SEQUENCE LISTING

<110> Dale, James B.

<110> University of Tennessee Research Foundation

<120> GROUP A STREPTOCOCCUS MULTIVALENT VACCINE

<130> 920098.414PC

<150> 61/498,397
<151> 2011-06-17

<150> 61/641,448
<151> 2012-05-02

<160> 61

<170> PatentIn version 3.5

<210> 1
<211> 450
<212> PRT
<213> Artificial Sequence

<220>
<223> Fusion protein of group A streptococcus M proteins.

<400> 1

```
Asn Gly Asp Gly Asn Pro Arg Glu Val Ile Glu Asp Leu Ala Ala Asn
1               5                  10                  15


Asn Pro Ala Ile Gln Asn Ile Arg Leu Arg His Glu Asn Lys Asp Leu
            20                  25                  30


Lys Ala Arg Leu Glu Asn Ala Met Glu Val Ala Gly Arg Asp Phe Lys
        35                  40                  45


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


Asn Tyr Gln Gln Tyr Asn Ala Gln Ala Gly Arg Leu Asp Leu Arg Gln
65                  70                  75                  80


Lys Ala Glu Tyr Leu Lys Gly Leu Asn Asp Trp Ala Glu Arg Leu Leu
                85                  90                  95
```

```
Gln Glu Leu Asn Arg Val Phe Pro Arg Gly Thr Val Glu Asn Pro Asp
            100                 105                 110

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

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

Lys Tyr Asp Val Glu Asn Ser Lys Asn Pro Val Pro Val Lys Lys Glu
145                 150                 155                 160

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

Lys Asn Pro Val Pro Val Lys Lys Glu Ala Lys Leu Ser Glu Ala Glu
            180                 185                 190

Leu His Asp Lys Ile Lys Asn Leu Ala Pro Leu Thr Arg Ala Thr Ala
        195                 200                 205

Asp Asn Lys Asp Glu Leu Ile Lys Arg Ala Asn Asp Tyr Glu Ile Gln
    210                 215                 220

Asn His Gln Leu Thr Val Glu Asn Lys Lys Leu Lys Thr Asp Lys Glu
225                 230                 235                 240

Gln Leu Thr Lys Glu Asn Asp Asp Leu Lys Ala Glu Ser Pro Lys Ser
                245                 250                 255

Thr Glu Thr Ser Ala Asn Gly Ala Asp Lys Leu Ala Asp Ala Tyr Asn
            260                 265                 270

Thr Leu Leu Thr Glu His Glu Lys Leu Arg Asp Glu Tyr Tyr Thr Leu
        275                 280                 285

Ile Asp Ala Lys Glu Glu Glu Pro Arg Tyr Lys Ala Asp His Ser Asp
    290                 295                 300
```

```
Leu Val Ala Glu Lys Gln Arg Leu Glu Asp Leu Gly Gln Lys Phe Glu
305                 310                 315                 320

Arg Leu Lys Gln Arg Ser Glu Leu Tyr Leu Gln Gln Tyr Tyr Asp Asn
                325                 330                 335

Lys Ser Asn Gly Tyr Lys Gly Asp Trp Tyr Val Gln Gln Leu Asp Ser
            340                 345                 350

Val Ser Gly Leu Glu Val Ala Asp Pro Ser Asp Ser Lys Lys Leu Ile
        355                 360                 365

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

Lys Glu Asp Ser Glu Ile Leu Ser Glu Leu Arg Asp Val Leu Lys Asn
385                 390                 395                 400

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

Asn Pro Ala Ile Gln Asn Ile Arg Leu Arg His Glu Asn Lys Asp Leu
            420                 425                 430

Lys Ala Arg Leu Glu Asn Ala Met Glu Val Ala Gly Arg Asp Phe Lys
        435                 440                 445

Arg Ala
    450
```

<210> 2
<211> 450
<212> PRT
<213> Artificial Sequence

<220>
<223> Fusion protein of group A streptococcus M proteins.

<400> 2

```
Ala Glu Ile Lys Lys Pro Gln Ala Asp Ser Ala Trp Asn Trp Pro Lys
1               5                  10                  15

Glu Tyr Asn Ala Leu Leu Lys Glu Asn Glu Glu Leu Lys Val Glu Arg
            20                  25                  30

Glu Lys Tyr Leu Ser Tyr Ala Asp Asp Lys Glu Lys Asp Pro Gln Tyr
        35                  40                  45

Arg Ala Ala Val Thr Arg Gly Thr Ile Asn Asp Pro Gln Arg Ala Lys
    50                  55                  60

Glu Ala Leu Asp Lys Tyr Glu Leu Glu Asn His Ala Val Thr Arg Gly
65                  70                  75                  80

Thr Ile Asn Asp Pro Gln Arg Ala Lys Glu Ala Leu Asp Lys Tyr Glu
                85                  90                  95

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

Gly Thr Asn Val Ser Ala Asp Leu Tyr Asn Ser Leu Trp Asp Glu Asn
        115                 120                 125

Lys Thr Leu Arg Glu Lys Gln Glu Glu Tyr Ile Thr Lys Ile Gln Asn
    130                 135                 140

Glu Glu Thr Lys Asn Lys Glu Glu Glu Arg Thr Phe Thr Glu Leu Pro
145                 150                 155                 160

Tyr Glu Ala Arg Tyr Lys Ala Trp Lys Ser Glu Asn Asp Glu Leu Arg
                165                 170                 175

Glu Asn Tyr Arg Arg Thr Leu Asp Lys Phe Asn Thr Glu Gln Gly Lys
            180                 185                 190

Thr Thr Arg Leu Glu Glu Gln Asn Arg Val Arg Tyr Thr Arg His Thr
        195                 200                 205
```

```
Pro Glu Asp Lys Leu Lys Lys Ile Ile Asp Asp Leu Asp Ala Lys Glu
    210                 215                 220

His Arg Val Arg Tyr Thr Arg His Thr Pro Glu Asp Lys Leu Lys Lys
225                 230                 235                 240

Ile Ile Asp Asp Leu Asp Ala Lys Glu His Arg Val Tyr Ile Thr Arg
                245                 250                 255

Arg Met Thr Lys Glu Asp Val Glu Lys Ile Ala Asn Asp Leu Asp Thr
            260                 265                 270

Glu Asn His Gly Leu Lys Gln Gln Asn Glu Gln Leu Ser Thr Glu Lys
        275                 280                 285

Gln Gly Leu Glu Glu Gln Asn Lys Gln Leu Ser Thr Asp Arg Val Ser
    290                 295                 300

Arg Ser Met Ser Arg Asp Asp Leu Leu Asn Arg Ala Gln Asp Leu Glu
305                 310                 315                 320

Ala Lys Asn His Gly Leu Glu His Gln Asn Thr Lys Leu Ser Thr Glu
                325                 330                 335

Asn Lys Thr Leu Gln Glu Gln Ala Glu Ala Arg Gln Lys Glu Val Ala
            340                 345                 350

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

Lys Phe Glu Ile Glu Asn Asn Thr Leu Lys Leu Lys Asn Ser Asp Leu
    370                 375                 380

Ser Phe Asn Asn Lys Ala Leu Lys Asp His Asn Asp Glu Leu Thr Glu
385                 390                 395                 400

Ala Glu Ile Lys Lys Pro Gln Ala Asp Ser Ala Trp Asn Trp Pro Lys
                405                 410                 415
```

```
Glu Tyr Asn Ala Leu Leu Lys Glu Asn Glu Glu Leu Lys Val Glu Arg
            420                 425                 430


Glu Lys Tyr Leu Ser Tyr Ala Asp Asp Lys Glu Lys Asp Pro Gln Tyr
        435                 440                 445


Arg Ala
    450
```

<210> 3
<211> 450
<212> PRT
<213> Artificial Sequence

<220>
<223> Fusion protein of group A streptococcus M proteins.

<400> 3

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


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


Glu Glu Glu His Lys Lys Asp His Glu Gln Leu Glu Lys Lys Ser Glu
        35                  40                  45


Asp Val Glu Ser Ser Asn Asn Ala Glu Ser Ser Asn Ile Ser Gln Glu
    50                  55                  60


Ser Lys Leu Ile Asn Thr Leu Thr Asp Glu Asn Glu Lys Leu Arg Glu
65                  70                  75                  80


Glu Leu Gln Gln Tyr Tyr Ala Leu Ser Asp Ala Lys Glu Glu Glu Pro
                85                  90                  95


Arg Tyr Lys Ala Asp Asn Gln Ser Pro Ala Pro Val Lys Lys Glu Ala
            100                 105                 110


Lys Lys Leu Asn Glu Ala Glu Leu Tyr Asn Lys Ile Gln Glu Leu Glu
        115                 120                 125
```

```
Glu Gly Lys Ala Glu Leu Phe Asp Lys Leu Glu Lys Val Glu Glu Glu
    130                 135                 140

Asn Lys Lys Val Lys Glu Asp Ser Asp Asn Ile Asn Arg Ser Val Ser
145                 150                 155                 160

Val Lys Asp Asn Glu Lys Glu Leu His Asn Lys Ile Ala Asp Leu Glu
                165                 170                 175

Glu Glu Arg Gly Glu His Leu Asp Lys Ile Asp Glu Leu Lys Glu Glu
            180                 185                 190

Leu Lys Ala Lys Glu Lys Ser Ser Asp Ser Ser Arg Glu Val Thr Asn
        195                 200                 205

Glu Leu Thr Ala Ser Met Trp Lys Ala Gln Ala Asp Ser Ala Lys Ala
    210                 215                 220

Lys Ala Lys Glu Leu Glu Lys Gln Val Glu Glu Tyr Lys Lys Asn Tyr
225                 230                 235                 240

Glu Thr Leu Glu Lys Gly Tyr Asp Asp Leu Ala Glu Ser Arg Ser Val
                245                 250                 255

Ser Gln Gly Ser Val Ser Leu Glu Leu Tyr Asp Lys Leu Ser Asp Glu
            260                 265                 270

Asn Asp Ile Leu Arg Glu Lys Gln Asp Glu Tyr Leu Thr Lys Ile Asp
        275                 280                 285

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

Ser Arg Ser Ile Thr Asn Glu Gln Leu Ile Asp Lys Leu Val Glu Glu
305                 310                 315                 320

Asn Asn Asp Leu Lys Glu Glu Arg Ala Lys Tyr Leu Asp Leu Leu Asp
                325                 330                 335
```

```
Asn Arg Glu Lys Asp Pro Gln Tyr Arg Ala Leu Met Gly Glu Ala Glu
            340                 345                 350

Lys Lys Val Glu Val Ala Asp Ser Asn Ala Ser Ser Val Ala Lys Leu
        355                 360                 365

Tyr Asn Gln Ile Ala Asp Leu Thr Asp Lys Asn Gly Glu Tyr Leu Glu
    370                 375                 380

Arg Ile Glu Glu Leu Glu Glu Arg Gln Lys Asn Leu Glu Lys Leu Glu
385                 390                 395                 400

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

Asp Leu Glu Glu Glu Arg Glu Lys Leu Leu Asn Lys Leu Asp Lys Val
            420                 425                 430

Glu Glu Glu His Lys Lys Asp His Glu Gln Leu Glu Lys Lys Ser Glu
        435                 440                 445

Asp Val
    450
```

<210> 4
<211> 400
<212> PRT
<213> Artificial Sequence

<220>
<223> Fusion protein of group A streptococcus M proteins.

<400> 4

```
Asp Asn Pro Arg Tyr Thr Asp Ala His Asn Ala Val Thr Gln Gly Arg
1               5                   10                  15

Thr Val Pro Leu Gln Asn Leu Leu His Glu Met Asp Lys Asn Gly Lys
            20                  25                  30
```

```
Leu Arg Ser Glu Asn Glu Glu Leu Lys Ala Asp Leu Gln Lys Lys Glu
        35                  40                  45

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

Phe Trp Lys Ser Lys Phe Asp Ala Glu Gln Asn Arg Ala Asn Glu Leu
65                  70                  75                  80

Glu Lys Lys Leu Ser Gly Tyr Glu Lys Asp Tyr Lys Thr Leu Glu Gln
                85                  90                  95

Glu Tyr Glu Asn Ala Gly Ser Glu Glu Asn Val Pro Lys Gln Gln Tyr
            100                 105                 110

