ile Xaa Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr Trp
50 55 60

Ala Ile Asp Leu Asn Ala
65 70

<210> 21
<211> 606
<212> DNA
<213> Mycobacterium avium paratuberculosis

<400> 21

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 gtttaa 606

<210> 22
 <211> 195
 <212> PRT
 <213> Mycobacterium avium paratuberculosis
 <400> 22

Met Pro Leu Leu Thr Ile Gly Asp Gln Phe Pro Ala Tyr Glu Leu Asp
 1 5 10 15

Arg Val Ile Ala Gly Asp Leu Ser Lys Val Asp Ala Lys Gln Pro Gly
 20 25 30

Asp Tyr Phe Thr Thr Val Thr Ser Glu Asp His Ala Gly Lys Trp Arg
 35 40 45

Val Val Phe Phe Trp Pro Lys Asp Phe Thr Phe Val Cys Pro Thr Glu
 50 55 60

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

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

Arg Ala Gln His Glu Asp Leu Lys Asn Leu Pro Phe Pro Met Leu Ser

100 105 110

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

Gly Val Ala Asp Arg Ala Thr Phe Ile Val Asp Pro Asn Asn Glu Ile
130 135 140

Gln Phe Val Ser Val Thr Ala Gly Ser Val Gly Arg Asn Val Glu Glu
145 150 155 160

Val Leu Arg Val Leu Asp Ala Leu Gln Ser Asp Glu Leu Cys Ala Cys
165 170 175

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

Ala Ser Ala
195

<210> 23

<211> 801

<212> DNA

<213> Mycobacterium avium

<400> 23

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ggcggttcga ccgatcggac cctcgacatc gcgaacagtt tccgcccga actcggctcg 180

cgactggtcg ttcacagcgg gcccgatgat ggcccctacg acgcatgaa ccgcggcgctc 240

ggcgtagcca caggcgaatg ggtactttt ttaggcgccg acgacaccct ctacgaacca 300

accacgttgg ccaggtagc cgcttttctc ggcgaccatg cggcaagcca tctgtctat 360

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tgcttctcca acccggcgct gattaccgcg tacatggacg tcgtgatttc cgaataaac 600

gacatgaccg gcttcagcat gaggcagggg actgataaag agttcagaaa acggctgcca 660

atgtacttct gggttgcagg gtgggagact tgcaggcgca tgctggcggt tttgaaagac 720
aaggagaatc gccgtctggc cttgcgtacg cggttgataa gggttaaggc cgtctccaaa 780
gaacgaagcg cagaaccgta g 801

<210> 24
<211> 266
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 24

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

Val Thr Leu Gln Ala Cys Leu Gly Ser Ile Val Gly Gln Thr Tyr Arg
20 25 30

Glu Val Glu Val Val Leu Val Asp Gly Gly Ser Thr Asp Arg Thr Leu
35 40 45

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

His Ser Gly Pro Asp Asp Gly Pro Tyr Asp Ala Met Asn Arg Gly Val
65 70 75 80

Gly Val Ala Thr Gly Glu Trp Val Leu Phe Leu Gly Ala Asp Asp Thr
85 90 95

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

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

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

Thr Asn Leu Cys His Gln Ser Ile Phe Tyr Arg Arg Glu Leu Phe Asp
145 150 155 160

Gly Ile Gly Pro Tyr Asn Leu Arg Tyr Arg Val Trp Ala Asp Trp Asp

165 170 175

Phe Asn Ile Arg Cys Phe Ser Asn Pro Ala Leu Ile Thr Arg Tyr Met
180 185 190

Asp Val Val Ile Ser Glu Tyr Asn Asp Met Thr Gly Phe Ser Met Arg
195 200 205

Gln Gly Thr Asp Lys Glu Phe Arg Lys Arg Leu Pro Met Tyr Phe Trp
210 215 220

Val Ala Gly Trp Glu Thr Cys Arg Arg Met Leu Ala Phe Leu Lys Asp
225 230 235 240

Lys Glu Asn Arg Arg Leu Ala Leu Arg Thr Arg Leu Ile Arg Val Lys
245 250 255

Ala Val Ser Lys Glu Arg Ser Ala Glu Pro
260 265

<210> 25

<211> 417

<212> DNA

<213> Mycobacterium avium paratuberculosis

<400> 25

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cgccctgcgc gcgtcgccgg cctggcgccg gtaccacgag attccggccg catcagcgga 180

aacctcaaac gccccgacg ctacgaccgg cgcctgctgc gcgcctgcta cctgtcggcc 240

ttggtcagca tccgcaccga cccctcctcg cgcacctact acgaccgaaa acgcaccgaa 300

ggaaaacgcc acaccaagc cgtcctcgcc ctggcccgcc gccgcctcaa cgtcctgtgg 360

gccatgctgc gcgaccacgc tgtctaccac cccgcaacca ctaccgcggc ggcttga 417

<210> 26

<211> 138

<212> PRT

<213> Mycobacterium avium

<400> 26

Arg Phe Arg Arg His Arg His Ala Glu Ile Ile Leu Ser Met Pro Gly
1 5 10 15

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

Met Ala Ala Phe Ala Ser Ala Asp Arg Leu Ala Gly Val Ala Gly Leu
35 40 45

Ala Pro Val Pro Arg Asp Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg
50 55 60

Pro Arg Arg Tyr Asp Arg Arg Leu Leu Arg Ala Cys Tyr Leu Ser Ala
65 70 75 80

Leu Val Ser Ile Arg Thr Asp Pro Ser Ser Arg Thr Tyr Tyr Asp Arg
85 90 95

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

Arg Arg Arg Leu Asn Val Leu Trp Ala Met Leu Arg Asp His Ala Val
115 120 125

Tyr His Pro Ala Thr Thr Thr Ala Ala Ala
130 135

<210> 27

<211> 402

<212> DNA

<213> Mycobacterium avium paratuberculosis

<400> 27

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cgcctcgccg gcgtcgccgg cctggcgccg gtaccacgag attccggccg catcagcgga 180

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<210> 28
<211> 133
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 28

Arg Phe Arg Arg His Arg His Ala Glu Ile Ile Leu Ser Met Pro Gly
1 5 10 15

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

Met Ala Ala Phe Ala Ser Ala Asp Arg Leu Ala Gly Val Ala Gly Leu
35 40 45

Ala Pro Val Pro Arg Asp Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg
50 55 60

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

Thr Asp Pro Ser Ser Arg Thr Tyr Tyr Asp Arg Lys Arg Thr Glu Gly
85 90 95

Lys Arg His Thr Gln Ala Val Leu Ala Leu Ala Arg Arg Arg Leu Asn
100 105 110

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

Thr Thr Ala Ala Ala
130

<210> 29
<211> 1335
<212> DNA
<213> Mycobacterium avium paratuberculosis

<400> 29

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gacaccgcaa gactactgga gtgcgtgcac aagcgcccc agctcgcggc tgaaagcgga 120

tgcaaagggg ttcgaagctt gagcaacatg cgaaggggag aacggcctat gagcctggga 180
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 agctggcttc gcaacccgca tcccgcctaa tacttcaccg ctcatgtct tcgtattctc 420
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<210> 30

<211> 444

<212> PRT

<213> Mycobacterium avium paratuberculosis

<400> 30

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Ala Val Glu Gln Asp Thr Ala Arg Leu Leu Glu Cys Val His Lys Arg

20 25 30

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

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

Pro Arg Ala Asn Ala Leu Asn Ala Trp Arg Leu Val Leu Ala Ser Gly
65 70 75 80

Val Ile Leu Trp His Ser Phe Pro Leu Thr Gly Arg Met Pro Trp Ala
85 90 95

Pro Phe Val Gln Leu Leu Gly Leu Gly Cys Val Asp Gly Phe Phe Ala
100 105 110

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

Ala Gln Tyr Phe Thr Ala Arg Cys Leu Arg Ile Leu Pro Gly Leu Trp
130 135 140

Ile Cys Leu Ile Leu Thr Ala Phe Val Ile Ala Pro Ile Gly Val Gly
145 150 155 160

Ala Gln Gly Gly Ser Ala Ala Lys Leu Leu Met Ser Gly Ala Pro Ile
165 170 175

Glu Tyr Val Leu Lys Asp Ser Ala Val Trp Met Val Lys Phe Asp Ile
180 185 190

Gly Gly Thr Pro Arg Asp Ile Pro Val Ala Gly Ile Trp Asn Gly Ser
195 200 205

Leu Trp Thr Leu Gly Trp Glu Val Leu Cys Tyr Ile Gly Val Ala Val
210 215 220

Phe Gly Met Leu Gly Leu Leu Ser Arg Arg Trp Phe Val Pro Gly Ile
225 230 235 240

Leu Ile Leu Ala Leu Ser Trp Ser Val Phe Leu Pro Ala Trp Gly Gly
245 250 255

Ile His Ala Ile Ala Ser Asn Ala Ala Arg Phe Ala Val Met Phe Ser
260 265 270

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

Ser Phe Val Ala Val Gly Leu Ile Ile Val Val Val Ser Ser Ala Val
290 295 300

Leu Pro Asp Tyr Arg Leu Val Ala Ala Leu Pro Met Ala Tyr Leu Ile
305 310 315 320

Ile Ala Ser Gly Ser Leu Ile His Asn Gln Arg Met Arg Phe Arg Thr
325 330 335

Asp Leu Ser Tyr Gly Val Tyr Ile Tyr Ala Phe Pro Ile Gln Gln Val
340 345 350

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

Ile Ser Val Ala Ala Ile Leu Pro Leu Ala Ala Leu Ser Trp Phe Leu
370 375 380

Val Glu Lys Pro Ala Leu Ser Trp Lys Ser Arg Leu Arg Arg Lys Asn
385 390 395 400

Ser Ser Ile Ala Leu Ala Asn Met Glu Asp Gly Gly Ser Val Gly Arg
405 410 415

Ser Asn Asp Ile Pro Gly Arg Arg Ala Arg Phe Ile Gly Glu Lys Ala
420 425 430

Glu Asp Pro Pro Ala Pro Ser Pro Arg Pro Ala Leu
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<210> 31

<211> 585

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon Optimised ahpC

<400> 31

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gttttgggcg tgtctatcga ttccgagttc gtgcacttca actggagagc acagcatgaa    300
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ctgagagttc tcgacgcact tcagagtgat gaactgtgtg cctgcaattg gcggaagga    540
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<210> 32

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<213> Mycobacterium avium paratuberculosis

<400> 32

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

Ala Gln His Glu Asp Leu Lys Asn Leu Pro Phe Pro Met Leu Ser Asp
100 105 110

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

Val Ala Asp Arg Ala Thr Phe Ile Val Asp Pro Asn Asn Glu Ile Gln
130 135 140

Phe Val Ser Val Thr Ala Gly Ser Val Gly Arg Asn Val Glu Glu Val
145 150 155 160

Leu Arg Val Leu Asp Ala Leu Gln Ser Asp Glu Leu Cys Ala Cys Asn
165 170 175

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

Ser Ala Leu
195

<210> 33
<211> 729
<212> DNA
<213> Artificial Sequence

<220>
<223> Modified Gsd

<400> 33
ggatccattg tcggacagac ctatagagag gtggaagttg tcctggtcga tggatgatct 60
acagatagga ctctcgacat tgccaactcc ttagaccag agctcggttc aaggctcgtt 120
gttcattctg gaccagatga tggaccatac gacgccatga acagaggtgt tggagttgct 180
acaggagaat gggctctgtt ccttggagct gatgacactc tgtacgaacc gactacattg 240
gctcaggttg cagcattttt gggagatcat gcagcttctc acctgtgta cggagatgtg 300
gtcatgagat ccaccaagtc cagacatgct ggaccattcg atcttgacag actcctgttc 360
gagaccaacc tctgtcatca gagcatcttc tacagacggg aactcttcga cggaattgga 420
ccttacaacc tcaggtacag gggttgggca gactgggatt tcaacatcag gtgcttctcg 480

aaccagctt tgatcacag gtacatggat gttgtgatct ccgagtacaa cgatatgacc 540
ggcttctcca tgagacaggg aaccgacaaa gagttcagga agcgcttgcc aatgtacttc 600
tgggttgctg gatgggaaac atgtcggaga atgcttgctt tcctgaagga caaggagaac 660
aggagacttg ctctcaggac tagactcatc agggtaaag cagtgtccaa ggaaaggagt 720
gctgaacct 729

<210> 34
<211> 243
<212> PRT
<213> Mycobacterium avium paratuberculosis
<400> 34

Gly Ser Ile Val Gly Gln Thr Tyr Arg Glu Val Glu Val Val Leu Val
1 5 10 15

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

Pro Glu Leu Gly Ser Arg Leu Val Val His Ser Gly Pro Asp Asp Gly
35 40 45

Pro Tyr Asp Ala Met Asn Arg Gly Val Gly Val Ala Thr Gly Glu Trp
50 55 60

Val Leu Phe Leu Gly Ala Asp Asp Thr Leu Tyr Glu Pro Thr Thr Leu
65 70 75 80

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

Tyr Gly Asp Val Val Met Arg Ser Thr Lys Ser Arg His Ala Gly Pro
100 105 110

Phe Asp Leu Asp Arg Leu Leu Phe Glu Thr Asn Leu Cys His Gln Ser
115 120 125

Ile Phe Tyr Arg Arg Glu Leu Phe Asp Gly Ile Gly Pro Tyr Asn Leu
130 135 140

Arg Tyr Arg Val Trp Ala Asp Trp Asp Phe Asn Ile Arg Cys Phe Ser
145 150 155 160

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

Asn Asp Met Thr Gly Phe Ser Met Arg Gln Gly Thr Asp Lys Glu Phe
 180 185 190

Arg Lys Arg Leu Pro Met Tyr Phe Trp Val Ala Gly Trp Glu Thr Cys
 195 200 205

Arg Arg Met Leu Ala Phe Leu Lys Asp Lys Glu Asn Arg Arg Leu Ala
 210 215 220

Leu Arg Thr Arg Leu Ile Arg Val Lys Ala Val Ser Lys Glu Arg Ser
225 230 235 240

Ala Glu Pro

<210> 35

<211> 420

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon Optimised P12

<400> 35

agaattcgga gacatagaca tgcagagatc atcctgagca tgcctggatt tggcgttatc 60

ctcggagctg aatttcttgc agcaacagga ggtgatatgg cagctttcgc atcagctgac 120

agattggctg gagttgcagg ttgggtcca gttccaagag attcaggag aatcagcggc 180

aacctcaaga gacctagacg ctacgacaga agactgctta gagcctgcta tctgagtgtc 240

ttggttagca ttagaaccga cccctctagt cgaacctact acgataggaa gcggactgaa 300

ggtaagagac ataccaggc agtgttggca ctgctagaa gacggcttaa tgttctgtgg 360

gctatgctga gagatcatgc cgtgtacat cctgctacca caacagctgc tgctagactt 420

<210> 36

<211> 140

<212> PRT

<213> Mycobacterium avium paratuberculosis

<400> 36

Arg Ile Arg Arg His Arg His Ala Glu Ile Ile Leu Ser Met Pro Gly
1 5 10 15

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

Met Ala Ala Phe Ala Ser Ala Asp Arg Leu Ala Gly Val Ala Gly Leu
35 40 45

Ala Pro Val Pro Arg Asp Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg
50 55 60

