SEQUENCE LISTING

<110> Regeneron Pharmaceuticals, Inc.

<120> A Rodent Model of Mood Disorders

<130> 36506PCT (10269WO01)

<150> 62/793,523
<151> 2017-01-17

<150> 62/899,849
<151> 2019-09-13

<160> 28

<170> PatentIn version 3.5

<210> 1
<211> 814
<212> PRT
<213> Homo sapien

<220>
<223> Wild type GPR156 long isoform protein E516 variant

<400> 1

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Met Glu Pro Glu Ile Asn Cys Ser Glu Leu Cys Asp Ser Phe Pro Gly
1               5                   10                  15

Gln Glu Leu Asp Arg Arg Pro Leu His Asp Leu Cys Lys Thr Thr Ile
            20                  25                  30

Thr Ser Ser His His Ser Ser Lys Thr Ile Ser Ser Leu Ser Pro Val
        35                  40                  45

Leu Leu Gly Ile Val Trp Thr Phe Leu Ser Cys Gly Leu Leu Leu Ile
    50                  55                  60

Leu Phe Phe Leu Ala Phe Thr Ile His Cys Arg Lys Asn Arg Ile Val
65                  70                  75                  80

Lys Met Ser Ser Pro Asn Leu Asn Ile Val Thr Leu Leu Gly Ser Cys
                85                  90                  95

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

Gly Ser Ser Met Glu Thr Leu Ile Gln Thr Arg Leu Ser Met Leu Cys
```

```
        115                 120                 125

Ile Gly Thr Ser Leu Val Phe Gly Pro Ile Leu Gly Lys Ser Trp Arg
    130                 135                 140

Leu Tyr Lys Val Phe Thr Gln Arg Val Pro Asp Lys Arg Val Ile Ile
145                 150                 155                 160

Lys Asp Leu Gln Leu Leu Gly Leu Val Ala Ala Leu Leu Met Ala Asp
                165                 170                 175

Val Ile Leu Leu Met Thr Trp Val Leu Thr Asp Pro Ile Gln Cys Leu
            180                 185                 190

Gln Ile Leu Ser Val Ser Met Thr Val Thr Gly Lys Asp Val Ser Cys
        195                 200                 205

Thr Ser Thr Ser Thr His Phe Cys Ala Ser Arg Tyr Ser Asp Val Trp
    210                 215                 220

Ile Ala Leu Ile Trp Gly Cys Lys Gly Leu Leu Leu Leu Tyr Gly Ala
225                 230                 235                 240

Tyr Leu Ala Gly Leu Thr Gly His Val Ser Ser Pro Pro Val Asn Gln
                245                 250                 255

Ser Leu Thr Ile Met Val Gly Val Asn Leu Leu Val Leu Ala Ala Gly
            260                 265                 270

Leu Leu Phe Val Val Thr Arg Tyr Leu His Ser Trp Pro Asn Leu Val
        275                 280                 285

Phe Gly Leu Thr Ser Gly Gly Ile Phe Val Cys Thr Thr Thr Ile Asn
    290                 295                 300

Cys Phe Ile Phe Ile Pro Gln Leu Lys Gln Trp Lys Ala Phe Glu Glu
305                 310                 315                 320

Glu Asn Gln Thr Ile Arg Arg Met Ala Lys Tyr Phe Ser Thr Pro Asn
                325                 330                 335

Lys Ser Phe His Thr Gln Tyr Gly Glu Glu Glu Asn Cys His Pro Arg
            340                 345                 350

Gly Glu Lys Ser Ser Met Glu Arg Leu Leu Thr Glu Lys Asn Ala Val
        355                 360                 365

Ile Glu Ser Leu Gln Glu Gln Val Asn Asn Ala Lys Glu Lys Ile Val
    370                 375                 380
```

```
Arg Leu Met Ser Ala Glu Cys Thr Tyr Asp Leu Pro Glu Gly Ala Ala
385                 390                 395                 400

Pro Pro Ala Ser Ser Pro Asn Lys Asp Val Gln Ala Val Ala Ser Val
                405                 410                 415

His Thr Leu Ala Ala Ala Gln Gly Pro Ser Gly His Leu Ser Asp Phe
            420                 425                 430

Gln Asn Asp Pro Gly Met Ala Ala Arg Asp Ser Gln Cys Thr Ser Gly
        435                 440                 445

Pro Ser Ser Tyr Ala Gln Ser Leu Glu Gly Pro Gly Lys Asp Ser Ser
    450                 455                 460

Phe Ser Pro Gly Lys Glu Glu Lys Ile Ser Asp Ser Lys Asp Phe Ser
465                 470                 475                 480

Asp His Leu Asp Ser Gly Cys Ser Gln Lys Pro Trp Thr Glu Gln Ser
                485                 490                 495

Leu Gly Pro Glu Arg Gly Asp Gln Val Pro Met Asn Pro Ser Gln Ser
            500                 505                 510

Leu Leu Pro Glu Arg Gly Gly Ser Asp Pro Gln Arg Gln Arg His Leu
        515                 520                 525

Glu Asn Ser Glu Glu Pro Pro Glu Arg Arg Ser Arg Val Ser Ser Val
    530                 535                 540

Ile Arg Glu Lys Leu Gln Glu Val Leu Gln Asp Leu Gly Leu Gly Pro
545                 550                 555                 560