Asn Ala Leu Trp Glu Glu Asn Glu Asp Leu Arg Gly Arg Glu Arg Lys
        115                 120                 125

Tyr Ile Ala Lys Leu Glu Lys Glu Glu Ile Gln Asn Gly Glu Leu Asn
    130                 135                 140

Glu Lys Asn Arg Lys Leu Glu Ser Pro Arg Glu Val Thr Asn Glu Leu
145                 150                 155                 160

Ala Ala Ser Val Trp Lys Lys Lys Val Glu Glu Ala Lys Glu Lys Ala
                165                 170                 175

Ser Lys Leu Glu Lys Gln Leu Glu Glu Ala Gln Lys Asp Tyr Ser Glu
            180                 185                 190

Ile Glu Gly Lys Leu Glu Gln Phe Val Glu Lys Lys Val Glu Ala Ala
        195                 200                 205

Glu Asn Asn Val Ser Ser Val Ala Arg Arg Glu Lys Glu Leu Tyr Asp
    210                 215                 220

Gln Ile Ala Asp Leu Thr Asp Lys Asn Gly Glu Tyr Leu Glu Arg Ile
225                 230                 235                 240
```

```
Gly Glu Leu Glu Glu Arg Gln Lys Asn Leu Asp Asp Arg Ser Val Ser
               245                 250                 255

Thr Asn Ser Gly Ser Val Ser Thr Pro Tyr Asn Asn Leu Leu Asn Glu
            260                 265                 270

Tyr Asp Asp Leu Leu Ala Lys His Gly Glu Leu Leu Ser Glu Tyr Asp
        275                 280                 285

Ala Leu Lys Glu Lys Gln Asp Lys Asn Gln Glu Glu Asn Ser Lys Asn
    290                 295                 300

Pro Ala Pro Ala Pro Ala Ser Ala Val Pro Val Lys Lys Glu Ala Thr
305                 310                 315                 320

Lys Leu Ser Glu Ala Glu Leu Tyr Asn Lys Ile Gln Glu Leu Glu Glu
               325                 330                 335

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

Pro Arg Tyr Thr Asp Ala His Asn Ala Val Thr Gln Gly Arg Thr Val
        355                 360                 365

Pro Leu Gln Asn Leu Leu His Glu Met Asp Lys Asn Gly Lys Leu Arg
    370                 375                 380

Ser Glu Asn Glu Glu Leu Lys Ala Asp Leu Gln Lys Lys Glu Gln Glu
385                 390                 395                 400
```

<210> 5
<211> 451
<212> PRT
<213> Artificial Sequence

<220>
<223> Fusion protein of group A streptococcus M proteins.

<400> 5

```
Met Asn Gly Asp Gly Asn Pro Arg Glu Val Ile Glu Asp Leu Ala Ala
1               5                   10                  15
```

```
Asn Asn Pro Ala Ile Gln Asn Ile Arg Leu Arg His Glu Asn Lys Asp
            20                  25                  30

Leu Lys Ala Arg Leu Glu Asn Ala Met Glu Val Ala Gly Arg Asp Phe
        35                  40                  45

Lys Arg Ala Leu Leu Asp Gln Val Thr Gln Leu Tyr Thr Lys His Asn
    50                  55                  60

Ser Asn Tyr Gln Gln Tyr Asn Ala Gln Ala Gly Arg Leu Asp Leu Arg
65                  70                  75                  80

Gln Lys Ala Glu Tyr Leu Lys Gly Leu Asn Asp Trp Ala Glu Arg Leu
                85                  90                  95

Leu Gln Glu Leu Asn Arg Val Phe Pro Arg Gly Thr Val Glu Asn Pro
            100                 105                 110

Asp Lys Ala Arg Glu Leu Leu Asn Lys Tyr Asp Val Glu Asn Arg Val
        115                 120                 125

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

Asn Lys Tyr Asp Val Glu Asn Ser Lys Asn Pro Val Pro Val Lys Lys
145                 150                 155                 160

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

Ser Lys Asn Pro Val Pro Val Lys Lys Glu Ala Lys Leu Ser Glu Ala
            180                 185                 190

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

Ala Asp Asn Lys Asp Glu Leu Ile Lys Arg Ala Asn Asp Tyr Glu Ile
    210                 215                 220
```

```
Gln Asn His Gln Leu Thr Val Glu Asn Lys Lys Leu Lys Thr Asp Lys
225                 230                 235                 240

Glu Gln Leu Thr Lys Glu Asn Asp Asp Leu Lys Ala Glu Ser Pro Lys
                245                 250                 255

Ser Thr Glu Thr Ser Ala Asn Gly Ala Asp Lys Leu Ala Asp Ala Tyr
            260                 265                 270

Asn Thr Leu Leu Thr Glu His Glu Lys Leu Arg Asp Glu Tyr Tyr Thr
        275                 280                 285

Leu Ile Asp Ala Lys Glu Glu Glu Pro Arg Tyr Lys Ala Asp His Ser
    290                 295                 300

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

Glu Arg Leu Lys Gln Arg Ser Glu Leu Tyr Leu Gln Gln Tyr Tyr Asp
                325                 330                 335

Asn Lys Ser Asn Gly Tyr Lys Gly Asp Trp Tyr Val Gln Gln Leu Asp
            340                 345                 350

Ser Val Ser Gly Leu Glu Val Ala Asp Pro Ser Asp Ser Lys Lys Leu
        355                 360                 365

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

Thr Lys Glu Asp Ser Glu Ile Leu Ser Glu Leu Arg Asp Val Leu Lys
385                 390                 395                 400

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

Asn Asn Pro Ala Ile Gln Asn Ile Arg Leu Arg His Glu Asn Lys Asp
            420                 425                 430
```

```
Leu Lys Ala Arg Leu Glu Asn Ala Met Glu Val Ala Gly Arg Asp Phe
        435                 440                 445


Lys Arg Ala
    450


<210>  6
<211>  451
<212>  PRT
<213>  Artificial Sequence

<220>
<223>  Fusion protein of group A streptococcus M proteins.

<400>  6

Met Ala Glu Ile Lys Lys Pro Gln Ala Asp Ser Ala Trp Asn Trp Pro
1               5                   10                  15


Lys Glu Tyr Asn Ala Leu Leu Lys Glu Asn Glu Glu Leu Lys Val Glu
            20                  25                  30


Arg Glu Lys Tyr Leu Ser Tyr Ala Asp Asp Lys Glu Lys Asp Pro Gln
        35                  40                  45


Tyr Arg Ala Ala Val Thr Arg Gly Thr Ile Asn Asp Pro Gln Arg Ala
    50                  55                  60


Lys Glu Ala Leu Asp Lys Tyr Glu Leu Glu Asn His Ala Val Thr Arg
65                  70                  75                  80


Gly Thr Ile Asn Asp Pro Gln Arg Ala Lys Glu Ala Leu Asp Lys Tyr
                85                  90                  95


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


Lys Gly Thr Asn Val Ser Ala Asp Leu Tyr Asn Ser Leu Trp Asp Glu
        115                 120                 125
```

```
Asn Lys Thr Leu Arg Glu Lys Gln Glu Glu Tyr Ile Thr Lys Ile Gln
    130                 135                 140

Asn Glu Glu Thr Lys Asn Lys Glu Glu Glu Arg Thr Phe Thr Glu Leu
145                 150                 155                 160

Pro Tyr Glu Ala Arg Tyr Lys Ala Trp Lys Ser Glu Asn Asp Glu Leu
                165                 170                 175

Arg Glu Asn Tyr Arg Arg Thr Leu Asp Lys Phe Asn Thr Glu Gln Gly
            180                 185                 190

Lys Thr Thr Arg Leu Glu Glu Gln Asn Arg Val Arg Tyr Thr Arg His
        195                 200                 205

Thr Pro Glu Asp Lys Leu Lys Lys Ile Ile Asp Asp Leu Asp Ala Lys
    210                 215                 220

Glu His Arg Val Arg Tyr Thr Arg His Thr Pro Glu Asp Lys Leu Lys
225                 230                 235                 240

Lys Ile Ile Asp Asp Leu Asp Ala Lys Glu His Arg Val Tyr Ile Thr
                245                 250                 255

Arg Arg Met Thr Lys Glu Asp Val Glu Lys Ile Ala Asn Asp Leu Asp
            260                 265                 270

Thr Glu Asn His Gly Leu Lys Gln Gln Asn Glu Gln Leu Ser Thr Glu
        275                 280                 285

Lys Gln Gly Leu Glu Glu Gln Asn Lys Gln Leu Ser Thr Asp Arg Val
    290                 295                 300

Ser Arg Ser Met Ser Arg Asp Asp Leu Leu Asn Arg Ala Gln Asp Leu
305                 310                 315                 320

Glu Ala Lys Asn His Gly Leu Glu His Gln Asn Thr Lys Leu Ser Thr
                325                 330                 335
```

```
Glu Asn Lys Thr Leu Gln Glu Gln Ala Glu Ala Arg Gln Lys Glu Val
            340                 345                 350

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

Asp Lys Phe Glu Ile Glu Asn Asn Thr Leu Lys Leu Lys Asn Ser Asp
    370                 375                 380

Leu Ser Phe Asn Asn Lys Ala Leu Lys Asp His Asn Asp Glu Leu Thr
385                 390                 395                 400

Glu Ala Glu Ile Lys Lys Pro Gln Ala Asp Ser Ala Trp Asn Trp Pro
                405                 410                 415

Lys Glu Tyr Asn Ala Leu Leu Lys Glu Asn Glu Glu Leu Lys Val Glu
            420                 425                 430

Arg Glu Lys Tyr Leu Ser Tyr Ala Asp Asp Lys Glu Lys Asp Pro Gln
        435                 440                 445

Tyr Arg Ala
    450
```

<210> 7
<211> 451
<212> PRT
<213> Artificial Sequence

<220>
<223> Fusion protein of group A streptococcus M proteins.

<400> 7

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

Thr Asp Leu Glu Glu Glu Arg Glu Lys Leu Leu Asn Lys Leu Asp Lys
            20                  25                  30

Val Glu Glu Glu His Lys Lys Asp His Glu Gln Leu Glu Lys Lys Ser
        35                  40                  45
```

```
Glu Asp Val Glu Ser Ser Asn Asn Ala Glu Ser Ser Asn Ile Ser Gln
    50                  55                  60

Glu Ser Lys Leu Ile Asn Thr Leu Thr Asp Glu Asn Glu Lys Leu Arg
65                  70                  75                  80

Glu Glu Leu Gln Gln Tyr Tyr Ala Leu Ser Asp Ala Lys Glu Glu Glu
                85                  90                  95

Pro Arg Tyr Lys Ala Asp Asn Gln Ser Pro Ala Pro Val Lys Lys Glu
            100                 105                 110

Ala Lys Lys Leu Asn Glu Ala Glu Leu Tyr Asn Lys Ile Gln Glu Leu
        115                 120                 125

Glu Glu Gly Lys Ala Glu Leu Phe Asp Lys Leu Glu Lys Val Glu Glu
    130                 135                 140

Glu Asn Lys Lys Val Lys Glu Asp Ser Asp Asn Ile Asn Arg Ser Val
145                 150                 155                 160

Ser Val Lys Asp Asn Glu Lys Glu Leu His Asn Lys Ile Ala Asp Leu
                165                 170                 175

Glu Glu Glu Arg Gly Glu His Leu Asp Lys Ile Asp Glu Leu Lys Glu
            180                 185                 190

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

Asn Glu Leu Thr Ala Ser Met Trp Lys Ala Gln Ala Asp Ser Ala Lys
    210                 215                 220

Ala Lys Ala Lys Glu Leu Glu Lys Gln Val Glu Glu Tyr Lys Lys Asn
225                 230                 235                 240

Tyr Glu Thr Leu Glu Lys Gly Tyr Asp Asp Leu Ala Glu Ser Arg Ser
                245                 250                 255
```

```
Val Ser Gln Gly Ser Val Ser Leu Glu Leu Tyr Asp Lys Leu Ser Asp
            260                 265                 270

Glu Asn Asp Ile Leu Arg Glu Lys Gln Asp Glu Tyr Leu Thr Lys Ile
        275                 280                 285

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

Asn Ser Arg Ser Ile Thr Asn Glu Gln Leu Ile Asp Lys Leu Val Glu
305                 310                 315                 320

Glu Asn Asn Asp Leu Lys Glu Glu Arg Ala Lys Tyr Leu Asp Leu Leu
                325                 330                 335

Asp Asn Arg Glu Lys Asp Pro Gln Tyr Arg Ala Leu Met Gly Glu Ala
            340                 345                 350

Glu Lys Lys Val Glu Val Ala Asp Ser Asn Ala Ser Ser Val Ala Lys
        355                 360                 365

Leu Tyr Asn Gln Ile Ala Asp Leu Thr Asp Lys Asn Gly Glu Tyr Leu
    370                 375                 380

Glu Arg Ile Glu Glu Leu Glu Glu Arg Gln Lys Asn Leu Glu Lys Leu
385                 390                 395                 400

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

Thr Asp Leu Glu Glu Glu Arg Glu Lys Leu Leu Asn Lys Leu Asp Lys
            420                 425                 430

Val Glu Glu Glu His Lys Lys Asp His Glu Gln Leu Glu Lys Lys Ser
        435                 440                 445

Glu Asp Val
    450
```

<210> 8
<211> 401
<212> PRT
<213> Artificial Sequence

<220>
<223> Fusion protein of group A streptococcus M proteins.