Pro Arg Arg Tyr Asp Arg Arg Leu Leu Arg Ala Cys Tyr Leu Ser Ala
65 70 75 80

Leu Val Ser Ile Arg Thr Asp Pro Ser Ser Arg Thr Tyr Tyr Asp Arg
85 90 95

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

Arg Arg Arg Leu Asn Val Leu Trp Ala Met Leu Arg Asp His Ala Val
115 120 125

Tyr His Pro Ala Thr Thr Thr Ala Ala Ala Arg Leu
130 135 140

<210> 37

<211> 405

<212> DNA

<213> Artificial Sequence

<220>

<223> Modified P12

<400> 37

agaattcgga gacatagaca tgcagagatc atcctgagca tgcctggatt tggcgttacc 60

ctcggagctg aatttcttgc agcaacagga ggtgatatgg cagctttcgc atcagctgac 120

agattggctg gagttgcagg ttggctcca gttccaagag attcaggag aatcagcggc 180

aacctcaaga gacctagacg ctacgacaga agactgctta gagcctgcgt tagcattaga 240
accgaccctt ctatcgaac ctactacgat aggaagcgga ctgaaggtaa gagacatacc 300
caggcagtgt tggcacttgc tagaagacgg cttaatgttc tgtgggctat gctgagagat 360
catgccgtgt accatcctgc taccacaaca gctgctgcta gactt 405

<210> 38
<211> 135
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 38

Arg Ile Arg Arg His Arg His Ala Glu Ile Ile Leu Ser Met Pro Gly
1 5 10 15

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

Met Ala Ala Phe Ala Ser Ala Asp Arg Leu Ala Gly Val Ala Gly Leu
35 40 45

Ala Pro Val Pro Arg Asp Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg
50 55 60

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

Thr Asp Pro Ser Ser Arg Thr Tyr Tyr Asp Arg Lys Arg Thr Glu Gly
85 90 95

Lys Arg His Thr Gln Ala Val Leu Ala Leu Ala Arg Arg Arg Leu Asn
100 105 110

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

Thr Thr Ala Ala Ala Arg Leu
130 135

<210> 39
<211> 738
<212> DNA

<213> Artificial Sequence

<220>

<223> Modified Mpa

<400> 39

aagcttcgca gaggtgagag acctatgagt cttggccagg tctttgatcc tagagctaataat 60
gcactgcact ctttcctct tacaggacgc atgccttggg ctccatttat cgtagttcc 120
tggctcagaa accctcatcc agctcagtac ttcacagcca gatgtctcag aatccttcct 180
ggcttttga ttggagcaca ggggtgttcc gcagctaagc tgttgatgag tggcgacca 240
atcgaatacg tctgaaaga ctcagcagtg tggatgttca agttcgacat tggaggaaca 300
ccaagggata ttctgtcgc tggatctgg aatggaagtt tgggacccc agcatgggga 360
ggatattcatg ctatcgcttc caacgcttac cagttccgaa atgtgatccc tgcaagatgg 420
tctgtgagtt cagccgtgtt gccaaactat agactgttg ctgctctccc catggcctac 480
cataatcagc gaatgaggtt tcggacagat ctgtcctatg gtgtgtacgg gttcgtgaa 540
atcaatccca tcgctctggg tgagaaacct gccctgtctt ggaaatccag actgagacgg 600
aagaactctt ccacgtctct cgcaaacatg gaagatgggtg gtagtggttg aaggagtaac 660
gacatccctg ggaggagggc tagatttatt ggtgagaaag ccgaagatcc tctgctcca 720
tctcctagac ccgcttg 738

<210> 40

<211> 246

<212> PRT

<213> Mycobacterium avium paratuberculosis

<400> 40

Lys Leu Arg Arg Gly Glu Arg Pro Met Ser Leu Gly Gln Val Phe Asp
1 5 10 15

Pro Arg Ala Asn Ala Leu His Ser Phe Pro Leu Thr Gly Arg Met Pro
20 25 30

Trp Ala Pro Phe Ile Val Ser Ser Trp Leu Arg Asn Pro His Pro Ala
35 40 45

Gln Tyr Phe Thr Ala Arg Cys Leu Arg Ile Leu Pro Gly Leu Trp Ile
50 55 60

Gly Ala Gln Gly Gly Ser Ala Ala Lys Leu Leu Met Ser Gly Ala Pro
65 70 75 80

Ile Glu Tyr Val Leu Lys Asp Ser Ala Val Trp Met Phe Lys Phe Asp
85 90 95

Ile Gly Gly Thr Pro Arg Asp Ile Pro Val Ala Gly Ile Trp Asn Gly
100 105 110

Ser Leu Trp Thr Pro Ala Trp Gly Gly Ile His Ala Ile Ala Ser Asn
115 120 125

Ala Tyr Gln Phe Arg Asn Val Ile Pro Ala Arg Trp Ser Val Ser Ser
130 135 140

Ala Val Leu Pro Asn Tyr Arg Leu Val Ala Ala Leu Pro Met Ala Tyr
145 150 155 160

His Asn Gln Arg Met Arg Phe Arg Thr Asp Leu Ser Tyr Gly Val Tyr
165 170 175

Gly Phe Ala Glu Ile Asn Pro Ile Ala Leu Val Glu Lys Pro Ala Leu
180 185 190

Ser Trp Lys Ser Arg Leu Arg Arg Lys Asn Ser Ser Ile Ala Leu Ala
195 200 205

Asn Met Glu Asp Gly Gly Ser Val Gly Arg Ser Asn Asp Ile Pro Gly
210 215 220

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

Ser Pro Arg Pro Ala Leu
245

<210> 41

<211> 833

<212> PRT

<213> Artificial Sequence

<220>

<223> vaccine polypeptide

<400> 41

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

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

Asp Ala Lys Gln Pro Gly Asp Tyr Phe Thr Thr Val Thr Ser Glu Asp
35 40 45

His Ala Gly Lys Trp Arg Val Val Phe Phe Trp Pro Lys Asp Phe Thr
50 55 60

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

Arg Asp Ala Gln Val Leu Gly Val Ser Ile Asp Ser Glu Phe Val His
85 90 95

Phe Asn Trp Arg Ala Gln His Glu Asp Leu Lys Asn Leu Pro Phe Pro
100 105 110

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

Asn Ala Asp Gly Val Ala Asp Arg Ala Thr Phe Ile Val Asp Pro Asn
130 135 140

Asn Glu Ile Gln Phe Val Ser Val Thr Ala Gly Ser Val Gly Arg Asn
145 150 155 160

Val Glu Glu Val Leu Arg Val Leu Asp Ala Leu Gln Ser Asp Glu Leu
165 170 175

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

Leu Leu Lys Ala Ser Ala Leu Gly Ser Ile Val Gly Gln Thr Tyr Arg
195 200 205

Glu Val Glu Val Val Leu Val Asp Gly Gly Ser Thr Asp Arg Thr Leu
210 215 220

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

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

Gly Val Ala Thr Gly Glu Trp Val Leu Phe Leu Gly Ala Asp Asp Thr
260 265 270

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

His Ala Ala Ser His Leu Val Tyr Gly Asp Val Val Met Arg Ser Thr
290 295 300

Lys Ser Arg His Ala Gly Pro Phe Asp Leu Asp Arg Leu Leu Phe Glu
305 310 315 320

Thr Asn Leu Cys His Gln Ser Ile Phe Tyr Arg Arg Glu Leu Phe Asp
325 330 335

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

Phe Asn Ile Arg Cys Phe Ser Asn Pro Ala Leu Ile Thr Arg Tyr Met
355 360 365

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

Gln Gly Thr Asp Lys Glu Phe Arg Lys Arg Leu Pro Met Tyr Phe Trp
385 390 395 400

Val Ala Gly Trp Glu Thr Cys Arg Arg Met Leu Ala Phe Leu Lys Asp
405 410 415

Lys Glu Asn Arg Arg Leu Ala Leu Arg Thr Arg Leu Ile Arg Val Lys
420 425 430

Ala Val Ser Lys Glu Arg Ser Ala Glu Pro Arg Ile Arg Arg His Arg
435 440 445

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

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

Ala Asp Arg Leu Ala Gly Val Ala Gly Leu Ala Pro Val Pro Arg Asp
485 490 495

Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg Pro Arg Arg Tyr Asp Arg
500 505 510

Arg Leu Leu Arg Ala Cys Val Ser Ile Arg Thr Asp Pro Ser Ser Arg
515 520 525

Thr Tyr Tyr Asp Arg Lys Arg Thr Glu Gly Lys Arg His Thr Gln Ala
530 535 540

Val Leu Ala Leu Ala Arg Arg Arg Leu Asn Val Leu Trp Ala Met Leu
545 550 555 560

Arg Asp His Ala Val Tyr His Pro Ala Thr Thr Thr Ala Ala Ala Arg
565 570 575

Leu Lys Leu Arg Arg Gly Glu Arg Pro Met Ser Leu Gly Gln Val Phe
580 585 590

Asp Pro Arg Ala Asn Ala Leu His Ser Phe Pro Leu Thr Gly Arg Met
595 600 605

Pro Trp Ala Pro Phe Ile Val Ser Ser Trp Leu Arg Asn Pro His Pro
610 615 620

Ala Gln Tyr Phe Thr Ala Arg Cys Leu Arg Ile Leu Pro Gly Leu Trp
625 630 635 640

Ile Gly Ala Gln Gly Gly Ser Ala Ala Lys Leu Leu Met Ser Gly Ala

645 650 655

Pro Ile Glu Tyr Val Leu Lys Asp Ser Ala Val Trp Met Phe Lys Phe
660 665 670

Asp Ile Gly Gly Thr Pro Arg Asp Ile Pro Val Ala Gly Ile Trp Asn
675 680 685

Gly Ser Leu Trp Thr Pro Ala Trp Gly Gly Ile His Ala Ile Ala Ser
690 695 700

Asn Ala Tyr Gln Phe Arg Asn Val Ile Pro Ala Arg Trp Ser Val Ser
705 710 715 720

Ser Ala Val Leu Pro Asn Tyr Arg Leu Val Ala Ala Leu Pro Met Ala
725 730 735

Tyr His Asn Gln Arg Met Arg Phe Arg Thr Asp Leu Ser Tyr Gly Val
740 745 750

Tyr Gly Phe Ala Glu Ile Asn Pro Ile Ala Leu Val Glu Lys Pro Ala
755 760 765

Leu Ser Trp Lys Ser Arg Leu Arg Arg Lys Asn Ser Ser Ile Ala Leu
770 775 780

Ala Asn Met Glu Asp Gly Gly Ser Val Gly Arg Ser Asn Asp Ile Pro
785 790 795 800

Gly Arg Arg Ala Arg Phe Ile Gly Glu Lys Ala Glu Asp Pro Pro Ala
805 810 815

Pro Ser Pro Arg Pro Ala Leu Arg Ile Pro Asn Pro Leu Leu Gly Leu
820 825 830

Asp

<210> 42

<211> 838

<212> PRT

<213> Artificial Sequence

<220>

<223> vaccine polypeptide

<400> 42

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

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

Asp Ala Lys Gln Pro Gly Asp Tyr Phe Thr Thr Val Thr Ser Glu Asp
35 40 45

His Ala Gly Lys Trp Arg Val Val Phe Phe Trp Pro Lys Asp Phe Thr
50 55 60

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

Arg Asp Ala Gln Val Leu Gly Val Ser Ile Asp Ser Glu Phe Val His
85 90 95

Phe Asn Trp Arg Ala Gln His Glu Asp Leu Lys Asn Leu Pro Phe Pro
100 105 110

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

Asn Ala Asp Gly Val Ala Asp Arg Ala Thr Phe Ile Val Asp Pro Asn
130 135 140

Asn Glu Ile Gln Phe Val Ser Val Thr Ala Gly Ser Val Gly Arg Asn
145 150 155 160

Val Glu Glu Val Leu Arg Val Leu Asp Ala Leu Gln Ser Asp Glu Leu
165 170 175

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

Leu Leu Lys Ala Ser Ala Leu Gly Ser Ile Val Gly Gln Thr Tyr Arg

195 200 205

Glu Val Glu Val Val Leu Val Asp Gly Gly Ser Thr Asp Arg Thr Leu
210 215 220

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

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

Gly Val Ala Thr Gly Glu Trp Val Leu Phe Leu Gly Ala Asp Asp Thr
260 265 270

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

His Ala Ala Ser His Leu Val Tyr Gly Asp Val Val Met Arg Ser Thr
290 295 300

Lys Ser Arg His Ala Gly Pro Phe Asp Leu Asp Arg Leu Leu Phe Glu
305 310 315 320

Thr Asn Leu Cys His Gln Ser Ile Phe Tyr Arg Arg Glu Leu Phe Asp
325 330 335

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

Phe Asn Ile Arg Cys Phe Ser Asn Pro Ala Leu Ile Thr Arg Tyr Met
355 360 365

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

Gln Gly Thr Asp Lys Glu Phe Arg Lys Arg Leu Pro Met Tyr Phe Trp
385 390 395 400

Val Ala Gly Trp Glu Thr Cys Arg Arg Met Leu Ala Phe Leu Lys Asp
405 410 415

Lys Glu Asn Arg Arg Leu Ala Leu Arg Thr Arg Leu Ile Arg Val Lys
420 425 430

Ala Val Ser Lys Glu Arg Ser Ala Glu Pro Arg Ile Arg Arg His Arg
435 440 445

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

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

Ala Asp Arg Leu Ala Gly Val Ala Gly Leu Ala Pro Val Pro Arg Asp
485 490 495

Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg Pro Arg Arg Tyr Asp Arg
500 505 510