<400> 8

Met Asp Asn Pro Arg Tyr Thr Asp Ala His Asn Ala Val Thr Gln Gly
1 5 10 15

Arg Thr Val Pro Leu Gln Asn Leu Leu His Glu Met Asp Lys Asn Gly
20 25 30

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

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

Lys Phe Trp Lys Ser Lys Phe Asp Ala Glu Gln Asn Arg Ala Asn Glu
65 70 75 80

Leu Glu Lys Lys Leu Ser Gly Tyr Glu Lys Asp Tyr Lys Thr Leu Glu
85 90 95

Gln Glu Tyr Glu Asn Ala Gly Ser Glu Glu Asn Val Pro Lys Gln Gln
100 105 110

Tyr Asn Ala Leu Trp Glu Glu Asn Glu Asp Leu Arg Gly Arg Glu Arg
115 120 125

Lys Tyr Ile Ala Lys Leu Glu Lys Glu Glu Ile Gln Asn Gly Glu Leu
130 135 140

Asn Glu Lys Asn Arg Lys Leu Glu Ser Pro Arg Glu Val Thr Asn Glu
145 150 155 160

```
Leu Ala Ala Ser Val Trp Lys Lys Lys Val Glu Glu Ala Lys Glu Lys
                165                 170                 175

Ala Ser Lys Leu Glu Lys Gln Leu Glu Glu Ala Gln Lys Asp Tyr Ser
            180                 185                 190

Glu Ile Glu Gly Lys Leu Glu Gln Phe Val Glu Lys Lys Val Glu Ala
        195                 200                 205

Ala Glu Asn Asn Val Ser Ser Val Ala Arg Arg Glu Lys Glu Leu Tyr
    210                 215                 220

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

Ile Gly Glu Leu Glu Glu Arg Gln Lys Asn Leu Asp Asp Arg Ser Val
                245                 250                 255

Ser Thr Asn Ser Gly Ser Val Ser Thr Pro Tyr Asn Asn Leu Leu Asn
            260                 265                 270

Glu Tyr Asp Asp Leu Leu Ala Lys His Gly Glu Leu Leu Ser Glu Tyr
        275                 280                 285

Asp Ala Leu Lys Glu Lys Gln Asp Lys Asn Gln Glu Glu Asn Ser Lys
    290                 295                 300

Asn Pro Ala Pro Ala Pro Ala Ser Ala Val Pro Val Lys Lys Glu Ala
305                 310                 315                 320

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

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

Asn Pro Arg Tyr Thr Asp Ala His Asn Ala Val Thr Gln Gly Arg Thr
        355                 360                 365
```

Val Pro Leu Gln Asn Leu Leu His Glu Met Asp Lys Asn Gly Lys Leu
370 375 380

Arg Ser Glu Asn Glu Glu Leu Lys Ala Asp Leu Gln Lys Lys Glu Gln
385 390 395 400

Glu

<210> 9
<211> 457
<212> PRT
<213> Artificial Sequence

<220>
<223> Fusion protein of group A streptococcus M proteins.

<400> 9

Met Asn Gly Asp Gly Asn Pro Arg Glu Val Ile Glu Asp Leu Ala Ala
1 5 10 15

Asn Asn Pro Ala Ile Gln Asn Ile Arg Leu Arg His Glu Asn Lys Asp
20 25 30

Leu Lys Ala Arg Leu Glu Asn Ala Met Glu Val Ala Gly Arg Asp Phe
35 40 45

Lys Arg Ala Leu Leu Asp Gln Val Thr Gln Leu Tyr Thr Lys His Asn
50 55 60

Ser Asn Tyr Gln Gln Tyr Asn Ala Gln Ala Gly Arg Leu Asp Leu Arg
65 70 75 80

Gln Lys Ala Glu Tyr Leu Lys Gly Leu Asn Asp Trp Ala Glu Arg Leu
85 90 95

Leu Gln Glu Leu Asn Arg Val Phe Pro Arg Gly Thr Val Glu Asn Pro
100 105 110

Asp Lys Ala Arg Glu Leu Leu Asn Lys Tyr Asp Val Glu Asn Arg Val
115 120 125

```
Phe Pro Arg Gly Thr Val Glu Asn Pro Asp Lys Ala Arg Glu Leu Leu
    130                 135                 140

Asn Lys Tyr Asp Val Glu Asn Ser Lys Asn Pro Val Pro Val Lys Lys
145                 150                 155                 160

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

Ser Lys Asn Pro Val Pro Val Lys Lys Glu Ala Lys Leu Ser Glu Ala
            180                 185                 190

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

Ala Asp Asn Lys Asp Glu Leu Ile Lys Arg Ala Asn Asp Tyr Glu Ile
    210                 215                 220

Gln Asn His Gln Leu Thr Val Glu Asn Lys Lys Leu Lys Thr Asp Lys
225                 230                 235                 240

Glu Gln Leu Thr Lys Glu Asn Asp Asp Leu Lys Ala Glu Ser Pro Lys
                245                 250                 255

Ser Thr Glu Thr Ser Ala Asn Gly Ala Asp Lys Leu Ala Asp Ala Tyr
            260                 265                 270

Asn Thr Leu Leu Thr Glu His Glu Lys Leu Arg Asp Glu Tyr Tyr Thr
        275                 280                 285

Leu Ile Asp Ala Lys Glu Glu Glu Pro Arg Tyr Lys Ala Asp His Ser
    290                 295                 300

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

Glu Arg Leu Lys Gln Arg Ser Glu Leu Tyr Leu Gln Gln Tyr Tyr Asp
                325                 330                 335
```

```
Asn Lys Ser Asn Gly Tyr Lys Gly Asp Trp Tyr Val Gln Gln Leu Asp
            340                 345                 350

Ser Val Ser Gly Leu Glu Val Ala Asp Pro Ser Asp Ser Lys Lys Leu
        355                 360                 365

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

Thr Lys Glu Asp Ser Glu Ile Leu Ser Glu Leu Arg Asp Val Leu Lys
385                 390                 395                 400

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

Asn Asn Pro Ala Ile Gln Asn Ile Arg Leu Arg His Glu Asn Lys Asp
            420                 425                 430

Leu Lys Ala Arg Leu Glu Asn Ala Met Glu Val Ala Gly Arg Asp Phe
        435                 440                 445

Lys Arg Ala His His His His His His
    450                 455
```

<210> 10
<211> 457
<212> PRT
<213> Artificial Sequence

<220>
<223> Fusion protein of group A streptococcus M proteins.

<400> 10

```
Met Ala Glu Ile Lys Lys Pro Gln Ala Asp Ser Ala Trp Asn Trp Pro
1               5                   10                  15

Lys Glu Tyr Asn Ala Leu Leu Lys Glu Asn Glu Glu Leu Lys Val Glu
            20                  25                  30
```

```
Arg Glu Lys Tyr Leu Ser Tyr Ala Asp Asp Lys Glu Lys Asp Pro Gln
        35                  40                  45

Tyr Arg Ala Ala Val Thr Arg Gly Thr Ile Asn Asp Pro Gln Arg Ala
    50                  55                  60

Lys Glu Ala Leu Asp Lys Tyr Glu Leu Glu Asn His Ala Val Thr Arg
65                  70                  75                  80

Gly Thr Ile Asn Asp Pro Gln Arg Ala Lys Glu Ala Leu Asp Lys Tyr
                85                  90                  95

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

Lys Gly Thr Asn Val Ser Ala Asp Leu Tyr Asn Ser Leu Trp Asp Glu
        115                 120                 125

Asn Lys Thr Leu Arg Glu Lys Gln Glu Glu Tyr Ile Thr Lys Ile Gln
    130                 135                 140

Asn Glu Glu Thr Lys Asn Lys Glu Glu Glu Arg Thr Phe Thr Glu Leu
145                 150                 155                 160

Pro Tyr Glu Ala Arg Tyr Lys Ala Trp Lys Ser Glu Asn Asp Glu Leu
                165                 170                 175

Arg Glu Asn Tyr Arg Arg Thr Leu Asp Lys Phe Asn Thr Glu Gln Gly
            180                 185                 190

Lys Thr Thr Arg Leu Glu Glu Gln Asn Arg Val Arg Tyr Thr Arg His
        195                 200                 205

Thr Pro Glu Asp Lys Leu Lys Lys Ile Ile Asp Asp Leu Asp Ala Lys
    210                 215                 220

Glu His Arg Val Arg Tyr Thr Arg His Thr Pro Glu Asp Lys Leu Lys
225                 230                 235                 240
```

```
Lys Ile Ile Asp Asp Leu Asp Ala Lys Glu His Arg Val Tyr Ile Thr
                245                 250                 255

Arg Arg Met Thr Lys Glu Asp Val Glu Lys Ile Ala Asn Asp Leu Asp
            260                 265                 270

Thr Glu Asn His Gly Leu Lys Gln Gln Asn Glu Gln Leu Ser Thr Glu
        275                 280                 285

Lys Gln Gly Leu Glu Glu Gln Asn Lys Gln Leu Ser Thr Asp Arg Val
    290                 295                 300

Ser Arg Ser Met Ser Arg Asp Asp Leu Leu Asn Arg Ala Gln Asp Leu
305                 310                 315                 320

Glu Ala Lys Asn His Gly Leu Glu His Gln Asn Thr Lys Leu Ser Thr
                325                 330                 335

Glu Asn Lys Thr Leu Gln Glu Gln Ala Glu Ala Arg Gln Lys Glu Val
            340                 345                 350

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

Asp Lys Phe Glu Ile Glu Asn Asn Thr Leu Lys Leu Lys Asn Ser Asp
    370                 375                 380

Leu Ser Phe Asn Asn Lys Ala Leu Lys Asp His Asn Asp Glu Leu Thr
385                 390                 395                 400

Glu Ala Glu Ile Lys Lys Pro Gln Ala Asp Ser Ala Trp Asn Trp Pro
                405                 410                 415

Lys Glu Tyr Asn Ala Leu Leu Lys Glu Asn Glu Glu Leu Lys Val Glu
            420                 425                 430

Arg Glu Lys Tyr Leu Ser Tyr Ala Asp Asp Lys Glu Lys Asp Pro Gln
        435                 440                 445
```

Tyr Arg Ala His His His His His His
450 455

<210> 11
<211> 457
<212> PRT
<213> Artificial Sequence

<220>
<223> Fusion protein of group A streptococcus M proteins.

<400> 11

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

Thr Asp Leu Glu Glu Glu Arg Glu Lys Leu Leu Asn Lys Leu Asp Lys
20 25 30

Val Glu Glu Glu His Lys Lys Asp His Glu Gln Leu Glu Lys Lys Ser
35 40 45

Glu Asp Val Glu Ser Ser Asn Asn Ala Glu Ser Ser Asn Ile Ser Gln
50 55 60

Glu Ser Lys Leu Ile Asn Thr Leu Thr Asp Glu Asn Glu Lys Leu Arg
65 70 75 80

Glu Glu Leu Gln Gln Tyr Tyr Ala Leu Ser Asp Ala Lys Glu Glu Glu
85 90 95

Pro Arg Tyr Lys Ala Asp Asn Gln Ser Pro Ala Pro Val Lys Lys Glu
100 105 110

Ala Lys Lys Leu Asn Glu Ala Glu Leu Tyr Asn Lys Ile Gln Glu Leu
115 120 125

Glu Glu Gly Lys Ala Glu Leu Phe Asp Lys Leu Glu Lys Val Glu Glu
130 135 140

Glu Asn Lys Lys Val Lys Glu Asp Ser Asp Asn Ile Asn Arg Ser Val
145 150 155 160

```
Ser Val Lys Asp Asn Glu Lys Glu Leu His Asn Lys Ile Ala Asp Leu
                165                 170                 175

Glu Glu Glu Arg Gly Glu His Leu Asp Lys Ile Asp Glu Leu Lys Glu
            180                 185                 190

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

Asn Glu Leu Thr Ala Ser Met Trp Lys Ala Gln Ala Asp Ser Ala Lys
    210                 215                 220

Ala Lys Ala Lys Glu Leu Glu Lys Gln Val Glu Glu Tyr Lys Lys Asn
225                 230                 235                 240

Tyr Glu Thr Leu Glu Lys Gly Tyr Asp Asp Leu Ala Glu Ser Arg Ser
                245                 250                 255

Val Ser Gln Gly Ser Val Ser Leu Glu Leu Tyr Asp Lys Leu Ser Asp
            260                 265                 270

Glu Asn Asp Ile Leu Arg Glu Lys Gln Asp Glu Tyr Leu Thr Lys Ile
        275                 280                 285

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

Asn Ser Arg Ser Ile Thr Asn Glu Gln Leu Ile Asp Lys Leu Val Glu
305                 310                 315                 320

Glu Asn Asn Asp Leu Lys Glu Glu Arg Ala Lys Tyr Leu Asp Leu Leu
                325                 330                 335

Asp Asn Arg Glu Lys Asp Pro Gln Tyr Arg Ala Leu Met Gly Glu Ala
            340                 345                 350

Glu Lys Lys Val Glu Val Ala Asp Ser Asn Ala Ser Ser Val Ala Lys
        355                 360                 365
```

```
Leu Tyr Asn Gln Ile Ala Asp Leu Thr Asp Lys Asn Gly Glu Tyr Leu
    370                 375                 380

Glu Arg Ile Glu Glu Leu Glu Glu Arg Gln Lys Asn Leu Glu Lys Leu
385                 390                 395                 400

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

Thr Asp Leu Glu Glu Glu Arg Glu Lys Leu Leu Asn Lys Leu Asp Lys
            420                 425                 430

Val Glu Glu Glu His Lys Lys Asp His Glu Gln Leu Glu Lys Lys Ser
        435                 440                 445

Glu Asp Val His His His His His His
    450                 455
```

<210> 12
<211> 407
<212> PRT
<213> Artificial Sequence

<220>
<223> Fusion protein of group A streptococcus M proteins.

<400> 12

```
Met Asp Asn Pro Arg Tyr Thr Asp Ala His Asn Ala Val Thr Gln Gly
1               5                   10                  15

Arg Thr Val Pro Leu Gln Asn Leu Leu His Glu Met Asp Lys Asn Gly
            20                  25                  30

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

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

```
Lys Phe Trp Lys Ser Lys Phe Asp Ala Glu Gln Asn Arg Ala Asn Glu
65                  70                  75                  80

Leu Glu Lys Lys Leu Ser Gly Tyr Glu Lys Asp Tyr Lys Thr Leu Glu
                85                  90                  95

Gln Glu Tyr Glu Asn Ala Gly Ser Glu Glu Asn Val Pro Lys Gln Gln
            100                 105                 110

Tyr Asn Ala Leu Trp Glu Glu Asn Glu Asp Leu Arg Gly Arg Glu Arg
        115                 120                 125

Lys Tyr Ile Ala Lys Leu Glu Lys Glu Glu Ile Gln Asn Gly Glu Leu
    130                 135                 140

Asn Glu Lys Asn Arg Lys Leu Glu Ser Pro Arg Glu Val Thr Asn Glu
145                 150                 155                 160

Leu Ala Ala Ser Val Trp Lys Lys Lys Val Glu Glu Ala Lys Glu Lys
                165                 170                 175

Ala Ser Lys Leu Glu Lys Gln Leu Glu Glu Ala Gln Lys Asp Tyr Ser
            180                 185                 190

Glu Ile Glu Gly Lys Leu Glu Gln Phe Val Glu Lys Lys Val Glu Ala
        195                 200                 205

Ala Glu Asn Asn Val Ser Ser Val Ala Arg Arg Glu Lys Glu Leu Tyr
    210                 215                 220

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

Ile Gly Glu Leu Glu Glu Arg Gln Lys Asn Leu Asp Asp Arg Ser Val
                245                 250                 255