Arg Leu Leu Arg Ala Cys Tyr Leu Ser Ala Leu Val Ser Ile Arg Thr
515 520 525

Asp Pro Ser Ser Arg Thr Tyr Tyr Asp Arg Lys Arg Thr Glu Gly Lys
530 535 540

Arg His Thr Gln Ala Val Leu Ala Leu Ala Arg Arg Arg Leu Asn Val
545 550 555 560

Leu Trp Ala Met Leu Arg Asp His Ala Val Tyr His Pro Ala Thr Thr
565 570 575

Thr Ala Ala Ala Arg Leu Lys Leu Arg Arg Gly Glu Arg Pro Met Ser
580 585 590

Leu Gly Gln Val Phe Asp Pro Arg Ala Asn Ala Leu His Ser Phe Pro
595 600 605

Leu Thr Gly Arg Met Pro Trp Ala Pro Phe Ile Val Ser Ser Trp Leu
610 615 620

Arg Asn Pro His Pro Ala Gln Tyr Phe Thr Ala Arg Cys Leu Arg Ile
625 630 635 640

Leu Pro Gly Leu Trp Ile Gly Ala Gln Gly Gly Ser Ala Ala Lys Leu
645 650 655

Leu Met Ser Gly Ala Pro Ile Glu Tyr Val Leu Lys Asp Ser Ala Val
660 665 670

Trp Met Phe Lys Phe Asp Ile Gly Gly Thr Pro Arg Asp Ile Pro Val
675 680 685

Ala Gly Ile Trp Asn Gly Ser Leu Trp Thr Pro Ala Trp Gly Gly Ile
690 695 700

His Ala Ile Ala Ser Asn Ala Tyr Gln Phe Arg Asn Val Ile Pro Ala
705 710 715 720

Arg Trp Ser Val Ser Ser Ala Val Leu Pro Asn Tyr Arg Leu Val Ala
725 730 735

Ala Leu Pro Met Ala Tyr His Asn Gln Arg Met Arg Phe Arg Thr Asp
740 745 750

Leu Ser Tyr Gly Val Tyr Gly Phe Ala Glu Ile Asn Pro Ile Ala Leu
755 760 765

Val Glu Lys Pro Ala Leu Ser Trp Lys Ser Arg Leu Arg Arg Lys Asn
770 775 780

Ser Ser Ile Ala Leu Ala Asn Met Glu Asp Gly Gly Ser Val Gly Arg
785 790 795 800

Ser Asn Asp Ile Pro Gly Arg Arg Ala Arg Phe Ile Gly Glu Lys Ala
805 810 815

Glu Asp Pro Pro Ala Pro Ser Pro Arg Pro Ala Leu Arg Ile Pro Asn
820 825 830

Pro Leu Leu Gly Leu Asp
835

<210> 43
<211> 406

<212> PRT

<213> Mycobacterium avium paratuberculosis

<400> 43

Met Thr Val Thr Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val
1 5 10 15

Asp Ala Gly Lys Ala Asp His Tyr Cys Met Val Ile Asn Asp Asp Ala
20 25 30

Gln Arg Leu Leu Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu
35 40 45

Glu Leu Ile Ala Ala Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
50 55 60

Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu Ile Ala Leu
65 70 75 80

Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly Arg Thr Val
85 90 95

His His Ala Ala Gly Ser Tyr Arg Gly Glu Gly Lys Thr Asp Ala Lys
100 105 110

Asp Ala Ala Ile Ile Ala Asp Gln Ala Arg Met Arg His Asp Leu Gln
115 120 125

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

Ser Arg Arg Ser Asp Leu Val Ala Asp Arg Thr Arg Ala Ile Asn Arg
145 150 155 160

Met Arg Ala Gln Leu Leu Glu Tyr Phe Pro Ala Leu Glu Arg Ala Phe
165 170 175

Asp Tyr Asn Lys Ser Arg Ala Ala Leu Ile Leu Leu Thr Gly Tyr Gln
180 185 190

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

Leu Arg Lys Arg Lys Ala Arg Asn Ala Asp Thr Val Ala Ala Thr Ala
210 215 220

Leu Gln Ala Ala Asn Ala Gln His Ser Ile Val Pro Gly Gln Gln Leu
225 230 235 240

Ala Ala Thr Val Val Ala Arg Leu Ala Lys Glu Val Met Ala Leu Asp
245 250 255

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

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

Leu Gly Ala Glu Phe Leu Ala Ala Thr Gly Gly Asp Met Ala Ala Phe
290 295 300

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

Arg Asp Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg Pro Arg Arg Tyr
325 330 335

Asp Arg Arg Leu Leu Arg Ala Cys Tyr Leu Ser Ala Leu Val Ser Ile
340 345 350

Arg Thr Asp Pro Ser Ser Arg Thr Tyr Tyr Asp Arg Lys Arg Thr Glu
355 360 365

Gly Lys Arg His Thr Gln Ala Val Leu Ala Leu Ala Arg Arg Arg Leu
370 375 380

Asn Val Leu Trp Ala Met Leu Arg Asp His Ala Val Tyr His Pro Ala
385 390 395 400

Thr Thr Thr Ala Ala Ala
405

<210> 44

<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 44

Val Ser Ile Arg Thr Asp Pro Ser Ser Arg
1 5 10

<210> 45
<211> 10
<212> PRT
<213> Artificial Sequence

<220>
<223> Phosphorylated A4 peptide

<220>
<221> MOD_RES
<222> (8)..(8)
<223> PHOSPHORYLATION

<400> 45

Val Ser Ile Arg Thr Asp Pro Ser Ser Arg
1 5 10

<210> 46
<211> 10
<212> PRT
<213> Artificial Sequence

<220>
<223> Phosphorylated A4 peptide

<220>
<221> MOD_RES
<222> (9)..(9)
<223> PHOSPHORYLATION

<400> 46

Val Ser Ile Arg Thr Asp Pro Ser Ser Arg
1 5 10

<210> 47
<211> 10
<212> PRT
<213> Artificial Sequence

<220>
<223> Phosphorylated A4 peptide

<220>
<221> MOD_RES
<222> (8)..(9)
<223> PHOSPHORYLATION

<400> 47

Val Ser Ile Arg Thr Asp Pro Ser Ser Arg
1 5 10

<210> 48
<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 48

Asn Leu Lys Arg Pro Arg Arg Tyr Asp Arg
1 5 10

<210> 49
<211> 2522
<212> DNA
<213> Artificial Sequence

<220>
<223> vaccine polynucleotide sequence

<400> 49

atgcagatct tcgtcaaact gccccttctc actatcggag accagttccc cgcttacgaa 60
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ttcactaccg ttaccagtga ggatcacgca ggtaaatgga gagtcgtctt cttctggcct 180
aaagacttca cctttgtgtg ccctactgag atcgcaacat tcgggaagct gaacgatgag 240
ttcgaagatc gagacgcaca ggttttgggc gtgtctatcg attccgagtt cgtgcacttc 300
aactggagag cacagcatga agatctcaag aaccttccat tccccatgct cagcgacatc 360
aagagagaac tgagcttggc aacaggtggt ctgaatgctg atggcggtgc tgacagagca 420
acattcattg ttgaccccaa taacgagatc cagttcgttt ccgttactgc tggttctgtc 480
ggtagaaacg ttgaagaggt cctgagagtt ctgcacgcac ttcagagtga tgaactgtgt 540
gcctgcaatt ggcggaaagg agatcctact ctcaatgcca cagagctgct taaagcaagt 600

gctctcggat ccattgtcgg acagacctat agagaggtgg aagttgtcct ggtcgtggt 660
ggatctacag ataggactct cgacattgcc aactcctta gaccagagct cggttcaagg 720
ctcgttggtc attctggacc agatgatgga ccatacgacg ccatgaacag aggtgttgga 780
gttgctacag gagaatgggt cttgttcctt ggagctgatg acactctgta cgaaccgact 840
acattggctc aggttgacgc attttggga gatcatgcag cttctcacct tgtgtacgga 900
gatgtggtca tgagatccac caagtccaga catgctggac cattcgatct tgacagactc 960
ctgttcgaga ccaacctctg tcacagagc atcttctaca gacgggaact ctcgacgga 1020
attggacctt acaacctcag gtacaggggt tgggcagact gggatttcaa catcaggtgc 1080
ttctgaacc cagcttggat cacacggtac atggatgttg tgatctccga gtacaacgat 1140
atgaccggct tctcatgag acaggaacc gacaaagagt tcaggaagcg cttgccaatg 1200
tacttctggg ttgctggatg ggaaacatgt cggagaatgc ttgcttctct gaaggacaag 1260
gagaacagga gacttgctct caggactaga ctcacaggg tcaaagcagt gtccaaggaa 1320
aggagtgtcg aacctagaat tcggagacat agacatgcag agatcctcct gagcatgcct 1380
ggatttggcg ttatctcgg agctgaattt cttgcagaa caggaggtga tatggcagct 1440
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gacattggag gaacaccaag ggatattcct gtcgctgga tctggaatgg aagtttggg 2100
accccagcat ggggaggtat tcattgctatc gttccaacg cttaccagtt ccgaaatgtg 2160
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tccagactga gacggaagaa ctctccatc gctctcgcaa acatggaaga tggtgtagt 2400
gttgaagga gtaacgacat ccctgggagg agggctagat ttattggtga gaaagccgaa 2460
gatcctctg ctccatctcc tagaccgcc ttgaggattc caaacctct tctcgtctt 2520
ga 2522

<210> 50
<211> 9
<212> PRT
<213> Artificial Sequence

<220>
<223> Synthetic Peptide

<400> 50

Val Asp Ala Gly Lys Ala Asp His Tyr
1 5

<210> 51
<211> 68
<212> PRT
<213> Artificial Sequence

<220>
<223> Synthetic polypeptide

<400> 51

Met Thr Val Thr Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val
1 5 10 15

Asp Ala Gly Lys Ala Asp His Tyr Cys Met Val Ile Asn Asp Asp Ala
20 25 30

Gln Arg Leu Leu Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu
35 40 45

Glu Leu Ile Ala Ala Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
50 55 60

Trp Ala Ile Asp
65

<210> 52
<211> 39
<212> PRT
<213> Artificial Sequence

<220>
<223> Synthetic polypeptide

<400> 52

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg Val Asp
1 5 10 15

Ala Gly Lys Ala Asp His Tyr Ala Val Thr Thr Leu Ala Asp Gly Gly
20 25 30

Glu Val Thr Trp Ala Ile Asp
35

<210> 53
<211> 22
<212> PRT
<213> Artificial Sequence

<220>
<223> Synthetic polypeptide

<400> 53

Leu Asn Ala Gly Gly Ala Ala Leu Leu Ile Ala Leu Leu Ile Ala Ala
1 5 10 15

Gly Gln Arg Leu Leu Tyr
20

<210> 54
<211> 16
<212> PRT
<213> Artificial Sequence

<220>
<223> Synthetic peptide

<400> 54

Ile Pro Gly Arg Thr Val His His Ala Ala Gly Ser Tyr Arg Gly Glu
1 5 10 15

<210> 55
<211> 16
<212> PRT
<213> Artificial Sequence

<220>
<223> Synthetic peptide

<400> 55

Ile Pro Gly Ala Thr Val His His Ala Ala Gly Ser Tyr Arg Gly Glu
1 5 10 15

<210> 56
<211> 38
<212> PRT
<213> Artificial Sequence

<220>
<223> Synthetic polypeptide

<400> 56

Leu Asn Ala Gly Gly Ala Ala Leu Leu Ile Ala Leu Leu Ile Ala Ala
1 5 10 15

Gly Gln Arg Leu Leu Tyr Ile Pro Gly Arg Thr Val His His Ala Ala
20 25 30

Gly Ser Tyr Arg Gly Glu
35

<210> 57
<211> 38
<212> PRT
<213> Artificial Sequence

<220>
<223> Synthetic polypeptide

<400> 57

Leu Asn Ala Gly Gly Ala Ala Leu Leu Ile Ala Leu Leu Ile Ala Ala
1 5 10 15

Gly Gln Arg Leu Leu Tyr Ile Pro Gly Ala Thr Val His His Ala Ala
20 25 30

Gly Ser Tyr Arg Gly Glu

<210> 58

<211> 106

<212> PRT

<213> Artificial Sequence

<220>

<223> Synthetic polypeptide

<400> 58

Met Thr Val Thr Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val
 1 5 10 15

Asp Ala Gly Lys Ala Asp His Tyr Cys Met Val Ile Asn Asp Asp Ala
 20 25 30

Gln Arg Leu Leu Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu
 35 40 45

Glu Leu Ile Ala Ala Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
 50 55 60

Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu Ile Ala Leu
 65 70 75 80

Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly Arg Thr Val
 85 90 95

His His Ala Ala Gly Ser Tyr Arg Gly Glu
 100 105

<210> 59

<211> 106

<212> PRT

<213> Artificial Sequence

<220>

<223> Synthetic polypeptide

<400> 59

Met Thr Val Thr Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val
 1 5 10 15

Asp Ala Gly Lys Ala Asp His Tyr Cys Met Val Ile Asn Asp Asp Ala
20 25 30

Gln Arg Leu Leu Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu
35 40 45

Glu Leu Ile Ala Ala Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
50 55 60

Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu Ile Ala Leu
65 70 75 80

Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly Ala Thr Val
85 90 95

His His Ala Ala Gly Ser Tyr Arg Gly Glu
100 105

<210> 60

<211> 77

<212> PRT

<213> Artificial Sequence

<220>

<223> Synthetic polypeptide

<400> 60

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg Val Asp
1 5 10 15

Ala Gly Lys Ala Asp His Tyr Ala Val Thr Thr Leu Ala Asp Gly Gly
20 25 30

Glu Val Thr Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu
35 40 45

Ile Ala Leu Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly
50 55 60

Arg Thr Val His His Ala Ala Gly Ser Tyr Arg Gly Glu
65 70 75

<210> 61

<211> 77
<212> PRT
<213> Artificial Sequence

<220>
<223> Synthetic polypeptide

<400> 61

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg Val Asp
1 5 10 15

Ala Gly Lys Ala Asp His Tyr Ala Val Thr Thr Leu Ala Asp Gly Gly
20 25 30

Glu Val Thr Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu
35 40 45

Ile Ala Leu Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly
50 55 60

Ala Thr Val His His Ala Ala Gly Ser Tyr Arg Gly Glu
65 70 75

<210> 62
<211> 968
<212> PRT
<213> Artificial Sequence

<220>
<223> Vaccine polypeptide

<400> 62

Met Thr Val Thr Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val
1 5 10 15