Ser Thr Asn Ser Gly Ser Val Ser Thr Pro Tyr Asn Asn Leu Leu Asn
            260                 265                 270
```

Glu Tyr Asp Asp Leu Leu Ala Lys His Gly Glu Leu Leu Ser Glu Tyr
275 280 285

Asp Ala Leu Lys Glu Lys Gln Asp Lys Asn Gln Glu Glu Asn Ser Lys
290 295 300

Asn Pro Ala Pro Ala Pro Ala Ser Ala Val Pro Val Lys Lys Glu Ala
305 310 315 320

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

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

Asn Pro Arg Tyr Thr Asp Ala His Asn Ala Val Thr Gln Gly Arg Thr
355 360 365

Val Pro Leu Gln Asn Leu Leu His Glu Met Asp Lys Asn Gly Lys Leu
370 375 380

Arg Ser Glu Asn Glu Glu Leu Lys Ala Asp Leu Gln Lys Lys Glu Gln
385 390 395 400

Glu His His His His His His
405

<210> 13
<211> 1463
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 13
agatctcgat cccgcgaaat taatacgact cactataggg gaattgtgag cggataacaa 60

ttcccctcta gaaataattt tgtttaactt taagaaggag atatcatatg aacggtgacg 120

gtaacccgcg tgaagttatc gaagacctgg ctgctaacaa cccggctatc cagaacatcc 180

gtctgcgtca cgaaaacaaa gacctgaaag ctcgtctgga aaacgctatg gaagttgctg 240

gtcgtgactt caaacgtgct ctgctggacc aggttaccca gctgtacacc aaacacaact 300

ccaactacca gcagtacaac gctcaggctg gtcgtctgga cctgcgtcag aaagctgaat 360

acctgaaagg tctgaacgac tgggctgaac gtctgctgca ggaactgaac cgtgttttcc 420

cgcgtggtac cgttgaaaac ccggacaaag ctcgtgaact gctgaacaaa tacgacgttg 480

aaaaccgtgt tttcccgcgt ggtaccgttg aaaacccgga caaagctcgt gaactgctga 540

acaaatacga cgttgaaaac tccaaaaacc cggttccggt taaaaaagaa gctaaactgt 600

ccgaagctga actgcacgac aaaatcaaaa acctgtccaa aaacccggtt ccggttaaaa 660

aagaagctaa actgtccgaa gctgaactgc acgacaaaat caaaaacctg gctccgctga 720

cccgtgctac cgctgacaac aaagacgaac tgatcaaacg tgctaacgac tacgaaatcc 780

agaaccacca gctgaccgtt gaaaacaaaa aactgaaaac cgacaaagaa cagctgacca 840

aagaaaacga cgacctgaaa gctgaatccc cgaaatccac cgaaacctcc gctaacggtg 900

ctgacaaact ggctgacgct tacaacaccc tgctgaccga acacgaaaaa ctgcgtgacg 960

aatactacac cctgatcgac gctaaagaag aagaaccgcg ttacaaagct gaccactccg 1020

acctggttgc tgaaaaacag cgtctggaag acctgggtca gaaattcgaa cgtctgaaac 1080

agcgttccga actgtacctg cagcagtact acgacaacaa atccaacggt tacaaaggtg 1140

actggtacgt tcagcagctg gactccgttt ccggtctgga agttgctgac ccgtccgact 1200

ccaaaaaact gatcgaactg ggtctggcta aatacctgaa cgacaaactg ccgttcaaaa 1260

ccaaagaaga ctccgaaatc ctgtccgaac tgcgtgacgt tctgaaaaac aacggtgacg 1320

gtaacccgcg tgaagttatc gaagacctgg ctgctaacaa cccggctatc cagaacatcc 1380

gtctgcgtca cgaaaacaaa gacctgaaag ctcgtctgga aaacgctatg gaagttgctg 1440

gtcgtgactt caaacgtgct tag 1463

<210> 14
<211> 1463
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus

M proteins.

<400> 14

agatctcgat cccgcgaaat taatacgact cactataggg gaattgtgag cggataacaa 60

ttcccctcta gaaataattt tgtttaactt taagaaggag atataccatg gctgaaatca 120

aaaaaccgca ggctgactcc gcttggaact ggccgaaaga atacaacgct ctgctgaaag 180

aaaacgaaga actgaaagtt gaacgtgaaa aatacctgtc ctacgctgac gacaaagaaa 240

aagacccgca gtaccgtgct gctgttaccc gtggtaccat caacgacccg cagcgtgcta 300

aagaagctct ggacaaatac gaactggaaa accacgctgt tacccgtggt accatcaacg 360

acccgcagcg tgctaaagaa gctctggaca aatacgaact ggaaaaccac accgaagtta 420

aagctgctgg tcagtccgct ccgaaaggta ccaacgtttc cgctgacctg tacaactccc 480

tgtgggacga aaacaaaacc ctgcgtgaaa aacaggaaga atacatcacc aaaatccaga 540

acgaagaaac caaaaacaaa gaagaagaac gtaccttcac cgaactgccg tacgaagctc 600

gttacaaagc ttggaaatcc gaaaacgacg aactgcgtga aaactaccgt cgtaccctgg 660

acaaattcaa caccgaacag ggtaaaacca cccgtctgga agaacagaac cgtgttcgtt 720

acacccgtca caccccggaa gacaaactga aaaaaatcat cgacgacctg gacgctaaag 780

aacaccgtgt tcgttacacc cgtcacaccc cggaagacaa actgaaaaaa atcatcgacg 840

acctggacgc taaagaacac cgtgtttaca tcacccgtcg tatgaccaaa gaagacgttg 900

aaaaaatcgc taacgacctg gacaccgaaa accacggtct gaaacagcag aacgaacagc 960

tgtccaccga aaaacagggt ctggaagaac agaacaaaca gctgtccacc gaccgtgttt 1020

cccgttccat gtcccgtgac gacctgctga accgtgctca ggacctggaa gctaaaaacc 1080

acggtctgga acaccagaac accaaactgt ccaccgaaaa caaaaccctg caggaacagg 1140

ctgaagctcg tcagaaagaa gttgctaccc gttcccagac cgacaccctg gaaaaagttc 1200

aggaacgtgc tgacaaattc gaaatcgaaa acaacaccct gaaactgaaa aactccgacc 1260

tgtccttcaa caacaaagct ctgaaagacc acaacgacga actgaccgaa gctgaaatca 1320

aaaaaccgca ggctgactcc gcttggaact ggccgaaaga atacaacgct ctgctgaaag 1380

aaaacgaaga actgaaagtt gaacgtgaaa aatacctgtc ctacgctgac gacaaagaaa 1440

aagacccgca gtaccgtgct tag 1463

<210> 15
<211> 1463
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 15
agatctcgat cccgcgaaat taatacgact cactataggg gaattgtgag cggataacaa 60

ttcccctcta gaaataattt tgtttaactt taagaaggag atataccatg gaaggtgttt 120

ccgttggttc cgacgcttcc ctgcacaacc gtatcaccga cctggaagaa gaacgtgaaa 180

aactgctgaa caaactggac aaagttgaag aagaacacaa aaaagaccac gaacagctgg 240

aaaaaaaatc cgaagacgtt gaatcctcca acaacgctga atcctccaac atctcccagg 300

aatccaaact gatcaacacc ctgaccgacg aaaacgaaaa actgcgtgaa gaactgcagc 360

agtactacgc tctgtccgac gctaaagaag aagaaccgcg ttacaaagct gacaaccagt 420

ccccggctcc ggttaaaaaa gaagctaaaa aactgaacga agctgaactg tacaacaaaa 480

tccaggaact ggaagaaggt aaagctgaac tgttcgacaa actggaaaaa gttgaagaag 540

aaaacaaaaa agttaaagaa gactccgaca acatcaaccg ttccgtttcc gttaaagaca 600

acgaaaaaga actgcacaac aaaatcgctg acctggaaga agaacgtggt gaacacctgg 660

acaaaatcga cgaactgaaa gaagaactga aagctaaaga aaaatcctcc gactcctccc 720

gtgaagttac caacgaactg accgcttcca tgtggaaagc tcaggctgac tccgctaaag 780

ctaaagctaa agaactggaa aaacaggttg aagaatacaa aaaaaactac gaaaccctgg 840

aaaaaggtta cgacgacctg gctgaatccc gttccgtttc ccagggttcc gtttccctgg 900

aactgtacga caaactgtcc gacgaaaacg acatcctgcg tgaaaaacag gacgaatacc 960

tgaccaaaat cgacggtctg gacaaagaaa acaaagaata cgcttcccag gaatcccaga 1020

actcccgttc catcaccaac gaacagctga tcgacaaact ggttgaagaa aacaacgacc 1080

tgaaagaaga acgtgctaaa tacctggacc tgctggacaa ccgtgaaaaa gacccgcagt 1140

accgtgctct gatgggtgaa gctgaaaaaa aagttgaagt tgctgactcc aacgcttcct 1200

ccgttgctaa actgtacaac cagatcgctg acctgaccga caaaaacggt gaatacctgg 1260

aacgtatcga agaactggaa gaacgtcaga aaaacctgga aaaactggaa gaaggtgttt 1320

ccgttggttc cgacgcttcc ctgcacaacc gtatcaccga cctggaagaa gaacgtgaaa 1380

aactgctgaa caaactggac aaagttgaag aagaacacaa aaaagaccac gaacagctgg 1440

aaaaaaaatc cgaagacgtt tag 1463

<210> 16
<211> 1313
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 16
agatctcgat cccgcgaaat taatacgact cactataggg gaattgtgag cggataacaa 60

ttcccctcta gaaataattt tgtttaactt taagaaggag atataccatg gacaacccgc 120

gttacaccga cgctcacaac gctgttaccc agggtcgtac cgttccgctg cagaacctgc 180

tgcacgaaat ggacaaaaac ggtaaactgc gttccgaaaa cgaagaactg aaagctgacc 240

tgcagaaaaa agaacaggaa gactcctcct cccgtgacat caccgaagct ggtgtttcca 300

aattctggaa atccaaattc gacgctgaac agaaccgtgc taacgaactg gaaaaaaaac 360

tgtccggtta cgaaaaagac tacaaaaccc tggaacagga atacgaaaac gctggttccg 420

aagaaaacgt tccgaaacag cagtacaacg ctctgtggga agaaaacgaa gacctgcgtg 480

gtcgtgaacg taaatacatc gctaaactgg aaaaagaaga aatccagaac ggtgaactga 540

acgaaaaaaa ccgtaaactg gaatccccgc gtgaagttac caacgaactg gctgcttccg 600

tttggaaaaa aaaagttgaa gaagctaaag aaaaagcttc caaactggaa aaacagctgg 660

aagaagctca gaaagactac tccgaaatcg aaggtaaact ggaacagttc gttgaaaaaa 720

aagttgaagc tgctgaaaac aacgtttcct ccgttgctcg tcgtgaaaaa gaactgtacg 780

accagatcgc tgacctgacc gacaaaaacg gtgaatacct ggaacgtatc ggtgaactgg 840

aagaacgtca gaaaaacctg gacgaccgtt ccgtttccac caactccggt tccgtttcca 900

ccccgtacaa caacctgctg aacgaatacg acgacctgct ggctaaacac ggtgaactgc 960

tgtccgaata cgacgctctg aaagaaaaac aggacaaaaa ccaggaagaa aactccaaaa 1020

acccggctcc ggctccggct tccgctgttc cggttaaaaa agaagctacc aaactgtccg 1080

aagctgaact gtacaacaaa atccaggaac tggaagaagg taaagctgaa ctgttcgaca 1140

aactggaaaa agttgaagaa gacaacccgc gttacaccga cgctcacaac gctgttaccc 1200

agggtcgtac cgttccgctg cagaacctgc tgcacgaaat ggacaaaaac ggtaaactgc 1260

gttccgaaaa cgaagaactg aaagctgacc tgcagaaaaa agaacaggaa tag 1313

<210> 17
<211> 1481
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 17
agatctcgat cccgcgaaat taatacgact cactataggg gaattgtgag cggataacaa 60

ttcccctcta gaaataattt tgtttaactt taagaaggag atatcatatg aacggtgacg 120

gtaacccgcg tgaagttatc gaagacctgg ctgctaacaa cccggctatc cagaacatcc 180

gtctgcgtca cgaaaacaaa gacctgaaag ctcgtctgga aaacgctatg gaagttgctg 240

gtcgtgactt caaacgtgct ctgctggacc aggttaccca gctgtacacc aaacacaact 300

ccaactacca gcagtacaac gctcaggctg gtcgtctgga cctgcgtcag aaagctgaat 360

acctgaaagg tctgaacgac tgggctgaac gtctgctgca ggaactgaac cgtgttttcc 420

cgcgtggtac cgttgaaaac ccggacaaag ctcgtgaact gctgaacaaa tacgacgttg 480

aaaaccgtgt tttcccgcgt ggtaccgttg aaaacccgga caaagctcgt gaactgctga 540

acaaatacga cgttgaaaac tccaaaaacc cggttccggt taaaaaagaa gctaaactgt 600

ccgaagctga actgcacgac aaaatcaaaa acctgtccaa aaacccggtt ccggttaaaa 660

aagaagctaa actgtccgaa gctgaactgc acgacaaaat caaaaacctg gctccgctga 720

cccgtgctac cgctgacaac aaagacgaac tgatcaaacg tgctaacgac tacgaaatcc 780

agaaccacca gctgaccgtt gaaaacaaaa aactgaaaac cgacaaagaa cagctgacca 840

aagaaaacga cgacctgaaa gctgaatccc cgaaatccac cgaaacctcc gctaacggtg 900

ctgacaaact ggctgacgct tacaacaccc tgctgaccga acacgaaaaa ctgcgtgacg 960

aatactacac cctgatcgac gctaaagaag aagaaccgcg ttacaaagct gaccactccg 1020

acctggttgc tgaaaaacag cgtctggaag acctgggtca gaaattcgaa cgtctgaaac 1080

agcgttccga actgtacctg cagcagtact acgacaacaa atccaacggt tacaaaggtg 1140

actggtacgt tcagcagctg gactccgttt ccggtctgga agttgctgac ccgtccgact 1200

ccaaaaaact gatcgaactg ggtctggcta aatacctgaa cgacaaactg ccgttcaaaa 1260

ccaaagaaga ctccgaaatc ctgtccgaac tgcgtgacgt tctgaaaaac aacggtgacg 1320

gtaacccgcg tgaagttatc gaagacctgg ctgctaacaa cccggctatc cagaacatcc 1380

gtctgcgtca cgaaaacaaa gacctgaaag ctcgtctgga aaacgctatg gaagttgctg 1440

gtcgtgactt caaacgtgct caccaccacc accaccacta g 1481

<210> 18
<211> 1481
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 18
agatctcgat cccgcgaaat taatacgact cactataggg gaattgtgag cggataacaa 60

ttcccctcta gaaataattt tgtttaactt taagaaggag atataccatg gctgaaatca 120

aaaaaccgca ggctgactcc gcttggaact ggccgaaaga atacaacgct ctgctgaaag 180

aaaacgaaga actgaaagtt gaacgtgaaa aatacctgtc ctacgctgac gacaaagaaa 240

aagacccgca gtaccgtgct gctgttaccc gtggtaccat caacgacccg cagcgtgcta 300

aagaagctct ggacaaatac gaactggaaa accacgctgt tacccgtggt accatcaacg 360

acccgcagcg tgctaaagaa gctctggaca aatacgaact ggaaaaccac accgaagtta 420

aagctgctgg tcagtccgct ccgaaaggta ccaacgtttc cgctgacctg tacaactccc 480

tgtgggacga aaacaaaacc ctgcgtgaaa aacaggaaga atacatcacc aaaatccaga 540

acgaagaaac caaaaacaaa gaagaagaac gtaccttcac cgaactgccg tacgaagctc 600

gttacaaagc ttggaaatcc gaaaacgacg aactgcgtga aaactaccgt cgtaccctgg 660

acaaattcaa caccgaacag ggtaaaacca cccgtctgga agaacagaac cgtgttcgtt 720

acacccgtca caccccggaa gacaaactga aaaaaatcat cgacgacctg gacgctaaag 780

aacaccgtgt tcgttacacc cgtcacaccc cggaagacaa actgaaaaaa atcatcgacg 840

acctggacgc taaagaacac cgtgtttaca tcacccgtcg tatgaccaaa gaagacgttg 900

aaaaaatcgc taacgacctg gacaccgaaa accacggtct gaaacagcag aacgaacagc 960

tgtccaccga aaaacagggt ctggaagaac agaacaaaca gctgtccacc gaccgtgttt 1020

cccgttccat gtcccgtgac gacctgctga accgtgctca ggacctggaa gctaaaaacc 1080

acggtctgga acaccagaac accaaactgt ccaccgaaaa caaaaccctg caggaacagg 1140

ctgaagctcg tcagaaagaa gttgctaccc gttcccagac cgacaccctg gaaaaagttc 1200

aggaacgtgc tgacaaattc gaaatcgaaa acaacaccct gaaactgaaa aactccgacc 1260

tgtccttcaa caacaaagct ctgaaagacc acaacgacga actgaccgaa gctgaaatca 1320

aaaaaccgca ggctgactcc gcttggaact ggccgaaaga atacaacgct ctgctgaaag 1380

aaaacgaaga actgaaagtt gaacgtgaaa aatacctgtc ctacgctgac gacaaagaaa 1440

aagacccgca gtaccgtgct caccaccacc accaccacta g 1481

<210> 19
<211> 1481
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 19
agatctcgat cccgcgaaat taatacgact cactataggg gaattgtgag cggataacaa 60

ttcccctcta gaaataattt tgtttaactt taagaaggag atataccatg gaaggtgttt 120

ccgttggttc cgacgcttcc ctgcacaacc gtatcaccga cctggaagaa gaacgtgaaa 180

aactgctgaa caaactggac aaagttgaag aagaacacaa aaaagaccac gaacagctgg 240

aaaaaaaatc cgaagacgtt gaatcctcca acaacgctga atcctccaac atctcccagg 300

aatccaaact gatcaacacc ctgaccgacg aaaacgaaaa actgcgtgaa gaactgcagc 360

agtactacgc tctgtccgac gctaaagaag aagaaccgcg ttacaaagct gacaaccagt 420

ccccggctcc ggttaaaaaa gaagctaaaa aactgaacga agctgaactg tacaacaaaa 480

tccaggaact ggaagaaggt aaagctgaac tgttcgacaa actggaaaaa gttgaagaag 540

aaaacaaaaa agttaaagaa gactccgaca acatcaaccg ttccgtttcc gttaaagaca 600

acgaaaaaga actgcacaac aaaatcgctg acctggaaga agaacgtggt gaacacctgg 660

acaaaatcga cgaactgaaa gaagaactga aagctaaaga aaaatcctcc gactcctccc 720

gtgaagttac caacgaactg accgcttcca tgtggaaagc tcaggctgac tccgctaaag 780

ctaaagctaa agaactggaa aaacaggttg aagaatacaa aaaaaactac gaaaccctgg 840

aaaaaggtta cgacgacctg gctgaatccc gttccgtttc ccagggttcc gtttccctgg 900

aactgtacga caaactgtcc gacgaaaacg acatcctgcg tgaaaaacag gacgaatacc 960

tgaccaaaat cgacggtctg gacaaagaaa acaaagaata cgcttcccag gaatcccaga 1020

actcccgttc catcaccaac gaacagctga tcgacaaact ggttgaagaa aacaacgacc 1080

tgaaagaaga acgtgctaaa tacctggacc tgctggacaa ccgtgaaaaa gacccgcagt 1140

accgtgctct gatgggtgaa gctgaaaaaa aagttgaagt tgctgactcc aacgcttcct 1200

ccgttgctaa actgtacaac cagatcgctg acctgaccga caaaaacggt gaatacctgg 1260

aacgtatcga agaactggaa gaacgtcaga aaaacctgga aaaactggaa gaaggtgttt 1320

ccgttggttc cgacgcttcc ctgcacaacc gtatcaccga cctggaagaa gaacgtgaaa 1380

aactgctgaa caaactggac aaagttgaag aagaacacaa aaaagaccac gaacagctgg 1440

aaaaaaaatc cgaagacgtt caccaccacc accaccacta g 1481

<210> 20
<211> 1331
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 20
agatctcgat cccgcgaaat taatacgact cactataggg gaattgtgag cggataacaa 60

ttcccctcta gaaataattt tgtttaactt taagaaggag atataccatg gacaacccgc 120

gttacaccga cgctcacaac gctgttaccc agggtcgtac cgttccgctg cagaacctgc 180

tgcacgaaat ggacaaaaac ggtaaactgc gttccgaaaa cgaagaactg aaagctgacc 240

tgcagaaaaa agaacaggaa gactcctcct cccgtgacat caccgaagct ggtgtttcca 300

aattctggaa atccaaattc gacgctgaac agaaccgtgc taacgaactg gaaaaaaaac 360

tgtccggtta cgaaaaagac tacaaaaccc tggaacagga atacgaaaac gctggttccg 420

aagaaaacgt tccgaaacag cagtacaacg ctctgtggga agaaaacgaa gacctgcgtg 480

gtcgtgaacg taaatacatc gctaaactgg aaaaagaaga aatccagaac ggtgaactga 540

acgaaaaaaa ccgtaaactg gaatccccgc gtgaagttac caacgaactg gctgcttccg 600

tttggaaaaa aaaagttgaa gaagctaaag aaaaagcttc caaactggaa aaacagctgg 660

aagaagctca gaaagactac tccgaaatcg aaggtaaact ggaacagttc gttgaaaaaa 720

aagttgaagc tgctgaaaac aacgtttcct ccgttgctcg tcgtgaaaaa gaactgtacg 780

accagatcgc tgacctgacc gacaaaaacg gtgaatacct ggaacgtatc ggtgaactgg 840

aagaacgtca gaaaaacctg gacgaccgtt ccgtttccac caactccggt tccgtttcca 900

ccccgtacaa caacctgctg aacgaatacg acgacctgct ggctaaacac ggtgaactgc 960

tgtccgaata cgacgctctg aaagaaaaac aggacaaaaa ccaggaagaa aactccaaaa 1020

acccggctcc ggctccggct tccgctgttc cggttaaaaa agaagctacc aaactgtccg 1080

aagctgaact gtacaacaaa atccaggaac tggaagaagg taaagctgaa ctgttcgaca 1140

aactggaaaa agttgaagaa gacaacccgc gttacaccga cgctcacaac gctgttaccc 1200

agggtcgtac cgttccgctg cagaacctgc tgcacgaaat ggacaaaaac ggtaaactgc 1260

gttccgaaaa cgaagaactg aaagctgacc tgcagaaaaa agaacaggaa caccaccacc 1320

accaccacta g 1331

<210> 21
<211> 1356
<212> DNA
<213> Artificial Sequence

<220>

<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 21

atgaacggtg acggtaaccc gcgtgaagtt atcgaagacc tggctgctaa caacccggct 60

atccagaaca tccgtctgcg tcacgaaaac aaagacctga aagctcgtct ggaaaacgct 120

atggaagttg ctggtcgtga cttcaaacgt gctctgctgg accaggttac ccagctgtac 180

accaaacaca actccaacta ccagcagtac aacgctcagg ctggtcgtct ggacctgcgt 240

cagaaagctg aatacctgaa aggtctgaac gactgggctg aacgtctgct gcaggaactg 300

aaccgtgttt tcccgcgtgg taccgttgaa aacccggaca aagctcgtga actgctgaac 360

aaatacgacg ttgaaaaccg tgttttcccg cgtggtaccg ttgaaaaccc ggacaaagct 420

cgtgaactgc tgaacaaata cgacgttgaa aactccaaaa acccggttcc ggttaaaaaa 480

gaagctaaac tgtccgaagc tgaactgcac gacaaaatca aaaacctgtc caaaaacccg 540

gttccggtta aaaaagaagc taaactgtcc gaagctgaac tgcacgacaa aatcaaaaac 600

ctggctccgc tgacccgtgc taccgctgac aacaaagacg aactgatcaa acgtgctaac 660

gactacgaaa tccagaacca ccagctgacc gttgaaaaca aaaaactgaa aaccgacaaa 720

gaacagctga ccaaagaaaa cgacgacctg aaagctgaat ccccgaaatc caccgaaacc 780

tccgctaacg gtgctgacaa actggctgac gcttacaaca ccctgctgac cgaacacgaa 840

aaactgcgtg acgaatacta caccctgatc gacgctaaag aagaagaacc gcgttacaaa 900

gctgaccact ccgacctggt tgctgaaaaa cagcgtctgg aagacctggg tcagaaattc 960

gaacgtctga aacagcgttc cgaactgtac ctgcagcagt actacgacaa caaatccaac 1020

ggttacaaag gtgactggta cgttcagcag ctggactccg tttccggtct ggaagttgct 1080

gacccgtccg actccaaaaa actgatcgaa ctgggtctgg ctaaatacct gaacgacaaa 1140

ctgccgttca aaaccaaaga agactccgaa atcctgtccg aactgcgtga cgttctgaaa 1200

aacaacggtg acggtaaccc gcgtgaagtt atcgaagacc tggctgctaa caacccggct 1260

atccagaaca tccgtctgcg tcacgaaaac aaagacctga aagctcgtct ggaaaacgct 1320

atggaagttg ctggtcgtga cttcaaacgt gcttag 1356

<210> 22

<211> 1356
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 22
atggctgaaa tcaaaaaacc gcaggctgac tccgcttgga actggccgaa agaatacaac 60

gctctgctga aagaaaacga agaactgaaa gttgaacgtg aaaaatacct gtcctacgct 120

gacgacaaag aaaaagaccc gcagtaccgt gctgctgtta cccgtggtac catcaacgac 180

ccgcagcgtg ctaaagaagc tctggacaaa tacgaactgg aaaaccacgc tgttacccgt 240

ggtaccatca acgacccgca gcgtgctaaa gaagctctgg acaaatacga actggaaaac 300

cacaccgaag ttaaagctgc tggtcagtcc gctccgaaag gtaccaacgt ttccgctgac 360

ctgtacaact ccctgtggga cgaaaacaaa accctgcgtg aaaaacagga agaatacatc 420

accaaaatcc agaacgaaga aaccaaaaac aaagaagaag aacgtacctt caccgaactg 480

ccgtacgaag ctcgttacaa agcttggaaa tccgaaaacg acgaactgcg tgaaaactac 540

cgtcgtaccc tggacaaatt caacaccgaa cagggtaaaa ccacccgtct ggaagaacag 600

aaccgtgttc gttacacccg tcacaccccg gaagacaaac tgaaaaaaat catcgacgac 660

ctggacgcta aagaacaccg tgttcgttac acccgtcaca ccccggaaga caaactgaaa 720

aaaatcatcg acgacctgga cgctaaagaa caccgtgttt acatcacccg tcgtatgacc 780

aaagaagacg ttgaaaaaat cgctaacgac ctggacaccg aaaaccacgg tctgaaacag 840

cagaacgaac agctgtccac cgaaaaacag ggtctggaag aacagaacaa acagctgtcc 900

accgaccgtg tttcccgttc catgtcccgt gacgacctgc tgaaccgtgc tcaggacctg 960

gaagctaaaa accacggtct ggaacaccag aacaccaaac tgtccaccga aaacaaaacc 1020

ctgcaggaac aggctgaagc tcgtcagaaa gaagttgcta cccgttccca gaccgacacc 1080

ctggaaaaag ttcaggaacg tgctgacaaa ttcgaaatcg aaaacaacac cctgaaactg 1140

aaaaactccg acctgtcctt caacaacaaa gctctgaaag accacaacga cgaactgacc 1200

gaagctgaaa tcaaaaaacc gcaggctgac tccgcttgga actggccgaa agaatacaac 1260

gctctgctga aagaaaacga agaactgaaa gttgaacgtg aaaaatacct gtcctacgct 1320

gacgacaaag aaaaagaccc gcagtaccgt gcttag 1356

<210> 23
<211> 1356
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 23
atggaaggtg tttccgttgg ttccgacgct tccctgcaca accgtatcac cgacctggaa 60

gaagaacgtg aaaaactgct gaacaaactg gacaaagttg aagaagaaca caaaaaagac 120

cacgaacagc tggaaaaaaa atccgaagac gttgaatcct ccaacaacgc tgaatcctcc 180

aacatctccc aggaatccaa actgatcaac accctgaccg acgaaaacga aaaactgcgt 240

gaagaactgc agcagtacta cgctctgtcc gacgctaaag aagaagaacc gcgttacaaa 300

gctgacaacc agtccccggc tccggttaaa aaagaagcta aaaaactgaa cgaagctgaa 360

ctgtacaaca aaatccagga actggaagaa ggtaaagctg aactgttcga caaactggaa 420

aaagttgaag aagaaaacaa aaaagttaaa gaagactccg acaacatcaa ccgttccgtt 480

tccgttaaag acaacgaaaa agaactgcac aacaaaatcg ctgacctgga agaagaacgt 540

ggtgaacacc tggacaaaat cgacgaactg aaagaagaac tgaaagctaa agaaaaatcc 600

tccgactcct cccgtgaagt taccaacgaa ctgaccgctt ccatgtggaa agctcaggct 660

gactccgcta aagctaaagc taaagaactg gaaaaacagg ttgaagaata caaaaaaaac 720

tacgaaaccc tggaaaaagg ttacgacgac ctggctgaat cccgttccgt ttcccagggt 780

tccgtttccc tggaactgta cgacaaactg tccgacgaaa acgacatcct gcgtgaaaaa 840

caggacgaat acctgaccaa aatcgacggt ctggacaaag aaaacaaaga atacgcttcc 900

caggaatccc agaactcccg ttccatcacc aacgaacagc tgatcgacaa actggttgaa 960

gaaaacaacg acctgaaaga agaacgtgct aaatacctgg acctgctgga caaccgtgaa 1020

aaagacccgc agtaccgtgc tctgatgggt gaagctgaaa aaaaagttga agttgctgac 1080

tccaacgctt cctccgttgc taaactgtac aaccagatcg ctgacctgac cgacaaaaac 1140

ggtgaatacc tggaacgtat cgaagaactg gaagaacgtc agaaaaacct ggaaaaactg 1200

gaagaaggtg tttccgttgg ttccgacgct tccctgcaca accgtatcac cgacctggaa 1260

gaagaacgtg aaaaactgct gaacaaactg gacaaagttg aagaagaaca caaaaaagac 1320

cacgaacagc tggaaaaaaa atccgaagac gtttag 1356

<210> 24
<211> 1206
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 24
atggacaacc cgcgttacac cgacgctcac aacgctgtta cccagggtcg taccgttccg 60

ctgcagaacc tgctgcacga aatggacaaa aacggtaaac tgcgttccga aaacgaagaa 120

ctgaaagctg acctgcagaa aaaagaacag gaagactcct cctcccgtga catcaccgaa 180

gctggtgttt ccaaattctg gaaatccaaa ttcgacgctg aacagaaccg tgctaacgaa 240

ctggaaaaaa aactgtccgg ttacgaaaaa gactacaaaa ccctggaaca ggaatacgaa 300

aacgctggtt ccgaagaaaa cgttccgaaa cagcagtaca acgctctgtg ggaagaaaac 360

gaagacctgc gtggtcgtga acgtaaatac atcgctaaac tggaaaaaga agaaatccag 420

aacggtgaac tgaacgaaaa aaaccgtaaa ctggaatccc cgcgtgaagt taccaacgaa 480

ctggctgctt ccgtttggaa aaaaaaagtt gaagaagcta aagaaaaagc ttccaaactg 540

gaaaaacagc tggaagaagc tcagaaagac tactccgaaa tcgaaggtaa actggaacag 600

ttcgttgaaa aaaaagttga agctgctgaa aacaacgttt cctccgttgc tcgtcgtgaa 660

aaagaactgt acgaccagat cgctgacctg accgacaaaa acggtgaata cctggaacgt 720

atcggtgaac tggaagaacg tcagaaaaac ctggacgacc gttccgtttc caccaactcc 780

ggttccgttt ccaccccgta caacaacctg ctgaacgaat acgacgacct gctggctaaa 840

cacggtgaac tgctgtccga atacgacgct ctgaaagaaa aacaggacaa aaaccaggaa 900

gaaaactcca aaaacccggc tccggctccg gcttccgctg ttccggttaa aaaagaagct 960

accaaactgt ccgaagctga actgtacaac aaaatccagg aactggaaga aggtaaagct 1020

gaactgttcg acaaactgga aaaagttgaa gaagacaacc cgcgttacac cgacgctcac 1080

aacgctgtta cccagggtcg taccgttccg ctgcagaacc tgctgcacga aatggacaaa 1140

aacggtaaac tgcgttccga aaacgaagaa ctgaaagctg acctgcagaa aaaagaacag 1200

gaatag 1206

<210> 25
<211> 1353
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 25
aacggtgacg gtaacccgcg tgaagttatc gaagacctgg ctgctaacaa cccggctatc 60

cagaacatcc gtctgcgtca cgaaaacaaa gacctgaaag ctcgtctgga aaacgctatg 120

gaagttgctg gtcgtgactt caaacgtgct ctgctggacc aggttaccca gctgtacacc 180

aaacacaact ccaactacca gcagtacaac gctcaggctg gtcgtctgga cctgcgtcag 240

aaagctgaat acctgaaagg tctgaacgac tgggctgaac gtctgctgca ggaactgaac 300

cgtgttttcc cgcgtggtac cgttgaaaac ccggacaaag ctcgtgaact gctgaacaaa 360

tacgacgttg aaaaccgtgt tttcccgcgt ggtaccgttg aaaacccgga caaagctcgt 420

gaactgctga acaaatacga cgttgaaaac tccaaaaacc cggttccggt taaaaaagaa 480

gctaaactgt ccgaagctga actgcacgac aaaatcaaaa acctgtccaa aaacccggtt 540

ccggttaaaa aagaagctaa actgtccgaa gctgaactgc acgacaaaat caaaaacctg 600

gctccgctga cccgtgctac cgctgacaac aaagacgaac tgatcaaacg tgctaacgac 660

tacgaaatcc agaaccacca gctgaccgtt gaaaacaaaa aactgaaaac cgacaaagaa 720

cagctgacca aagaaaacga cgacctgaaa gctgaatccc cgaaatccac cgaaacctcc 780

gctaacggtg ctgacaaact ggctgacgct tacaacaccc tgctgaccga acacgaaaaa 840

ctgcgtgacg aatactacac cctgatcgac gctaaagaag aagaaccgcg ttacaaagct 900

gaccactccg acctggttgc tgaaaaacag cgtctggaag acctgggtca gaaattcgaa 960

cgtctgaaac agcgttccga actgtacctg cagcagtact acgacaacaa atccaacggt 1020

tacaaaggtg actggtacgt tcagcagctg gactccgttt ccggtctgga agttgctgac 1080

ccgtccgact ccaaaaaact gatcgaactg ggtctggcta aatacctgaa cgacaaactg 1140

ccgttcaaaa ccaaagaaga ctccgaaatc ctgtccgaac tgcgtgacgt tctgaaaaac 1200

aacggtgacg gtaacccgcg tgaagttatc gaagacctgg ctgctaacaa cccggctatc 1260

cagaacatcc gtctgcgtca cgaaaacaaa gacctgaaag ctcgtctgga aaacgctatg 1320

gaagttgctg gtcgtgactt caaacgtgct tag 1353

<210> 26
<211> 1353
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 26
gctgaaatca aaaaaccgca ggctgactcc gcttggaact ggccgaaaga atacaacgct 60

ctgctgaaag aaaacgaaga actgaaagtt gaacgtgaaa aatacctgtc ctacgctgac 120

gacaaagaaa aagacccgca gtaccgtgct gctgttaccc gtggtaccat caacgacccg 180

cagcgtgcta aagaagctct ggacaaatac gaactggaaa accacgctgt tacccgtggt 240

accatcaacg acccgcagcg tgctaaagaa gctctggaca aatacgaact ggaaaaccac 300

accgaagtta aagctgctgg tcagtccgct ccgaaaggta ccaacgtttc cgctgacctg 360

tacaactccc tgtgggacga aaacaaaacc ctgcgtgaaa aacaggaaga atacatcacc 420

aaaatccaga acgaagaaac caaaaacaaa gaagaagaac gtaccttcac cgaactgccg 480

tacgaagctc gttacaaagc ttggaaatcc gaaaacgacg aactgcgtga aaactaccgt 540

cgtaccctgg acaaattcaa caccgaacag ggtaaaacca cccgtctgga agaacagaac 600

cgtgttcgtt acacccgtca caccccggaa gacaaactga aaaaaatcat cgacgacctg 660

gacgctaaag aacaccgtgt tcgttacacc cgtcacaccc cggaagacaa actgaaaaaa 720

atcatcgacg acctggacgc taaagaacac cgtgtttaca tcacccgtcg tatgaccaaa 780

gaagacgttg aaaaaatcgc taacgacctg gacaccgaaa accacggtct gaaacagcag 840

aacgaacagc tgtccaccga aaaacagggt ctggaagaac agaacaaaca gctgtccacc 900