Asp Ala Gly Lys Ala Asp His Tyr Cys Met Val Ile Asn Asp Asp Ala
20 25 30

Gln Arg Leu Leu Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu
35 40 45

Glu Leu Ile Ala Ala Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
50 55 60

Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu Ile Ala Leu
65 70 75 80

Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly Ala Thr Val
85 90 95

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

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

Gly Pro Met Gln Ile Phe Val Lys Leu Pro Leu Leu Thr Ile Gly Asp
130 135 140

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

Lys Val Asp Ala Lys Gln Pro Gly Asp Tyr Phe Thr Thr Val Thr Ser
165 170 175

Glu Asp His Ala Gly Lys Trp Arg Val Val Phe Phe Trp Pro Lys Asp
180 185 190

Phe Thr Gly Pro Glu Ile Ala Thr Phe Gly Lys Leu Asn Asp Glu Phe
195 200 205

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

Val His Phe Asn Trp Arg Ala Gln His Glu Asp Leu Lys Asn Leu Pro
225 230 235 240

Phe Pro Met Leu Ser Asp Ile Lys Arg Glu Leu Ser Leu Ala Thr Gly
245 250 255

Val Leu Asn Ala Asp Gly Val Ala Asp Arg Ala Thr Phe Ile Val Asp
260 265 270

Pro Asn Asn Glu Ile Gln Phe Val Ser Val Thr Ala Gly Ser Val Gly
275 280 285

Arg Asn Val Glu Glu Val Leu Arg Val Leu Asp Ala Leu Gln Ser Asp
290 295 300

Glu Leu Cys Ala Cys Asn Trp Arg Lys Gly Asp Pro Thr Leu Asn Ala
305 310 315 320

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

Tyr Arg Glu Val Glu Val Val Leu Val Asp Gly Gly Ser Thr Asp Arg
340 345 350

Thr Leu Asp Ile Ala Asn Ser Phe Arg Pro Glu Leu Gly Ser Arg Leu
355 360 365

Val Val His Ser Gly Pro Asp Asp Gly Pro Tyr Asp Ala Met Asn Arg
370 375 380

Gly Val Gly Val Ala Thr Gly Glu Trp Val Leu Phe Leu Gly Ala Asp
385 390 395 400

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

Gly Asp His Ala Ala Ser His Leu Val Tyr Gly Asp Val Val Met Arg
420 425 430

Ser Thr Lys Ser Arg His Ala Gly Pro Phe Asp Leu Asp Arg Leu Leu
435 440 445

Phe Glu Thr Asn Leu Cys His Gln Ser Ile Phe Tyr Arg Arg Glu Leu
450 455 460

Phe Asp Gly Ile Gly Pro Tyr Asn Leu Arg Tyr Arg Val Trp Ala Asp
465 470 475 480

Trp Asp Phe Asn Ile Arg Cys Phe Ser Asn Pro Ala Leu Ile Thr Arg
485 490 495

Tyr Met Asp Val Val Ile Ser Glu Tyr Asn Asp Met Thr Gly Phe Ser
500 505 510

Met Arg Gln Gly Thr Asp Lys Glu Phe Arg Lys Arg Leu Pro Met Tyr
515 520 525

Phe Trp Val Ala Gly Trp Glu Thr Cys Arg Arg Met Leu Ala Phe Leu
530 535 540

Lys Asp Lys Glu Asn Arg Arg Leu Ala Leu Arg Thr Arg Leu Ile Arg
545 550 555 560

Val Lys Ala Val Ser Lys Glu Arg Ser Ala Glu Pro Arg Ile Arg Arg
565 570 575

His Arg His Ala Glu Ile Ile Leu Ser Met Pro Gly Phe Gly Val Ile
580 585 590

Leu Gly Ala Glu Phe Leu Ala Ala Thr Gly Gly Asp Met Ala Ala Phe
595 600 605

Ala Ser Ala Asp Arg Leu Ala Gly Val Ala Gly Leu Ala Pro Val Pro
610 615 620

Arg Asp Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg Pro Arg Arg Tyr
625 630 635 640

Asp Arg Arg Leu Leu Arg Ala Cys Tyr Leu Ser Ala Leu Val Ser Ile
645 650 655

Arg Thr Asp Pro Ser Ser Arg Thr Tyr Tyr Asp Arg Lys Arg Thr Glu
660 665 670

Gly Lys Arg His Thr Gln Ala Val Leu Ala Leu Ala Arg Arg Arg Leu
675 680 685

Asn Val Leu Trp Ala Met Leu Arg Asp His Ala Val Tyr His Pro Ala
690 695 700

Thr Thr Thr Ala Ala Ala Arg Leu Lys Leu Arg Arg Gly Glu Arg Pro
705 710 715 720

Met Ser Leu Gly Gln Val Phe Asp Pro Arg Ala Asn Ala Leu His Ser

725 730 735

Phe Pro Leu Thr Gly Arg Met Pro Trp Ala Pro Phe Ile Val Ser Ser
740 745 750

Trp Leu Arg Asn Pro His Pro Ala Gln Tyr Phe Thr Ala Arg Cys Leu
755 760 765

Arg Ile Leu Pro Gly Leu Trp Ile Gly Ala Gln Gly Gly Ser Ala Ala
770 775 780

Lys Leu Leu Met Ser Gly Ala Pro Ile Glu Tyr Val Leu Lys Asp Ser
785 790 795 800

Ala Val Trp Met Phe Lys Phe Asp Ile Gly Gly Thr Pro Arg Asp Ile
805 810 815

Pro Val Ala Gly Ile Trp Asn Gly Ser Leu Trp Thr Pro Ala Trp Gly
820 825 830

Gly Ile His Ala Ile Ala Ser Asn Ala Tyr Gln Phe Arg Asn Val Ile
835 840 845

Pro Ala Arg Trp Ser Val Ser Ser Ala Val Leu Pro Asn Tyr Arg Leu
850 855 860

Val Ala Ala Leu Pro Met Ala Tyr His Asn Gln Arg Met Arg Phe Arg
865 870 875 880

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

Ala Leu Val Glu Lys Pro Ala Leu Ser Trp Lys Ser Arg Leu Arg Arg
900 905 910

Lys Asn Ser Ser Ile Ala Leu Ala Asn Met Glu Asp Gly Gly Ser Val
915 920 925

Gly Arg Ser Asn Asp Ile Pro Gly Arg Arg Ala Arg Phe Ile Gly Glu
930 935 940

Lys Ala Glu Asp Pro Pro Ala Pro Ser Pro Arg Pro Ala Leu Arg Ile
945 950 955 960

Pro Asn Pro Leu Leu Gly Leu Asp
965

<210> 63

<211> 963

<212> PRT

<213> Artificial Sequence

<220>

<223> Vaccine polypeptide

<400> 63

Met Thr Val Thr Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val
1 5 10 15

Asp Ala Gly Lys Ala Asp His Tyr Cys Met Val Ile Asn Asp Asp Ala
20 25 30

Gln Arg Leu Leu Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu
35 40 45

Glu Leu Ile Ala Ala Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
50 55 60

Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu Ile Ala Leu
65 70 75 80

Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly Ala Thr Val
85 90 95

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

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

Gly Pro Met Gln Ile Phe Val Lys Leu Pro Leu Leu Thr Ile Gly Asp
130 135 140

Gln Phe Pro Ala Tyr Glu Leu Thr Ala Leu Ile Ala Gly Asp Leu Ser

145 150 155 160

Lys Val Asp Ala Lys Gln Pro Gly Asp Tyr Phe Thr Thr Val Thr Ser
165 170 175

Glu Asp His Ala Gly Lys Trp Arg Val Val Phe Phe Trp Pro Lys Asp
180 185 190

Phe Thr Gly Pro Glu Ile Ala Thr Phe Gly Lys Leu Asn Asp Glu Phe
195 200 205

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

Val His Phe Asn Trp Arg Ala Gln His Glu Asp Leu Lys Asn Leu Pro
225 230 235 240

Phe Pro Met Leu Ser Asp Ile Lys Arg Glu Leu Ser Leu Ala Thr Gly
245 250 255

Val Leu Asn Ala Asp Gly Val Ala Asp Arg Ala Thr Phe Ile Val Asp
260 265 270

Pro Asn Asn Glu Ile Gln Phe Val Ser Val Thr Ala Gly Ser Val Gly
275 280 285

Arg Asn Val Glu Glu Val Leu Arg Val Leu Asp Ala Leu Gln Ser Asp
290 295 300

Glu Leu Cys Ala Cys Asn Trp Arg Lys Gly Asp Pro Thr Leu Asn Ala
305 310 315 320

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

Tyr Arg Glu Val Glu Val Val Leu Val Asp Gly Gly Ser Thr Asp Arg
340 345 350

Thr Leu Asp Ile Ala Asn Ser Phe Arg Pro Glu Leu Gly Ser Arg Leu
355 360 365

Val Val His Ser Gly Pro Asp Asp Gly Pro Tyr Asp Ala Met Asn Arg
370 375 380

Gly Val Gly Val Ala Thr Gly Glu Trp Val Leu Phe Leu Gly Ala Asp
385 390 395 400

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

Gly Asp His Ala Ala Ser His Leu Val Tyr Gly Asp Val Val Met Arg
420 425 430

Ser Thr Lys Ser Arg His Ala Gly Pro Phe Asp Leu Asp Arg Leu Leu
435 440 445

Phe Glu Thr Asn Leu Cys His Gln Ser Ile Phe Tyr Arg Arg Glu Leu
450 455 460

Phe Asp Gly Ile Gly Pro Tyr Asn Leu Arg Tyr Arg Val Trp Ala Asp
465 470 475 480

Trp Asp Phe Asn Ile Arg Cys Phe Ser Asn Pro Ala Leu Ile Thr Arg
485 490 495

Tyr Met Asp Val Val Ile Ser Glu Tyr Asn Asp Met Thr Gly Phe Ser
500 505 510

Met Arg Gln Gly Thr Asp Lys Glu Phe Arg Lys Arg Leu Pro Met Tyr
515 520 525

Phe Trp Val Ala Gly Trp Glu Thr Cys Arg Arg Met Leu Ala Phe Leu
530 535 540

Lys Asp Lys Glu Asn Arg Arg Leu Ala Leu Arg Thr Arg Leu Ile Arg
545 550 555 560

Val Lys Ala Val Ser Lys Glu Arg Ser Ala Glu Pro Arg Ile Arg Arg
565 570 575

His Arg His Ala Glu Ile Ile Leu Ser Met Pro Gly Phe Gly Val Ile
580 585 590

Leu Gly Ala Glu Phe Leu Ala Ala Thr Gly Gly Asp Met Ala Ala Phe
595 600 605

Ala Ser Ala Asp Arg Leu Ala Gly Val Ala Gly Leu Ala Pro Val Pro
610 615 620

Arg Asp Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg Pro Arg Arg Tyr
625 630 635 640

Asp Arg Arg Leu Leu Arg Ala Cys Val Ser Ile Arg Thr Asp Pro Ser
645 650 655

Ser Arg Thr Tyr Tyr Asp Arg Lys Arg Thr Glu Gly Lys Arg His Thr
660 665 670

Gln Ala Val Leu Ala Leu Ala Arg Arg Arg Leu Asn Val Leu Trp Ala
675 680 685

Met Leu Arg Asp His Ala Val Tyr His Pro Ala Thr Thr Thr Ala Ala
690 695 700

Ala Arg Leu Lys Leu Arg Arg Gly Glu Arg Pro Met Ser Leu Gly Gln
705 710 715 720

Val Phe Asp Pro Arg Ala Asn Ala Leu His Ser Phe Pro Leu Thr Gly
725 730 735

Arg Met Pro Trp Ala Pro Phe Ile Val Ser Ser Trp Leu Arg Asn Pro
740 745 750

His Pro Ala Gln Tyr Phe Thr Ala Arg Cys Leu Arg Ile Leu Pro Gly
755 760 765

Leu Trp Ile Gly Ala Gln Gly Gly Ser Ala Ala Lys Leu Leu Met Ser
770 775 780

Gly Ala Pro Ile Glu Tyr Val Leu Lys Asp Ser Ala Val Trp Met Phe
785 790 795 800

Lys Phe Asp Ile Gly Gly Thr Pro Arg Asp Ile Pro Val Ala Gly Ile
805 810 815

Trp Asn Gly Ser Leu Trp Thr Pro Ala Trp Gly Gly Ile His Ala Ile
820 825 830

Ala Ser Asn Ala Tyr Gln Phe Arg Asn Val Ile Pro Ala Arg Trp Ser
835 840 845

Val Ser Ser Ala Val Leu Pro Asn Tyr Arg Leu Val Ala Ala Leu Pro
850 855 860

Met Ala Tyr His Asn Gln Arg Met Arg Phe Arg Thr Asp Leu Ser Tyr
865 870 875 880

Gly Val Tyr Gly Phe Ala Glu Ile Asn Pro Ile Ala Leu Val Glu Lys
885 890 895

Pro Ala Leu Ser Trp Lys Ser Arg Leu Arg Arg Lys Asn Ser Ser Ile
900 905 910

Ala Leu Ala Asn Met Glu Asp Gly Gly Ser Val Gly Arg Ser Asn Asp
915 920 925

Ile Pro Gly Arg Arg Ala Arg Phe Ile Gly Glu Lys Ala Glu Asp Pro
930 935 940

Pro Ala Pro Ser Pro Arg Pro Ala Leu Arg Ile Pro Asn Pro Leu Leu
945 950 955 960

Gly Leu Asp

<210> 64

<211> 968

<212> PRT

<213> Artificial Sequence

<220>

<223> Vaccine polypeptide

<400> 64

Met Thr Val Thr Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val
1 5 10 15