gaccgtgttt cccgttccat gtcccgtgac gacctgctga accgtgctca ggacctggaa 960

gctaaaaacc acggtctgga acaccagaac accaaactgt ccaccgaaaa caaaaccctg 1020

caggaacagg ctgaagctcg tcagaaagaa gttgctaccc gttcccagac cgacaccctg 1080

gaaaaagttc aggaacgtgc tgacaaattc gaaatcgaaa acaacaccct gaaactgaaa 1140

aactccgacc tgtccttcaa caacaaagct ctgaaagacc acaacgacga actgaccgaa 1200

gctgaaatca aaaaaccgca ggctgactcc gcttggaact ggccgaaaga atacaacgct 1260

ctgctgaaag aaaacgaaga actgaaagtt gaacgtgaaa aatacctgtc ctacgctgac 1320

gacaaagaaa aagacccgca gtaccgtgct tag 1353

<210> 27
<211> 1353
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 27
gaaggtgttt ccgttggttc cgacgcttcc ctgcacaacc gtatcaccga cctggaagaa 60

gaacgtgaaa aactgctgaa caaactggac aaagttgaag aagaacacaa aaaagaccac 120

gaacagctgg aaaaaaaatc cgaagacgtt gaatcctcca acaacgctga atcctccaac 180

atctcccagg aatccaaact gatcaacacc ctgaccgacg aaaacgaaaa actgcgtgaa 240

gaactgcagc agtactacgc tctgtccgac gctaaagaag aagaaccgcg ttacaaagct 300

gacaaccagt ccccggctcc ggttaaaaaa gaagctaaaa aactgaacga agctgaactg 360

tacaacaaaa tccaggaact ggaagaaggt aaagctgaac tgttcgacaa actggaaaaa 420

gttgaagaag aaaacaaaaa agttaaagaa gactccgaca acatcaaccg ttccgtttcc 480

gttaaagaca acgaaaaaga actgcacaac aaaatcgctg acctggaaga agaacgtggt 540

gaacacctgg acaaaatcga cgaactgaaa gaagaactga aagctaaaga aaaatcctcc 600

gactcctccc gtgaagttac caacgaactg accgcttcca tgtggaaagc tcaggctgac 660

tccgctaaag ctaaagctaa agaactggaa aaacaggttg aagaatacaa aaaaaactac 720

gaaaccctgg aaaaaggtta cgacgacctg gctgaatccc gttccgtttc ccagggttcc 780

gtttccctgg aactgtacga caaactgtcc gacgaaaacg acatcctgcg tgaaaaacag 840

gacgaatacc tgaccaaaat cgacggtctg gacaaagaaa acaaagaata cgcttcccag 900

gaatcccaga actcccgttc catcaccaac gaacagctga tcgacaaact ggttgaagaa 960

aacaacgacc tgaaagaaga acgtgctaaa tacctggacc tgctggacaa ccgtgaaaaa 1020

gacccgcagt accgtgctct gatgggtgaa gctgaaaaaa aagttgaagt tgctgactcc 1080

aacgcttcct ccgttgctaa actgtacaac cagatcgctg acctgaccga caaaaacggt 1140

gaatacctgg aacgtatcga agaactggaa gaacgtcaga aaaacctgga aaaactggaa 1200

gaaggtgttt ccgttggttc cgacgcttcc ctgcacaacc gtatcaccga cctggaagaa 1260

gaacgtgaaa aactgctgaa caaactggac aaagttgaag aagaacacaa aaaagaccac 1320

gaacagctgg aaaaaaaatc cgaagacgtt tag 1353

<210> 28
<211> 1203
<212> DNA
<213> Artificial Sequence

<220>
<223> Polynucleotide encoding a fusion protein of group A streptococcus M proteins.

<400> 28
gacaacccgc gttacaccga cgctcacaac gctgttaccc agggtcgtac cgttccgctg 60

cagaacctgc tgcacgaaat ggacaaaaac ggtaaactgc gttccgaaaa cgaagaactg 120

aaagctgacc tgcagaaaaa agaacaggaa gactcctcct cccgtgacat caccgaagct 180

ggtgtttcca aattctggaa atccaaattc gacgctgaac agaaccgtgc taacgaactg 240

gaaaaaaaac tgtccggtta cgaaaaagac tacaaaaccc tggaacagga atacgaaaac 300

gctggttccg aagaaaacgt tccgaaacag cagtacaacg ctctgtggga agaaaacgaa 360

gacctgcgtg gtcgtgaacg taaatacatc gctaaactgg aaaaagaaga aatccagaac 420

ggtgaactga acgaaaaaaa ccgtaaactg gaatccccgc gtgaagttac caacgaactg 480

gctgcttccg tttggaaaaa aaaagttgaa gaagctaaag aaaaagcttc caaactggaa 540

aaacagctgg aagaagctca gaaagactac tccgaaatcg aaggtaaact ggaacagttc 600

gttgaaaaaa aagttgaagc tgctgaaaac aacgtttcct ccgttgctcg tcgtgaaaaa 660

gaactgtacg accagatcgc tgacctgacc gacaaaaacg gtgaatacct ggaacgtatc 720

ggtgaactgg aagaacgtca gaaaaacctg gacgaccgtt ccgtttccac caactccggt 780

tccgtttcca ccccgtacaa caacctgctg aacgaatacg acgacctgct ggctaaacac 840

ggtgaactgc tgtccgaata cgacgctctg aaagaaaaac aggacaaaaa ccaggaagaa 900

aactccaaaa acccggctcc ggctccggct tccgctgttc cggttaaaaa agaagctacc 960

aaactgtccg aagctgaact gtacaacaaa atccaggaac tggaagaagg taaagctgaa 1020

ctgttcgaca aactggaaaa agttgaagaa gacaacccgc gttacaccga cgctcacaac 1080

gctgttaccc agggtcgtac cgttccgctg cagaacctgc tgcacgaaat ggacaaaaac 1140

ggtaaactgc gttccgaaaa cgaagaactg aaagctgacc tgcagaaaaa agaacaggaa 1200

tag 1203

<210> 29
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 29

Asn Gly Asp Gly Asn Pro Arg Glu Val Ile Glu Asp Leu Ala Ala Asn
1 5 10 15

Asn Pro Ala Ile Gln Asn Ile Arg Leu Arg His Glu Asn Lys Asp Leu
20 25 30

Lys Ala Arg Leu Glu Asn Ala Met Glu Val Ala Gly Arg Asp Phe Lys
35 40 45

Arg Ala
50

<210> 30
<211> 50
<212> PRT

<213> Streptococcus pyogenes

<400> 30

Leu Leu Asp Gln Val Thr Gln Leu Tyr Thr Lys His Asn Ser Asn Tyr
1 5 10 15

Gln Gln Tyr Asn Ala Gln Ala Gly Arg Leu Asp Leu Arg Gln Lys Ala
20 25 30

Glu Tyr Leu Lys Gly Leu Asn Asp Trp Ala Glu Arg Leu Leu Gln Glu
35 40 45

Leu Asn
50

<210> 31
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 31

Arg Val Phe Pro Arg Gly Thr Val Glu Asn Pro Asp Lys Ala Arg Glu
1 5 10 15

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

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

Glu Asn
50

<210> 32
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 32

Ser Lys Asn Pro Val Pro Val Lys Lys Glu Ala Lys Leu Ser Glu Ala
1 5 10 15

Glu Leu His Asp Lys Ile Lys Asn Leu Ser Lys Asn Pro Val Pro Val
20 25 30

Lys Lys Glu Ala Lys Leu Ser Glu Ala Glu Leu His Asp Lys Ile Lys
35 40 45

Asn Leu
50

<210> 33
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 33

Ala Pro Leu Thr Arg Ala Thr Ala Asp Asn Lys Asp Glu Leu Ile Lys
1 5 10 15

Arg Ala Asn Asp Tyr Glu Ile Gln Asn His Gln Leu Thr Val Glu Asn
20 25 30

Lys Lys Leu Lys Thr Asp Lys Glu Gln Leu Thr Lys Glu Asn Asp Asp
35 40 45

Leu Lys
50

<210> 34
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 34

Ala Glu Ser Pro Lys Ser Thr Glu Thr Ser Ala Asn Gly Ala Asp Lys
1 5 10 15

Leu Ala Asp Ala Tyr Asn Thr Leu Leu Thr Glu His Glu Lys Leu Arg
20 25 30

Asp Glu Tyr Tyr Thr Leu Ile Asp Ala Lys Glu Glu Glu Pro Arg Tyr
35 40 45

Lys Ala
50

<210> 35
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 35

Asp His Ser Asp Leu Val Ala Glu Lys Gln Arg Leu Glu Asp Leu Gly
1 5 10 15

Gln Lys Phe Glu Arg Leu Lys Gln Arg Ser Glu Leu Tyr Leu Gln Gln
20 25 30

Tyr Tyr Asp Asn Lys Ser Asn Gly Tyr Lys Gly Asp Trp Tyr Val Gln
35 40 45

Gln Leu
50

<210> 36
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 36

Asp Ser Val Ser Gly Leu Glu Val Ala Asp Pro Ser Asp Ser Lys Lys
1 5 10 15

Leu Ile Glu Leu Gly Leu Ala Lys Tyr Leu Asn Asp Lys Leu Pro Phe
20 25 30

Lys Thr Lys Glu Asp Ser Glu Ile Leu Ser Glu Leu Arg Asp Val Leu
35 40 45

Lys Asn
50

<210> 37
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 37

Ala Glu Ile Lys Lys Pro Gln Ala Asp Ser Ala Trp Asn Trp Pro Lys
1 5 10 15

Glu Tyr Asn Ala Leu Leu Lys Glu Asn Glu Glu Leu Lys Val Glu Arg
20 25 30

Glu Lys Tyr Leu Ser Tyr Ala Asp Asp Lys Glu Lys Asp Pro Gln Tyr
35 40 45

Arg Ala
50

<210> 38
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 38

Ala Val Thr Arg Gly Thr Ile Asn Asp Pro Gln Arg Ala Lys Glu Ala
1 5 10 15

Leu Asp Lys Tyr Glu Leu Glu Asn His Ala Val Thr Arg Gly Thr Ile
20 25 30

Asn Asp Pro Gln Arg Ala Lys Glu Ala Leu Asp Lys Tyr Glu Leu Glu
35 40 45

Asn His
50

<210> 39
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 39

Thr Glu Val Lys Ala Ala Gly Gln Ser Ala Pro Lys Gly Thr Asn Val
1 5 10 15

Ser Ala Asp Leu Tyr Asn Ser Leu Trp Asp Glu Asn Lys Thr Leu Arg
20 25 30

Glu Lys Gln Glu Glu Tyr Ile Thr Lys Ile Gln Asn Glu Glu Thr Lys
35 40 45

Asn Lys
50

<210> 40
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 40

Glu Glu Glu Arg Thr Phe Thr Glu Leu Pro Tyr Glu Ala Arg Tyr Lys
1 5 10 15

Ala Trp Lys Ser Glu Asn Asp Glu Leu Arg Glu Asn Tyr Arg Arg Thr
20 25 30

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

Gln Asn
50

<210> 41
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 41

Arg Val Arg Tyr Thr Arg His Thr Pro Glu Asp Lys Leu Lys Lys Ile
1 5 10 15

Ile Asp Asp Leu Asp Ala Lys Glu His Arg Val Arg Tyr Thr Arg His
            20   25   30

Thr Pro Glu Asp Lys Leu Lys Lys Ile Ile Asp Asp Leu Asp Ala Lys
        35   40   45

Glu His
    50

<210> 42
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 42

Arg Val Tyr Ile Thr Arg Arg Met Thr Lys Glu Asp Val Glu Lys Ile
1   5   10   15

Ala Asn Asp Leu Asp Thr Glu Asn His Gly Leu Lys Gln Gln Asn Glu
            20   25   30

Gln Leu Ser Thr Glu Lys Gln Gly Leu Glu Glu Gln Asn Lys Gln Leu
        35   40   45

Ser Thr
    50

<210> 43
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 43

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

Gln Asp Leu Glu Ala Lys Asn His Gly Leu Glu His Gln Asn Thr Lys
            20   25   30

Leu Ser Thr Glu Asn Lys Thr Leu Gln Glu Gln Ala Glu Ala Arg Gln

35 40 45

Lys Glu
50

<210> 44
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 44

Val Ala Thr Arg Ser Gln Thr Asp Thr Leu Glu Lys Val Gln Glu Arg
1 5 10 15

Ala Asp Lys Phe Glu Ile Glu Asn Asn Thr Leu Lys Leu Lys Asn Ser
20 25 30

Asp Leu Ser Phe Asn Asn Lys Ala Leu Lys Asp His Asn Asp Glu Leu
35 40 45

Thr Glu
50

<210> 45
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 45

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

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

Glu Glu Glu His Lys Lys Asp His Glu Gln Leu Glu Lys Lys Ser Glu
35 40 45

Asp Val
50

<210> 46
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 46

Glu Ser Ser Asn Asn Ala Glu Ser Ser Asn Ile Ser Gln Glu Ser Lys
1 5 10 15

Leu Ile Asn Thr Leu Thr Asp Glu Asn Glu Lys Leu Arg Glu Glu Leu
20 25 30

Gln Gln Tyr Tyr Ala Leu Ser Asp Ala Lys Glu Glu Glu Pro Arg Tyr
35 40 45

Lys Ala
50

<210> 47
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 47

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

Glu Ala Glu Leu Tyr Asn Lys Ile Gln Glu Leu Glu Glu Gly Lys Ala
20 25 30

Glu Leu Phe Asp Lys Leu Glu Lys Val Glu Glu Glu Asn Lys Lys Val
35 40 45

Lys Glu
50

<210> 48
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 48

Asp Ser Asp Asn Ile Asn Arg Ser Val Ser Val Lys Asp Asn Glu Lys
1 5 10 15

Glu Leu His Asn Lys Ile Ala Asp Leu Glu Glu Glu Arg Gly Glu His
20 25 30

Leu Asp Lys Ile Asp Glu Leu Lys Glu Glu Leu Lys Ala Lys Glu Lys
35 40 45

Ser Ser
50

<210> 49
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 49

Asp Ser Ser Arg Glu Val Thr Asn Glu Leu Thr Ala Ser Met Trp Lys
1 5 10 15

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

Val Glu Glu Tyr Lys Lys Asn Tyr Glu Thr Leu Glu Lys Gly Tyr Asp
35 40 45

Asp Leu
50

<210> 50
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 50

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

Asp Lys Leu Ser Asp Glu Asn Asp Ile Leu Arg Glu Lys Gln Asp Glu
20 25 30

Tyr Leu Thr Lys Ile Asp Gly Leu Asp Lys Glu Asn Lys Glu Tyr Ala
35 40 45

Ser Gln
50

<210> 51
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 51

Glu Ser Gln Asn Ser Arg Ser Ile Thr Asn Glu Gln Leu Ile Asp Lys
1 5 10 15

Leu Val Glu Glu Asn Asn Asp Leu Lys Glu Glu Arg Ala Lys Tyr Leu
20 25 30

Asp Leu Leu Asp Asn Arg Glu Lys Asp Pro Gln Tyr Arg Ala Leu Met
35 40 45

Gly Glu
50

<210> 52
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 52

Ala Glu Lys Lys Val Glu Val Ala Asp Ser Asn Ala Ser Ser Val Ala
1 5 10 15

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

Leu Glu Arg Ile Glu Glu Leu Glu Glu Arg Gln Lys Asn Leu Glu Lys
35 40 45

Leu Glu
50

<210> 53
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 53

Asp Asn Pro Arg Tyr Thr Asp Ala His Asn Ala Val Thr Gln Gly Arg
1 5 10 15

Thr Val Pro Leu Gln Asn Leu Leu His Glu Met Asp Lys Asn Gly Lys
20 25 30

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

Gln Glu
50

<210> 54
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 54

Asp Ser Ser Ser Arg Asp Ile Thr Glu Ala Gly Val Ser Lys Phe Trp
1 5 10 15

Lys Ser Lys Phe Asp Ala Glu Gln Asn Arg Ala Asn Glu Leu Glu Lys
20 25 30

Lys Leu Ser Gly Tyr Glu Lys Asp Tyr Lys Thr Leu Glu Gln Glu Tyr
35 40 45

Glu Asn
50

<210> 55
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 55

Ala Gly Ser Glu Glu Asn Val Pro Lys Gln Gln Tyr Asn Ala Leu Trp
1 5 10 15

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

Leu Glu Lys Glu Glu Ile Gln Asn Gly Glu Leu Asn Glu Lys Asn Arg
35 40 45

Lys Leu
50

<210> 56
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 56

Glu Ser Pro Arg Glu Val Thr Asn Glu Leu Ala Ala Ser Val Trp Lys
1 5 10 15

Lys Lys Val Glu Glu Ala Lys Glu Lys Ala Ser Lys Leu Glu Lys Gln
20 25 30

Leu Glu Glu Ala Gln Lys Asp Tyr Ser Glu Ile Glu Gly Lys Leu Glu
35 40 45

Gln Phe
50

<210> 57
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 57