Asp Ala Gly Lys Ala Asp His Tyr Cys Met Val Ile Asn Asp Asp Ala
20 25 30

Gln Arg Leu Leu Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu
35 40 45

Glu Leu Ile Ala Ala Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
50 55 60

Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu Ile Ala Leu
65 70 75 80

Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly Arg Thr Val
85 90 95

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

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

Gly Pro Met Gln Ile Phe Val Lys Leu Pro Leu Leu Thr Ile Gly Asp
130 135 140

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

Lys Val Asp Ala Lys Gln Pro Gly Asp Tyr Phe Thr Thr Val Thr Ser
165 170 175

Glu Asp His Ala Gly Lys Trp Arg Val Val Phe Phe Trp Pro Lys Asp
180 185 190

Phe Thr Gly Pro Glu Ile Ala Thr Phe Gly Lys Leu Asn Asp Glu Phe
195 200 205

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

Val His Phe Asn Trp Arg Ala Gln His Glu Asp Leu Lys Asn Leu Pro
225 230 235 240

Phe Pro Met Leu Ser Asp Ile Lys Arg Glu Leu Ser Leu Ala Thr Gly
245 250 255

Val Leu Asn Ala Asp Gly Val Ala Asp Arg Ala Thr Phe Ile Val Asp
260 265 270

Pro Asn Asn Glu Ile Gln Phe Val Ser Val Thr Ala Gly Ser Val Gly
275 280 285

Arg Asn Val Glu Glu Val Leu Arg Val Leu Asp Ala Leu Gln Ser Asp
290 295 300

Glu Leu Cys Ala Cys Asn Trp Arg Lys Gly Asp Pro Thr Leu Asn Ala
305 310 315 320

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

Tyr Arg Glu Val Glu Val Val Leu Val Asp Gly Gly Ser Thr Asp Arg
340 345 350

Thr Leu Asp Ile Ala Asn Ser Phe Arg Pro Glu Leu Gly Ser Arg Leu
355 360 365

Val Val His Ser Gly Pro Asp Asp Gly Pro Tyr Asp Ala Met Asn Arg
370 375 380

Gly Val Gly Val Ala Thr Gly Glu Trp Val Leu Phe Leu Gly Ala Asp
385 390 395 400

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

Gly Asp His Ala Ala Ser His Leu Val Tyr Gly Asp Val Val Met Arg
420 425 430

Ser Thr Lys Ser Arg His Ala Gly Pro Phe Asp Leu Asp Arg Leu Leu
435 440 445

Phe Glu Thr Asn Leu Cys His Gln Ser Ile Phe Tyr Arg Arg Glu Leu

450 455 460

Phe Asp Gly Ile Gly Pro Tyr Asn Leu Arg Tyr Arg Val Trp Ala Asp
465 470 475 480

Trp Asp Phe Asn Ile Arg Cys Phe Ser Asn Pro Ala Leu Ile Thr Arg
485 490 495

Tyr Met Asp Val Val Ile Ser Glu Tyr Asn Asp Met Thr Gly Phe Ser
500 505 510

Met Arg Gln Gly Thr Asp Lys Glu Phe Arg Lys Arg Leu Pro Met Tyr
515 520 525

Phe Trp Val Ala Gly Trp Glu Thr Cys Arg Arg Met Leu Ala Phe Leu
530 535 540

Lys Asp Lys Glu Asn Arg Arg Leu Ala Leu Arg Thr Arg Leu Ile Arg
545 550 555 560

Val Lys Ala Val Ser Lys Glu Arg Ser Ala Glu Pro Arg Ile Arg Arg
565 570 575

His Arg His Ala Glu Ile Ile Leu Ser Met Pro Gly Phe Gly Val Ile
580 585 590

Leu Gly Ala Glu Phe Leu Ala Ala Thr Gly Gly Asp Met Ala Ala Phe
595 600 605

Ala Ser Ala Asp Arg Leu Ala Gly Val Ala Gly Leu Ala Pro Val Pro
610 615 620

Arg Asp Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg Pro Arg Arg Tyr
625 630 635 640

Asp Arg Arg Leu Leu Arg Ala Cys Tyr Leu Ser Ala Leu Val Ser Ile
645 650 655

Arg Thr Asp Pro Ser Ser Arg Thr Tyr Tyr Asp Arg Lys Arg Thr Glu
660 665 670

Gly Lys Arg His Thr Gln Ala Val Leu Ala Leu Ala Arg Arg Arg Leu
675 680 685

Asn Val Leu Trp Ala Met Leu Arg Asp His Ala Val Tyr His Pro Ala
690 695 700

Thr Thr Thr Ala Ala Ala Arg Leu Lys Leu Arg Arg Gly Glu Arg Pro
705 710 715 720

Met Ser Leu Gly Gln Val Phe Asp Pro Arg Ala Asn Ala Leu His Ser
725 730 735

Phe Pro Leu Thr Gly Arg Met Pro Trp Ala Pro Phe Ile Val Ser Ser
740 745 750

Trp Leu Arg Asn Pro His Pro Ala Gln Tyr Phe Thr Ala Arg Cys Leu
755 760 765

Arg Ile Leu Pro Gly Leu Trp Ile Gly Ala Gln Gly Gly Ser Ala Ala
770 775 780

Lys Leu Leu Met Ser Gly Ala Pro Ile Glu Tyr Val Leu Lys Asp Ser
785 790 795 800

Ala Val Trp Met Phe Lys Phe Asp Ile Gly Gly Thr Pro Arg Asp Ile
805 810 815

Pro Val Ala Gly Ile Trp Asn Gly Ser Leu Trp Thr Pro Ala Trp Gly
820 825 830

Gly Ile His Ala Ile Ala Ser Asn Ala Tyr Gln Phe Arg Asn Val Ile
835 840 845

Pro Ala Arg Trp Ser Val Ser Ser Ala Val Leu Pro Asn Tyr Arg Leu
850 855 860

Val Ala Ala Leu Pro Met Ala Tyr His Asn Gln Arg Met Arg Phe Arg
865 870 875 880

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

Ala Leu Val Glu Lys Pro Ala Leu Ser Trp Lys Ser Arg Leu Arg Arg
900 905 910

Lys Asn Ser Ser Ile Ala Leu Ala Asn Met Glu Asp Gly Gly Ser Val
915 920 925

Gly Arg Ser Asn Asp Ile Pro Gly Arg Arg Ala Arg Phe Ile Gly Glu
930 935 940

Lys Ala Glu Asp Pro Pro Ala Pro Ser Pro Arg Pro Ala Leu Arg Ile
945 950 955 960

Pro Asn Pro Leu Leu Gly Leu Asp
965

<210> 65

<211> 963

<212> PRT

<213> Artificial Sequence

<220>

<223> Vaccine polypeptide

<400> 65

Met Thr Val Thr Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val
1 5 10 15

Asp Ala Gly Lys Ala Asp His Tyr Cys Met Val Ile Asn Asp Asp Ala
20 25 30

Gln Arg Leu Leu Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu
35 40 45

Glu Leu Ile Ala Ala Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
50 55 60

Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu Ile Ala Leu
65 70 75 80

Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly Arg Thr Val
85 90 95

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

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

Gly Pro Met Gln Ile Phe Val Lys Leu Pro Leu Leu Thr Ile Gly Asp
130 135 140

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

Lys Val Asp Ala Lys Gln Pro Gly Asp Tyr Phe Thr Thr Val Thr Ser
165 170 175

Glu Asp His Ala Gly Lys Trp Arg Val Val Phe Phe Trp Pro Lys Asp
180 185 190

Phe Thr Gly Pro Glu Ile Ala Thr Phe Gly Lys Leu Asn Asp Glu Phe
195 200 205

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

Val His Phe Asn Trp Arg Ala Gln His Glu Asp Leu Lys Asn Leu Pro
225 230 235 240

Phe Pro Met Leu Ser Asp Ile Lys Arg Glu Leu Ser Leu Ala Thr Gly
245 250 255

Val Leu Asn Ala Asp Gly Val Ala Asp Arg Ala Thr Phe Ile Val Asp
260 265 270

Pro Asn Asn Glu Ile Gln Phe Val Ser Val Thr Ala Gly Ser Val Gly
275 280 285

Arg Asn Val Glu Glu Val Leu Arg Val Leu Asp Ala Leu Gln Ser Asp
290 295 300

Glu Leu Cys Ala Cys Asn Trp Arg Lys Gly Asp Pro Thr Leu Asn Ala
305 310 315 320

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

Tyr Arg Glu Val Glu Val Val Leu Val Asp Gly Gly Ser Thr Asp Arg
340 345 350

Thr Leu Asp Ile Ala Asn Ser Phe Arg Pro Glu Leu Gly Ser Arg Leu
355 360 365

Val Val His Ser Gly Pro Asp Asp Gly Pro Tyr Asp Ala Met Asn Arg
370 375 380

Gly Val Gly Val Ala Thr Gly Glu Trp Val Leu Phe Leu Gly Ala Asp
385 390 395 400

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

Gly Asp His Ala Ala Ser His Leu Val Tyr Gly Asp Val Val Met Arg
420 425 430

Ser Thr Lys Ser Arg His Ala Gly Pro Phe Asp Leu Asp Arg Leu Leu
435 440 445

Phe Glu Thr Asn Leu Cys His Gln Ser Ile Phe Tyr Arg Arg Glu Leu
450 455 460

Phe Asp Gly Ile Gly Pro Tyr Asn Leu Arg Tyr Arg Val Trp Ala Asp
465 470 475 480

Trp Asp Phe Asn Ile Arg Cys Phe Ser Asn Pro Ala Leu Ile Thr Arg
485 490 495

Tyr Met Asp Val Val Ile Ser Glu Tyr Asn Asp Met Thr Gly Phe Ser
500 505 510

Met Arg Gln Gly Thr Asp Lys Glu Phe Arg Lys Arg Leu Pro Met Tyr
515 520 525

Phe Trp Val Ala Gly Trp Glu Thr Cys Arg Arg Met Leu Ala Phe Leu
530 535 540

Lys Asp Lys Glu Asn Arg Arg Leu Ala Leu Arg Thr Arg Leu Ile Arg
545 550 555 560

Val Lys Ala Val Ser Lys Glu Arg Ser Ala Glu Pro Arg Ile Arg Arg
565 570 575

His Arg His Ala Glu Ile Ile Leu Ser Met Pro Gly Phe Gly Val Ile
580 585 590

Leu Gly Ala Glu Phe Leu Ala Ala Thr Gly Gly Asp Met Ala Ala Phe
595 600 605

Ala Ser Ala Asp Arg Leu Ala Gly Val Ala Gly Leu Ala Pro Val Pro
610 615 620

Arg Asp Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg Pro Arg Arg Tyr
625 630 635 640

Asp Arg Arg Leu Leu Arg Ala Cys Val Ser Ile Arg Thr Asp Pro Ser
645 650 655

Ser Arg Thr Tyr Tyr Asp Arg Lys Arg Thr Glu Gly Lys Arg His Thr
660 665 670

Gln Ala Val Leu Ala Leu Ala Arg Arg Arg Leu Asn Val Leu Trp Ala
675 680 685

Met Leu Arg Asp His Ala Val Tyr His Pro Ala Thr Thr Thr Ala Ala
690 695 700

Ala Arg Leu Lys Leu Arg Arg Gly Glu Arg Pro Met Ser Leu Gly Gln
705 710 715 720

Val Phe Asp Pro Arg Ala Asn Ala Leu His Ser Phe Pro Leu Thr Gly
725 730 735

Arg Met Pro Trp Ala Pro Phe Ile Val Ser Ser Trp Leu Arg Asn Pro
740 745 750

His Pro Ala Gln Tyr Phe Thr Ala Arg Cys Leu Arg Ile Leu Pro Gly

755 760 765

Leu Trp Ile Gly Ala Gln Gly Gly Ser Ala Ala Lys Leu Leu Met Ser
770 775 780

Gly Ala Pro Ile Glu Tyr Val Leu Lys Asp Ser Ala Val Trp Met Phe
785 790 795 800

Lys Phe Asp Ile Gly Gly Thr Pro Arg Asp Ile Pro Val Ala Gly Ile
805 810 815

Trp Asn Gly Ser Leu Trp Thr Pro Ala Trp Gly Gly Ile His Ala Ile
820 825 830

Ala Ser Asn Ala Tyr Gln Phe Arg Asn Val Ile Pro Ala Arg Trp Ser
835 840 845

Val Ser Ser Ala Val Leu Pro Asn Tyr Arg Leu Val Ala Ala Leu Pro
850 855 860

Met Ala Tyr His Asn Gln Arg Met Arg Phe Arg Thr Asp Leu Ser Tyr
865 870 875 880

Gly Val Tyr Gly Phe Ala Glu Ile Asn Pro Ile Ala Leu Val Glu Lys
885 890 895

Pro Ala Leu Ser Trp Lys Ser Arg Leu Arg Arg Lys Asn Ser Ser Ile
900 905 910

Ala Leu Ala Asn Met Glu Asp Gly Gly Ser Val Gly Arg Ser Asn Asp
915 920 925

Ile Pro Gly Arg Arg Ala Arg Phe Ile Gly Glu Lys Ala Glu Asp Pro
930 935 940

Pro Ala Pro Ser Pro Arg Pro Ala Leu Arg Ile Pro Asn Pro Leu Leu
945 950 955 960

Gly Leu Asp

<210> 66
<211> 939
<212> PRT
<213> Artificial Sequence

<220>
<223> Vaccine polypeptide

<400> 66

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg Val Asp
1 5 10 15

Ala Gly Lys Ala Asp His Tyr Ala Val Thr Thr Leu Ala Asp Gly Gly
20 25 30

Glu Val Thr Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu
35 40 45

Ile Ala Leu Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly
50 55 60

Ala Thr Val His His Ala Ala Gly Ser Tyr Arg Gly Glu Ala Pro Val
65 70 75 80

Lys Gln Thr Leu Asn Phe Asp Leu Leu Lys Leu Ala Gly Asp Val Glu
85 90 95

Ser Asn Pro Gly Pro Met Gln Ile Phe Val Lys Leu Pro Leu Leu Thr
100 105 110

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

Asp Leu Ser Lys Val Asp Ala Lys Gln Pro Gly Asp Tyr Phe Thr Thr
130 135 140

Val Thr Ser Glu Asp His Ala Gly Lys Trp Arg Val Val Phe Phe Trp
145 150 155 160

Pro Lys Asp Phe Thr Gly Pro Glu Ile Ala Thr Phe Gly Lys Leu Asn
165 170 175

Asp Glu Phe Glu Asp Arg Asp Ala Gln Val Leu Gly Val Ser Ile Asp

180 185 190

Ser Glu Phe Val His Phe Asn Trp Arg Ala Gln His Glu Asp Leu Lys
195 200 205

Asn Leu Pro Phe Pro Met Leu Ser Asp Ile Lys Arg Glu Leu Ser Leu
210 215 220

Ala Thr Gly Val Leu Asn Ala Asp Gly Val Ala Asp Arg Ala Thr Phe
225 230 235 240

Ile Val Asp Pro Asn Asn Glu Ile Gln Phe Val Ser Val Thr Ala Gly
245 250 255

Ser Val Gly Arg Asn Val Glu Glu Val Leu Arg Val Leu Asp Ala Leu
260 265 270

Gln Ser Asp Glu Leu Cys Ala Cys Asn Trp Arg Lys Gly Asp Pro Thr
275 280 285

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

Gly Gln Thr Tyr Arg Glu Val Glu Val Val Leu Val Asp Gly Gly Ser
305 310 315 320

Thr Asp Arg Thr Leu Asp Ile Ala Asn Ser Phe Arg Pro Glu Leu Gly
325 330 335

Ser Arg Leu Val Val His Ser Gly Pro Asp Asp Gly Pro Tyr Asp Ala
340 345 350

Met Asn Arg Gly Val Gly Val Ala Thr Gly Glu Trp Val Leu Phe Leu
355 360 365

Gly Ala Asp Asp Thr Leu Tyr Glu Pro Thr Thr Leu Ala Gln Val Ala
370 375 380

Ala Phe Leu Gly Asp His Ala Ala Ser His Leu Val Tyr Gly Asp Val
385 390 395 400

Val Met Arg Ser Thr Lys Ser Arg His Ala Gly Pro Phe Asp Leu Asp
405 410 415

Arg Leu Leu Phe Glu Thr Asn Leu Cys His Gln Ser Ile Phe Tyr Arg
420 425 430

Arg Glu Leu Phe Asp Gly Ile Gly Pro Tyr Asn Leu Arg Tyr Arg Val
435 440 445

Trp Ala Asp Trp Asp Phe Asn Ile Arg Cys Phe Ser Asn Pro Ala Leu
450 455 460

Ile Thr Arg Tyr Met Asp Val Val Ile Ser Glu Tyr Asn Asp Met Thr
465 470 475 480

Gly Phe Ser Met Arg Gln Gly Thr Asp Lys Glu Phe Arg Lys Arg Leu
485 490 495

Pro Met Tyr Phe Trp Val Ala Gly Trp Glu Thr Cys Arg Arg Met Leu
500 505 510

Ala Phe Leu Lys Asp Lys Glu Asn Arg Arg Leu Ala Leu Arg Thr Arg
515 520 525

Leu Ile Arg Val Lys Ala Val Ser Lys Glu Arg Ser Ala Glu Pro Arg
530 535 540

Ile Arg Arg His Arg His Ala Glu Ile Ile Leu Ser Met Pro Gly Phe
545 550 555 560

Gly Val Ile Leu Gly Ala Glu Phe Leu Ala Ala Thr Gly Gly Asp Met
565 570 575

Ala Ala Phe Ala Ser Ala Asp Arg Leu Ala Gly Val Ala Gly Leu Ala
580 585 590

Pro Val Pro Arg Asp Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg Pro
595 600 605

Arg Arg Tyr Asp Arg Arg Leu Leu Arg Ala Cys Tyr Leu Ser Ala Leu
610 615 620

Val Ser Ile Arg Thr Asp Pro Ser Ser Arg Thr Tyr Tyr Asp Arg Lys
625 630 635 640

Arg Thr Glu Gly Lys Arg His Thr Gln Ala Val Leu Ala Leu Ala Arg
 645 650 655

Arg Arg Leu Asn Val Leu Trp Ala Met Leu Arg Asp His Ala Val Tyr
 660 665 670

His Pro Ala Thr Thr Thr Ala Ala Ala Arg Leu Lys Leu Arg Arg Gly
 675 680 685

Glu Arg Pro Met Ser Leu Gly Gln Val Phe Asp Pro Arg Ala Asn Ala
 690 695 700

Leu His Ser Phe Pro Leu Thr Gly Arg Met Pro Trp Ala Pro Phe Ile
705 710 715 720

Val Ser Ser Trp Leu Arg Asn Pro His Pro Ala Gln Tyr Phe Thr Ala
 725 730 735

Arg Cys Leu Arg Ile Leu Pro Gly Leu Trp Ile Gly Ala Gln Gly Gly
 740 745 750

Ser Ala Ala Lys Leu Leu Met Ser Gly Ala Pro Ile Glu Tyr Val Leu
 755 760 765

Lys Asp Ser Ala Val Trp Met Phe Lys Phe Asp Ile Gly Gly Thr Pro
 770 775 780

Arg Asp Ile Pro Val Ala Gly Ile Trp Asn Gly Ser Leu Trp Thr Pro
785 790 795 800

Ala Trp Gly Gly Ile His Ala Ile Ala Ser Asn Ala Tyr Gln Phe Arg
 805 810 815

Asn Val Ile Pro Ala Arg Trp Ser Val Ser Ser Ala Val Leu Pro Asn
 820 825 830

Tyr Arg Leu Val Ala Ala Leu Pro Met Ala Tyr His Asn Gln Arg Met
 835 840 845

Arg Phe Arg Thr Asp Leu Ser Tyr Gly Val Tyr Gly Phe Ala Glu Ile
850 855 860

Asn Pro Ile Ala Leu Val Glu Lys Pro Ala Leu Ser Trp Lys Ser Arg
865 870 875 880

Leu Arg Arg Lys Asn Ser Ser Ile Ala Leu Ala Asn Met Glu Asp Gly
885 890 895

Gly Ser Val Gly Arg Ser Asn Asp Ile Pro Gly Arg Arg Ala Arg Phe
900 905 910

Ile Gly Glu Lys Ala Glu Asp Pro Pro Ala Pro Ser Pro Arg Pro Ala
915 920 925

Leu Arg Ile Pro Asn Pro Leu Leu Gly Leu Asp
930 935

<210> 67

<211> 934

<212> PRT

<213> Artificial Sequence

<220>

<223> Vaccine polypeptide

<400> 67

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg Val Asp
1 5 10 15

Ala Gly Lys Ala Asp His Tyr Ala Val Thr Thr Leu Ala Asp Gly Gly
20 25 30

Glu Val Thr Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu
35 40 45

Ile Ala Leu Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly
50 55 60

Ala Thr Val His His Ala Ala Gly Ser Tyr Arg Gly Glu Ala Pro Val
65 70 75 80

Lys Gln Thr Leu Asn Phe Asp Leu Leu Lys Leu Ala Gly Asp Val Glu
85 90 95

Ser Asn Pro Gly Pro Met Gln Ile Phe Val Lys Leu Pro Leu Leu Thr
100 105 110

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

Asp Leu Ser Lys Val Asp Ala Lys Gln Pro Gly Asp Tyr Phe Thr Thr
130 135 140

Val Thr Ser Glu Asp His Ala Gly Lys Trp Arg Val Val Phe Phe Trp
145 150 155 160

Pro Lys Asp Phe Thr Gly Pro Glu Ile Ala Thr Phe Gly Lys Leu Asn
165 170 175

Asp Glu Phe Glu Asp Arg Asp Ala Gln Val Leu Gly Val Ser Ile Asp
180 185 190

Ser Glu Phe Val His Phe Asn Trp Arg Ala Gln His Glu Asp Leu Lys
195 200 205

Asn Leu Pro Phe Pro Met Leu Ser Asp Ile Lys Arg Glu Leu Ser Leu
210 215 220

Ala Thr Gly Val Leu Asn Ala Asp Gly Val Ala Asp Arg Ala Thr Phe
225 230 235 240

Ile Val Asp Pro Asn Asn Glu Ile Gln Phe Val Ser Val Thr Ala Gly
245 250 255

Ser Val Gly Arg Asn Val Glu Glu Val Leu Arg Val Leu Asp Ala Leu
260 265 270

Gln Ser Asp Glu Leu Cys Ala Cys Asn Trp Arg Lys Gly Asp Pro Thr
275 280 285

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

Gly Gln Thr Tyr Arg Glu Val Glu Val Val Leu Val Asp Gly Gly Ser
305 310 315 320

Thr Asp Arg Thr Leu Asp Ile Ala Asn Ser Phe Arg Pro Glu Leu Gly
325 330 335

Ser Arg Leu Val Val His Ser Gly Pro Asp Asp Gly Pro Tyr Asp Ala
340 345 350

Met Asn Arg Gly Val Gly Val Ala Thr Gly Glu Trp Val Leu Phe Leu
355 360 365

Gly Ala Asp Asp Thr Leu Tyr Glu Pro Thr Thr Leu Ala Gln Val Ala
370 375 380

Ala Phe Leu Gly Asp His Ala Ala Ser His Leu Val Tyr Gly Asp Val
385 390 395 400

Val Met Arg Ser Thr Lys Ser Arg His Ala Gly Pro Phe Asp Leu Asp
405 410 415

Arg Leu Leu Phe Glu Thr Asn Leu Cys His Gln Ser Ile Phe Tyr Arg
420 425 430

Arg Glu Leu Phe Asp Gly Ile Gly Pro Tyr Asn Leu Arg Tyr Arg Val
435 440 445

Trp Ala Asp Trp Asp Phe Asn Ile Arg Cys Phe Ser Asn Pro Ala Leu
450 455 460

Ile Thr Arg Tyr Met Asp Val Val Ile Ser Glu Tyr Asn Asp Met Thr
465 470 475 480

Gly Phe Ser Met Arg Gln Gly Thr Asp Lys Glu Phe Arg Lys Arg Leu
485 490 495

Pro Met Tyr Phe Trp Val Ala Gly Trp Glu Thr Cys Arg Arg Met Leu
500 505 510

Ala Phe Leu Lys Asp Lys Glu Asn Arg Arg Leu Ala Leu Arg Thr Arg

515 520 525

Leu Ile Arg Val Lys Ala Val Ser Lys Glu Arg Ser Ala Glu Pro Arg
530 535 540

Ile Arg Arg His Arg His Ala Glu Ile Ile Leu Ser Met Pro Gly Phe
545 550 555 560

Gly Val Ile Leu Gly Ala Glu Phe Leu Ala Ala Thr Gly Gly Asp Met
565 570 575

Ala Ala Phe Ala Ser Ala Asp Arg Leu Ala Gly Val Ala Gly Leu Ala
580 585 590

Pro Val Pro Arg Asp Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg Pro
595 600 605