```
Val Glu Lys Lys Val Glu Ala Ala Glu Asn Asn Val Ser Ser Val Ala
1               5                   10                  15


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


Asn Gly Glu Tyr Leu Glu Arg Ile Gly Glu Leu Glu Glu Arg Gln Lys
        35                  40                  45


Asn Leu
    50
```

<210> 58
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 58

```
Asp Asp Arg Ser Val Ser Thr Asn Ser Gly Ser Val Ser Thr Pro Tyr
1               5                   10                  15


Asn Asn Leu Leu Asn Glu Tyr Asp Asp Leu Leu Ala Lys His Gly Glu
            20                  25                  30


Leu Leu Ser Glu Tyr Asp Ala Leu Lys Glu Lys Gln Asp Lys Asn Gln
        35                  40                  45


Glu Glu
    50
```

<210> 59
<211> 50
<212> PRT
<213> Streptococcus pyogenes

<400> 59

```
Asn Ser Lys Asn Pro Ala Pro Ala Pro Ala Ser Ala Val Pro Val Lys
1               5                   10                  15


Lys Glu Ala Thr Lys Leu Ser Glu Ala Glu Leu Tyr Asn Lys Ile Gln
```

20 25 30

Glu Leu Glu Glu Gly Lys Ala Glu Leu Phe Asp Lys Leu Glu Lys Val
35 40 45

Glu Glu
50

<210> 60
<211> 8
<212> PRT
<213> Artificial Sequence

<220>
<223> Epitope tag sequence

<400> 60

Asp Tyr Lys Asp Asp Asp Asp Lys
1 5

<210> 61
<211> 8
<212> PRT
<213> Artificial Sequence

<220>
<223> Epitope tag sequence

<400> 61

Asp Tyr Lys Asp Asp Asp Asp Lys
1 5