Arg Arg Tyr Asp Arg Arg Leu Leu Arg Ala Cys Val Ser Ile Arg Thr
610 615 620

Asp Pro Ser Ser Arg Thr Tyr Tyr Asp Arg Lys Arg Thr Glu Gly Lys
625 630 635 640

Arg His Thr Gln Ala Val Leu Ala Leu Ala Arg Arg Arg Leu Asn Val
645 650 655

Leu Trp Ala Met Leu Arg Asp His Ala Val Tyr His Pro Ala Thr Thr
660 665 670

Thr Ala Ala Ala Arg Leu Lys Leu Arg Arg Gly Glu Arg Pro Met Ser
675 680 685

Leu Gly Gln Val Phe Asp Pro Arg Ala Asn Ala Leu His Ser Phe Pro
690 695 700

Leu Thr Gly Arg Met Pro Trp Ala Pro Phe Ile Val Ser Ser Trp Leu
705 710 715 720

Arg Asn Pro His Pro Ala Gln Tyr Phe Thr Ala Arg Cys Leu Arg Ile
725 730 735

Leu Pro Gly Leu Trp Ile Gly Ala Gln Gly Gly Ser Ala Ala Lys Leu
740 745 750

Leu Met Ser Gly Ala Pro Ile Glu Tyr Val Leu Lys Asp Ser Ala Val
755 760 765

Trp Met Phe Lys Phe Asp Ile Gly Gly Thr Pro Arg Asp Ile Pro Val
770 775 780

Ala Gly Ile Trp Asn Gly Ser Leu Trp Thr Pro Ala Trp Gly Gly Ile
785 790 795 800

His Ala Ile Ala Ser Asn Ala Tyr Gln Phe Arg Asn Val Ile Pro Ala
805 810 815

Arg Trp Ser Val Ser Ser Ala Val Leu Pro Asn Tyr Arg Leu Val Ala
820 825 830

Ala Leu Pro Met Ala Tyr His Asn Gln Arg Met Arg Phe Arg Thr Asp
835 840 845

Leu Ser Tyr Gly Val Tyr Gly Phe Ala Glu Ile Asn Pro Ile Ala Leu
850 855 860

Val Glu Lys Pro Ala Leu Ser Trp Lys Ser Arg Leu Arg Arg Lys Asn
865 870 875 880

Ser Ser Ile Ala Leu Ala Asn Met Glu Asp Gly Gly Ser Val Gly Arg
885 890 895

Ser Asn Asp Ile Pro Gly Arg Arg Ala Arg Phe Ile Gly Glu Lys Ala
900 905 910

Glu Asp Pro Pro Ala Pro Ser Pro Arg Pro Ala Leu Arg Ile Pro Asn
915 920 925

Pro Leu Leu Gly Leu Asp
930

<210> 68

<211> 939

<212> PRT

<213> Artificial Sequence

<220>

<223> Vaccine polypeptide

<400> 68

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg Val Asp
1 5 10 15

Ala Gly Lys Ala Asp His Tyr Ala Val Thr Thr Leu Ala Asp Gly Gly
20 25 30

Glu Val Thr Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu
35 40 45

Ile Ala Leu Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly
50 55 60

Arg Thr Val His His Ala Ala Gly Ser Tyr Arg Gly Glu Ala Pro Val
65 70 75 80

Lys Gln Thr Leu Asn Phe Asp Leu Leu Lys Leu Ala Gly Asp Val Glu
85 90 95

Ser Asn Pro Gly Pro Met Gln Ile Phe Val Lys Leu Pro Leu Leu Thr
100 105 110

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

Asp Leu Ser Lys Val Asp Ala Lys Gln Pro Gly Asp Tyr Phe Thr Thr
130 135 140

Val Thr Ser Glu Asp His Ala Gly Lys Trp Arg Val Val Phe Phe Trp
145 150 155 160

Pro Lys Asp Phe Thr Gly Pro Glu Ile Ala Thr Phe Gly Lys Leu Asn
165 170 175

Asp Glu Phe Glu Asp Arg Asp Ala Gln Val Leu Gly Val Ser Ile Asp
180 185 190

Ser Glu Phe Val His Phe Asn Trp Arg Ala Gln His Glu Asp Leu Lys
195 200 205

Asn Leu Pro Phe Pro Met Leu Ser Asp Ile Lys Arg Glu Leu Ser Leu
210 215 220

Ala Thr Gly Val Leu Asn Ala Asp Gly Val Ala Asp Arg Ala Thr Phe
225 230 235 240

Ile Val Asp Pro Asn Asn Glu Ile Gln Phe Val Ser Val Thr Ala Gly
245 250 255

Ser Val Gly Arg Asn Val Glu Glu Val Leu Arg Val Leu Asp Ala Leu
260 265 270

Gln Ser Asp Glu Leu Cys Ala Cys Asn Trp Arg Lys Gly Asp Pro Thr
275 280 285

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

Gly Gln Thr Tyr Arg Glu Val Glu Val Val Leu Val Asp Gly Gly Ser
305 310 315 320

Thr Asp Arg Thr Leu Asp Ile Ala Asn Ser Phe Arg Pro Glu Leu Gly
325 330 335

Ser Arg Leu Val Val His Ser Gly Pro Asp Asp Gly Pro Tyr Asp Ala
340 345 350

Met Asn Arg Gly Val Gly Val Ala Thr Gly Glu Trp Val Leu Phe Leu
355 360 365

Gly Ala Asp Asp Thr Leu Tyr Glu Pro Thr Thr Leu Ala Gln Val Ala
370 375 380

Ala Phe Leu Gly Asp His Ala Ala Ser His Leu Val Tyr Gly Asp Val
385 390 395 400

Val Met Arg Ser Thr Lys Ser Arg His Ala Gly Pro Phe Asp Leu Asp
405 410 415

Arg Leu Leu Phe Glu Thr Asn Leu Cys His Gln Ser Ile Phe Tyr Arg
420 425 430

Arg Glu Leu Phe Asp Gly Ile Gly Pro Tyr Asn Leu Arg Tyr Arg Val
435 440 445

Trp Ala Asp Trp Asp Phe Asn Ile Arg Cys Phe Ser Asn Pro Ala Leu
450 455 460

Ile Thr Arg Tyr Met Asp Val Val Ile Ser Glu Tyr Asn Asp Met Thr
465 470 475 480

Gly Phe Ser Met Arg Gln Gly Thr Asp Lys Glu Phe Arg Lys Arg Leu
485 490 495

Pro Met Tyr Phe Trp Val Ala Gly Trp Glu Thr Cys Arg Arg Met Leu
500 505 510

Ala Phe Leu Lys Asp Lys Glu Asn Arg Arg Leu Ala Leu Arg Thr Arg
515 520 525

Leu Ile Arg Val Lys Ala Val Ser Lys Glu Arg Ser Ala Glu Pro Arg
530 535 540

Ile Arg Arg His Arg His Ala Glu Ile Ile Leu Ser Met Pro Gly Phe
545 550 555 560

Gly Val Ile Leu Gly Ala Glu Phe Leu Ala Ala Thr Gly Gly Asp Met
565 570 575

Ala Ala Phe Ala Ser Ala Asp Arg Leu Ala Gly Val Ala Gly Leu Ala
580 585 590

Pro Val Pro Arg Asp Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg Pro
595 600 605

Arg Arg Tyr Asp Arg Arg Leu Leu Arg Ala Cys Tyr Leu Ser Ala Leu
610 615 620

Val Ser Ile Arg Thr Asp Pro Ser Ser Arg Thr Tyr Tyr Asp Arg Lys
625 630 635 640

Arg Thr Glu Gly Lys Arg His Thr Gln Ala Val Leu Ala Leu Ala Arg
645 650 655

Arg Arg Leu Asn Val Leu Trp Ala Met Leu Arg Asp His Ala Val Tyr
660 665 670

His Pro Ala Thr Thr Thr Ala Ala Ala Arg Leu Lys Leu Arg Arg Gly
675 680 685

Glu Arg Pro Met Ser Leu Gly Gln Val Phe Asp Pro Arg Ala Asn Ala
690 695 700

Leu His Ser Phe Pro Leu Thr Gly Arg Met Pro Trp Ala Pro Phe Ile
705 710 715 720

Val Ser Ser Trp Leu Arg Asn Pro His Pro Ala Gln Tyr Phe Thr Ala
725 730 735

Arg Cys Leu Arg Ile Leu Pro Gly Leu Trp Ile Gly Ala Gln Gly Gly
740 745 750

Ser Ala Ala Lys Leu Leu Met Ser Gly Ala Pro Ile Glu Tyr Val Leu
755 760 765

Lys Asp Ser Ala Val Trp Met Phe Lys Phe Asp Ile Gly Gly Thr Pro
770 775 780

Arg Asp Ile Pro Val Ala Gly Ile Trp Asn Gly Ser Leu Trp Thr Pro
785 790 795 800

Ala Trp Gly Gly Ile His Ala Ile Ala Ser Asn Ala Tyr Gln Phe Arg
805 810 815

Asn Val Ile Pro Ala Arg Trp Ser Val Ser Ser Ala Val Leu Pro Asn
820 825 830

Tyr Arg Leu Val Ala Ala Leu Pro Met Ala Tyr His Asn Gln Arg Met
835 840 845

Arg Phe Arg Thr Asp Leu Ser Tyr Gly Val Tyr Gly Phe Ala Glu Ile

850 855 860

Asn Pro Ile Ala Leu Val Glu Lys Pro Ala Leu Ser Trp Lys Ser Arg
865 870 875 880

Leu Arg Arg Lys Asn Ser Ser Ile Ala Leu Ala Asn Met Glu Asp Gly
885 890 895

Gly Ser Val Gly Arg Ser Asn Asp Ile Pro Gly Arg Arg Ala Arg Phe
900 905 910

Ile Gly Glu Lys Ala Glu Asp Pro Pro Ala Pro Ser Pro Arg Pro Ala
915 920 925

Leu Arg Ile Pro Asn Pro Leu Leu Gly Leu Asp
930 935

<210> 69

<211> 934

<212> PRT

<213> Artificial Sequence

<220>

<223> Vaccine polypeptide

<400> 69

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg Val Asp
1 5 10 15

Ala Gly Lys Ala Asp His Tyr Ala Val Thr Thr Leu Ala Asp Gly Gly
20 25 30

Glu Val Thr Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu
35 40 45

Ile Ala Leu Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly
50 55 60

Arg Thr Val His His Ala Ala Gly Ser Tyr Arg Gly Glu Ala Pro Val
65 70 75 80

Lys Gln Thr Leu Asn Phe Asp Leu Leu Lys Leu Ala Gly Asp Val Glu
85 90 95

Ser Asn Pro Gly Pro Met Gln Ile Phe Val Lys Leu Pro Leu Leu Thr
100 105 110

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

Asp Leu Ser Lys Val Asp Ala Lys Gln Pro Gly Asp Tyr Phe Thr Thr
130 135 140

Val Thr Ser Glu Asp His Ala Gly Lys Trp Arg Val Val Phe Phe Trp
145 150 155 160

Pro Lys Asp Phe Thr Gly Pro Glu Ile Ala Thr Phe Gly Lys Leu Asn
165 170 175

Asp Glu Phe Glu Asp Arg Asp Ala Gln Val Leu Gly Val Ser Ile Asp
180 185 190

Ser Glu Phe Val His Phe Asn Trp Arg Ala Gln His Glu Asp Leu Lys
195 200 205

Asn Leu Pro Phe Pro Met Leu Ser Asp Ile Lys Arg Glu Leu Ser Leu
210 215 220

Ala Thr Gly Val Leu Asn Ala Asp Gly Val Ala Asp Arg Ala Thr Phe
225 230 235 240

Ile Val Asp Pro Asn Asn Glu Ile Gln Phe Val Ser Val Thr Ala Gly
245 250 255

Ser Val Gly Arg Asn Val Glu Glu Val Leu Arg Val Leu Asp Ala Leu
260 265 270

Gln Ser Asp Glu Leu Cys Ala Cys Asn Trp Arg Lys Gly Asp Pro Thr
275 280 285

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

Gly Gln Thr Tyr Arg Glu Val Glu Val Val Leu Val Asp Gly Gly Ser

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

Leu Ile Arg Val Lys Ala Val Ser Lys Glu Arg Ser Ala Glu Pro Arg
530 535 540

Ile Arg Arg His Arg His Ala Glu Ile Ile Leu Ser Met Pro Gly Phe
545 550 555 560

Gly Val Ile Leu Gly Ala Glu Phe Leu Ala Ala Thr Gly Gly Asp Met
565 570 575

Ala Ala Phe Ala Ser Ala Asp Arg Leu Ala Gly Val Ala Gly Leu Ala
580 585 590

Pro Val Pro Arg Asp Ser Gly Arg Ile Ser Gly Asn Leu Lys Arg Pro
595 600 605

Arg Arg Tyr Asp Arg Arg Leu Leu Arg Ala Cys Val Ser Ile Arg Thr
610 615 620

Asp Pro Ser Ser Arg Thr Tyr Tyr Asp Arg Lys Arg Thr Glu Gly Lys
625 630 635 640

Arg His Thr Gln Ala Val Leu Ala Leu Ala Arg Arg Arg Leu Asn Val
645 650 655

Leu Trp Ala Met Leu Arg Asp His Ala Val Tyr His Pro Ala Thr Thr
660 665 670

Thr Ala Ala Ala Arg Leu Lys Leu Arg Arg Gly Glu Arg Pro Met Ser
675 680 685

Leu Gly Gln Val Phe Asp Pro Arg Ala Asn Ala Leu His Ser Phe Pro
690 695 700

Leu Thr Gly Arg Met Pro Trp Ala Pro Phe Ile Val Ser Ser Trp Leu
705 710 715 720

Arg Asn Pro His Pro Ala Gln Tyr Phe Thr Ala Arg Cys Leu Arg Ile
725 730 735

Leu Pro Gly Leu Trp Ile Gly Ala Gln Gly Gly Ser Ala Ala Lys Leu
740 745 750

Leu Met Ser Gly Ala Pro Ile Glu Tyr Val Leu Lys Asp Ser Ala Val
755 760 765

Trp Met Phe Lys Phe Asp Ile Gly Gly Thr Pro Arg Asp Ile Pro Val
770 775 780

Ala Gly Ile Trp Asn Gly Ser Leu Trp Thr Pro Ala Trp Gly Gly Ile
785 790 795 800

His Ala Ile Ala Ser Asn Ala Tyr Gln Phe Arg Asn Val Ile Pro Ala
805 810 815

Arg Trp Ser Val Ser Ser Ala Val Leu Pro Asn Tyr Arg Leu Val Ala
820 825 830

Ala Leu Pro Met Ala Tyr His Asn Gln Arg Met Arg Phe Arg Thr Asp
835 840 845

Leu Ser Tyr Gly Val Tyr Gly Phe Ala Glu Ile Asn Pro Ile Ala Leu
850 855 860

Val Glu Lys Pro Ala Leu Ser Trp Lys Ser Arg Leu Arg Arg Lys Asn
865 870 875 880

Ser Ser Ile Ala Leu Ala Asn Met Glu Asp Gly Gly Ser Val Gly Arg
885 890 895

Ser Asn Asp Ile Pro Gly Arg Arg Ala Arg Phe Ile Gly Glu Lys Ala
900 905 910

Glu Asp Pro Pro Ala Pro Ser Pro Arg Pro Ala Leu Arg Ile Pro Asn
915 920 925

Pro Leu Leu Gly Leu Asp
930

<210> 70

<211> 9

<212> PRT

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<220>

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<222> (5)..(5)

<223> Xaa can be any naturally occurring amino acid

<400> 70

Gly Asp Val Glu Xaa Asn Pro Gly Pro
1 5

<210> 71

<211> 24

<212> PRT

<213> Artificial Sequence

<220>

<223> a 2A peptide

<400> 71

Ala Pro Val Lys Gln Thr Leu Asn Phe Asp Leu Leu Lys Leu Ala Gly
1 5 10 15

Asp Val Glu Ser Asn Pro Gly Pro
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<210> 72

<211> 4

<212> PRT

<213> Artificial Sequence

<220>

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<400> 72

Met Thr Val Thr
1

<210> 73

<211> 10

<212> PRT

<213> Artificial Sequence

<220>

<223> Synthetic peptide

<400> 73

Val Asp Ala Gly Lys Ala Asp His Tyr Ala
1 5 10

<210> 74

<211> 7

<212> PRT

<213> Artificial Sequence

<220>

<223> leader sequence

<400> 74

Met Gln Ile Phe Val Lys Leu
1 5

<210> 75

<211> 13

<212> PRT

<213> Artificial Sequence

<220>

<223> peptide tag

<400> 75

Pro Ala Leu Arg Ile Pro Asn Pro Leu Leu Gly Leu Asp
1 5 10

<210> 76

<211> 9

<212> PRT

<213> Artificial Sequence

<220>

<223> Mpa T cell epitope

<400> 76

Gly Phe Ala Glu Ile Asn Pro Ile Ala
1 5

<210> 77

<211> 4

<212> PRT

<213> Artificial Sequence

<220>

<223> peptide linker

<400> 77

Ser Gly Ser Gly
1

<210> 78

<211> 4

<212> PRT

<213> Artificial Sequence

<220>

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<400> 78

Gly Gly Gly Ser
1

<210> 79

<211> 5

<212> PRT

<213> Artificial Sequence

<220>

<223> peptide linker

<400> 79

Glu Ala Ala Ala Lys
1 5

<210> 80

<211> 12

<212> PRT

<213> Artificial Sequence

<220>

<223> peptide linker

<400> 80

His Glu Tyr Gly Ala Glu Ala Leu Glu Arg Ala Gly
1 5 10

<210> 81

<211> 15

<212> PRT

<213> Artificial Sequence

<220>

<223> Synthetic peptide

<400> 81

Tyr Leu Ser Ala Leu Val Ser Ile Arg Thr Asp Pro Ser Ser Arg
1 5 10 15

<210> 82

<211> 15

<212> PRT

<213> Artificial Sequence

<220>

<223> Synthetic peptide

<220>

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<222> (14)..(14)

<223> PHOSPHORYLATION

<400> 82

Tyr Leu Ser Ala Leu Val Ser Ile Arg Thr Asp Pro Ser Ser Arg
1 5 10 15

<210> 83

<211> 106

<212> PRT

<213> Artificial Sequence

<220>

<223> vaccine polypeptide

<400> 83

Met Thr Val Thr Glu Val Val Val Ala Gln Pro Val Trp Ala Gly Val
1 5 10 15

Asp Ala Gly Lys Ala Asp His Tyr Cys Met Val Ile Asn Asp Asp Ala
20 25 30

Gln Arg Leu Leu Ser Gln Arg Val Ala Asn Asp Glu Ala Ala Leu Leu
35 40 45

Glu Leu Ile Ala Ala Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
50 55 60

Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu Ile Ala Leu
65 70 75 80

Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly Ala Thr Val
85 90 95

His His Ala Ala Gly Ser Tyr Arg Gly Glu
100 105

<210> 84
<211> 77
<212> PRT
<213> Artificial Sequence

<220>
<223> vaccine polypeptide

<400> 84

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg Val Asp
1 5 10 15

Ala Gly Lys Ala Asp His Tyr Ala Val Thr Thr Leu Ala Asp Gly Gly
20 25 30

Glu Val Thr Trp Ala Ile Asp Leu Asn Ala Gly Gly Ala Ala Leu Leu
35 40 45

Ile Ala Leu Leu Ile Ala Ala Gly Gln Arg Leu Leu Tyr Ile Pro Gly
50 55 60

Ala Thr Val His His Ala Ala Gly Ser Tyr Arg Gly Glu
65 70 75

<210> 85
<211> 15
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 85

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

<210> 86
<211> 15
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 86

Asp Arg Lys Arg Thr Glu Gly Lys Arg His Thr Gln Ala Val Leu
1 5 10 15

<210> 87

<211> 15

<212> PRT

<213> Mycobacterium avium paratuberculosis

<400> 87

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

<210> 88

<211> 15

<212> PRT

<213> Mycobacterium avium paratuberculosis

<400> 88

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

<210> 89

<211> 15

<212> PRT

<213> Mycobacterium avium paratuberculosis

<400> 89

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

<210> 90

<211> 40

<212> PRT

<213> Mycobacterium avium paratuberculosis

<400> 90

Gly Arg Ile Ser Gly Asn Leu Lys Arg Pro Arg Arg Tyr Asp Arg Arg
1 5 10 15

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

Pro Ser Ser Arg Thr Tyr Tyr Asp
35 40

<210> 91
<211> 18
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 91

Asn Lys Ser Arg Ala Ala Leu Ile Leu Leu Thr Gly Tyr Gln Thr Pro
1 5 10 15

Asp Ala

<210> 92
<211> 18
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 92

Asn Leu Lys Arg Pro Arg Arg Tyr Asp Arg Arg Leu Leu Arg Ala Gly
1 5 10 15

Tyr Leu

<210> 93
<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 93

Met Val Ile Asn Asp Asp Ala Gln Arg Leu
1 5 10

<210> 94
<211> 11
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 94

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Cys
1 5 10

<210> 95
<211> 11
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 95

Cys Asn Leu Lys Arg Pro Arg Arg Tyr Asp Arg
1 5 10

<210> 96
<211> 11
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 96

Cys Val Ser Ile Arg Thr Asp Pro Ser Ser Arg
1 5 10

<210> 97
<211> 15
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 97

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg Cys
1 5 10 15

<210> 98
<211> 16
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 98

Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr Trp Ala Ile Asp Cys
1 5 10 15

<210> 99
<211> 16
<212> PRT
<213> Mycobacterium avium paratuberculosis

<400> 99

Tyr Leu Ser Ala Leu Val Ser Ile Arg Thr Asp Pro Ser Ser Arg Cys
1 5 10 15

<210> 100
<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<223> ACETYLATION

<220>
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<223> 8branchedPolylysineOctamer

<400> 100

Met Val Ile Asn Asp Asp Ala Gln Arg Leu
1 5 10

<210> 101
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<222> (10)..(10)
<223> AMIDATION

<400> 101

Met Val Ile Asn Asp Asp Ala Gln Arg Leu
1 5 10

<210> 102
<211> 9
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
<223> Biotinyl

<220>
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<223> AMIDATION

<400> 102

Met Val Ile Asn Asp Asp Leu Gln Arg
1 5

<210> 103
<211> 8
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
<223> Biotinyl

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<222> (8)..(8)
<223> AMIDATION

<400> 103

Met Val Ile Asn Asn Asp Ala Glu
1 5

<210> 104
<211> 11
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<223> ACETYLTATION

<220>
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<223> 8branchedPolylysineOctamer

<400> 104

Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
1 5 10

<210> 105
<211> 11
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<223> AMIDATION

<400> 105

Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
1 5 10

<210> 106
<211> 11
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
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<223> AMIDATION

<400> 106

Val Ala Thr Met Ala Asp Gly Gly Glu Val Thr
1 5 10

<210> 107
<211> 11
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<400> 107

Val Thr Arg Leu Ala Asp Gly Gly Glu Val Thr
1 5 10

<210> 108
<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<223> ACETYLTATION

<220>
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<400> 108

Asn Leu Lys Arg Pro Arg Arg Tyr Asp Arg
1 5 10

<210> 109
<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
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<223> AMIDATION

<400> 109

Asn Leu Lys Arg Pro Arg Arg Tyr Asp Arg
1 5 10

<210> 110
<211> 7
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
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<223> AMIDATION

<400> 110

Asn Leu Lys Arg Pro Arg Arg
1 5

<210> 111
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<220>
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<222> (1)..(1)
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<222> (10)..(10)
<223> ACETYLATION

<400> 111

Asn Leu Arg Arg Pro Arg Arg Tyr His Arg
1 5 10

<210> 112
<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
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<400> 112

Asn Leu His Arg Pro Arg Arg Tyr His Arg
1 5 10

<210> 113
<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
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<400> 113

Asn Met Arg Arg Pro Arg Arg Tyr Asn Arg
1 5 10

<210> 114
<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<400> 114

Asn Leu Arg Arg Pro Lys Arg Tyr Asn Arg
1 5 10

<210> 115
<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<400> 115

Asn Leu Gln Arg Pro Arg Arg Tyr Asn Arg
1 5 10

<210> 116
<211> 10
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<213> Mycobacterium avium paratuberculosis

<220>
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<223> ACETYLATION

<220>
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<222> (10)..(10)
<223> 8branchedPolylysineOctamer

<400> 116

Val Ser Ile Arg Thr Asp Pro Ser Ser Arg
1 5 10

<210> 117
<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
<223> Biotinyl

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<223> AMIDATION

<400> 117

Val Ser Ile Arg Thr Asp Pro Ser Ser Arg
1 5 10

<210> 118
<211> 7
<212> PRT
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<220>
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<222> (1)..(1)
<223> biotinyl

<220>
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<222> (7)..(7)
<223> AMIDATION

<400> 118

Val Ser Ile Arg Thr Asp Pro
1 5

<210> 119
<211> 9
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
<221> MISC_FEATURE
<222> (1)..(1)
<223> Biotinyl

<220>
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<222> (9)..(9)
<223> AMIDATION

<400> 119

Ser Ile Arg Ser Asp Pro Ser Ser Arg
1 5

<210> 120
<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
<223> Biotinyl

<220>
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<222> (10)..(10)
<223> AMIDATION

<400> 120

Tyr Ser Ile Arg Ser Asp Pro Ala Ser Arg
1 5 10

<210> 121
<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
<223> Biotinyl

<220>
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<222> (10)..(10)
<223> AMIDATION

<400> 121

Val Ser Val Arg Tyr Asp Pro Ser Ser Arg
1 5 10

<210> 122
<211> 10
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
<223> Biotinyl

<220>
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<222> (10)..(10)
<223> AMIDATION

<400> 122

Ile Ala Ile Arg Thr Asp Pro Ala Ser Arg
1 5 10

<210> 123
<211> 11
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
<221> MOD_RES
<222> (1)..(1)
<223> ACETYLTATION

<400> 123

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Cys
1 5 10

<210> 124
<211> 12
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
<221> MOD_RES
<222> (1)..(1)
<223> ACETYLTATION

<400> 124

Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr Cys
1 5 10

<210> 125
<211> 11
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
<221> MOD_RES
<222> (1)..(1)

<223> ACETYLATION

<400> 125

Asn Leu Lys Arg Pro Arg Arg Tyr Asp Arg Cys
1 5 10

<210> 126

<211> 11

<212> PRT

<213> Mycobacterium avium paratuberculosis

<220>

<221> MOD_RES

<222> (1)..(1)

<223> ACETYLATION

<400> 126

Val Ser Ile Arg Thr Asp Pro Ser Ser Arg Cys
1 5 10

<210> 127

<211> 15

<212> PRT

<213> Mycobacterium avium paratuberculosis

<220>

<221> MOD_RES

<222> (15)..(15)

<223> AMIDATION

<400> 127

Cys Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg
1 5 10 15

<210> 128

<211> 14

<212> PRT

<213> Mycobacterium avium paratuberculosis

<220>

<221> MISC_FEATURE

<222> (1)..(1)

<223> Biotinyl

<220>

<221> MOD_RES

<222> (14)..(14)
<223> AMIDATION

<400> 128

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg
1 5 10

<210> 129
<211> 14
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
<223> Biotinyl

<220>
<221> MOD_RES
<222> (14)..(14)
<223> AMIDATION

<400> 129

Met Val Ile Asn Asp Asp Leu Gln Arg Ile Ile Leu Phe Leu
1 5 10

<210> 130
<211> 14
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
<223> Biotinyl

<220>
<221> MOD_RES
<222> (14)..(14)
<223> AMIDATION

<400> 130

Met Ser Ile Asn Asp Asp Ala Gln Lys Leu Lys Asp Arg Leu
1 5 10

<210> 131
<211> 15

<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
<221> MOD_RES
<222> (13)..(13)
<223> PHOSPHORYLATION

<220>
<221> MISC_FEATURE
<222> (15)..(15)
<223> Amide BSA conjugated

<400> 131

Cys Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg
1 5 10 15

<210> 132
<211> 14
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
<223> Biotinyl

<220>
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<222> (12)..(12)
<223> PHOSPHORYLATION

<220>
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<222> (14)..(14)
<223> AMIDATION

<400> 132

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg
1 5 10

<210> 133
<211> 14
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
<223> Biotinyl

<220>
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<222> (14)..(14)
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<400> 133

Met Val Ile Asn Asp Asp Ala Gln Arg Leu Leu Ser Gln Arg
1 5 10

<210> 134
<211> 21
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
<223> ACETYLATION

<220>
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<222> (21)..(21)
<223> BSA conjugated

<400> 134

Ala Ala Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr Trp Ala Ile
1 5 10 15

Asp Gly Lys Lys Cys
20

<210> 135
<211> 20
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
<223> Biotinyl

<220>
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<222> (20)..(20)
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<400> 135

Lys Lys Gly Ala Ala Val Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
1 5 10 15

Trp Ala Ile Asp
20

<210> 136

<211> 20

<212> PRT

<213> Mycobacterium avium paratuberculosis

<220>

<221> MISC_FEATURE

<222> (1)..(1)

<223> Biotinyl

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<221> MOD_RES

<222> (20)..(20)

<223> AMIDATION

<400> 136

Lys Lys Gly Ala Ala Gly Thr Thr Leu Ala Asp Gly Gly Glu Val Thr
1 5 10 15

Trp Ala Ile Asp
20

<210> 137

<211> 20

<212> PRT

<213> Mycobacterium avium paratuberculosis

<220>

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<222> (1)..(1)

<223> Biotinyl

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<222> (20)..(20)

<223> AMIDATION

<400> 137

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

Trp Ala Ile Asp
20

<210> 138
<211> 20
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (20)..(20)
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<400> 138

Lys Lys Gly Gln Ala Val Thr Arg Leu Ala Asp Gly Gly Glu Val Thr
1 5 10 15

Trp Ala Val Asp
20

<210> 139
<211> 20
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<222> (20)..(20)
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<400> 139

Lys Lys Gly Phe Glu Val Thr Thr Leu Ala Asp Gly Thr Glu Val Ala
1 5 10 15

Thr Ser Pro Leu
20

<210> 140
<211> 16
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (15)..(15)
<223> PHOSPHORYLATION

<220>
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<222> (16)..(16)
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<400> 140

Cys Tyr Leu Ser Ala Leu Val Ser Ile Arg Thr Asp Pro Ser Ser Arg
1 5 10 15

<210> 141
<211> 15
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
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<223> PHOSPHORYLATION

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<221> MOD_RES
<222> (15)..(15)
<223> AMIDATION

<400> 141

Tyr Leu Ser Ala Leu Val Ser Ile Arg Thr Asp Pro Ser Ser Arg
1 5 10 15

<210> 142

<211> 15
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<222> (1)..(1)
<223> Biotinyl

<220>
<221> MOD_RES
<222> (15)..(15)
<223> AMIDATION

<400> 142

Tyr Leu Ser Ala Leu Val Ser Ile Arg Thr Asp Pro Ser Ser Arg
1 5 10 15

<210> 143
<211> 15
<212> PRT
<213> Mycobacterium avium paratuberculosis

<220>
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<223> PHOSPHORYLATION

<220>
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<222> (15)..(15)
<223> AMIDATION

<400> 143

Tyr Leu Ser Ala Leu Tyr Ser Ile Arg Ser Asp Pro Ala Ser Arg
1 5 10 15

<210> 144
<211> 15
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<213> Mycobacterium avium paratuberculosis

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<223> PHOSPHORYLATION

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<400> 144

Tyr Leu Ser Ala Leu Val Ser Val Arg Tyr Asp Pro Ser Ser Arg
1 5 10 15

<210> 145
<211> 15
<212> PRT
<213> Mycobacterium avium paratuberculosis

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Ala Gly Lys Ala Asp His Tyr Ala Val Thr Thr Leu Ala Asp Gly Gly
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Glu Val Thr Trp Ala Ile Asp Leu Asn Ala
 35 40