Glu Ala Ser Leu Ser Thr Ala Pro Ser Cys His Gln Gln Thr Trp Lys
                565                 570                 575

Asn Ser Ala Ala Phe Ser Pro Gln Lys Met Pro Leu Ser Lys Glu Leu
            580                 585                 590

Gly Phe Ser Pro Tyr Met Val Arg Arg Arg Arg Ala Ala Gln Arg Ala
        595                 600                 605

Arg Ser His Phe Pro Gly Ser Ala Pro Ser Ser Val Gly His Arg Ala
    610                 615                 620

Asn Arg Thr Val Pro Gly Ala His Ser Arg Leu His Val Gln Asn Gly
625                 630                 635                 640

Asp Ser Pro Ser Leu Ala Pro Gln Thr Thr Asp Ser Arg Val Arg Arg
                645                 650                 655
```

```
Pro Ser Ser Arg Lys Pro Ser Leu Pro Ser Asp Pro Gln Asp Arg Pro
            660                 665                 670

Gly Thr Leu Glu Gly Ser Lys Gln Ser Gln Thr Glu Pro Glu Gly Ala
        675                 680                 685

Arg Gly Ser Lys Ala Ala Phe Leu Arg Gln Pro Ser Gly Ser Gly Arg
    690                 695                 700

Ala Pro Ser Pro Ala Ala Pro Cys Leu Ser Lys Ala Ser Pro Asp Leu
705                 710                 715                 720

Pro Glu Gln Trp Gln Leu Trp Pro Pro Val Pro Ser Gly Cys Ala Ser
                725                 730                 735

Leu Ser Ser Gln His Ser Tyr Phe Asp Thr Glu Ser Ser Ser Ser Asp
            740                 745                 750

Glu Phe Phe Cys Arg Cys His Arg Pro Tyr Cys Glu Ile Cys Phe Gln
        755                 760                 765

Ser Ser Ser Asp Ser Ser Asp Ser Gly Thr Ser Asp Thr Asp Pro Glu
    770                 775                 780

Pro Thr Gly Gly Leu Ala Ser Trp Glu Lys Leu Trp Ala Arg Ser Lys
785                 790                 795                 800

Pro Ile Val Asn Phe Lys Asp Asp Leu Lys Pro Thr Leu Val
                805                 810
```

<210> 2
<211> 814
<212> PRT
<213> Homo sapien

<220>
<223> Wild type GPR156 long isoform protein D516 variant

<400> 2

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Met Glu Pro Glu Ile Asn Cys Ser Glu Leu Cys Asp Ser Phe Pro Gly
1               5                   10                  15

Gln Glu Leu Asp Arg Arg Pro Leu His Asp Leu Cys Lys Thr Thr Ile
            20                  25                  30

Thr Ser Ser His His Ser Ser Lys Thr Ile Ser Ser Leu Ser Pro Val
        35                  40                  45
```

```
Leu Leu Gly Ile Val Trp Thr Phe Leu Ser Cys Gly Leu Leu Leu Ile
    50                  55                  60

Leu Phe Phe Leu Ala Phe Thr Ile His Cys Arg Lys Asn Arg Ile Val
65                  70                  75                  80

Lys Met Ser Ser Pro Asn Leu Asn Ile Val Thr Leu Leu Gly Ser Cys
                85                  90                  95

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

Gly Ser Ser Met Glu Thr Leu Ile Gln Thr Arg Leu Ser Met Leu Cys
        115                 120                 125

Ile Gly Thr Ser Leu Val Phe Gly Pro Ile Leu Gly Lys Ser Trp Arg
    130                 135                 140

Leu Tyr Lys Val Phe Thr Gln Arg Val Pro Asp Lys Arg Val Ile Ile
145                 150                 155                 160

Lys Asp Leu Gln Leu Leu Gly Leu Val Ala Ala Leu Leu Met Ala Asp
                165                 170                 175

Val Ile Leu Leu Met Thr Trp Val Leu Thr Asp Pro Ile Gln Cys Leu
            180                 185                 190

Gln Ile Leu Ser Val Ser Met Thr Val Thr Gly Lys Asp Val Ser Cys
        195                 200                 205

Thr Ser Thr Ser Thr His Phe Cys Ala Ser Arg Tyr Ser Asp Val Trp
    210                 215                 220

Ile Ala Leu Ile Trp Gly Cys Lys Gly Leu Leu Leu Leu Tyr Gly Ala
225                 230                 235                 240

Tyr Leu Ala Gly Leu Thr Gly His Val Ser Ser Pro Pro Val Asn Gln
                245                 250                 255

Ser Leu Thr Ile Met Val Gly Val Asn Leu Leu Val Leu Ala Ala Gly
            260                 265                 270

Leu Leu Phe Val Val Thr Arg Tyr Leu His Ser Trp Pro Asn Leu Val
        275                 280                 285

Phe Gly Leu Thr Ser Gly Gly Ile Phe Val Cys Thr Thr Thr Ile Asn
    290                 295                 300

Cys Phe Ile Phe Ile Pro Gln Leu Lys Gln Trp Lys Ala Phe Glu Glu
```

```
305                 310                 315                 320

Glu Asn Gln Thr Ile Arg Arg Met Ala Lys Tyr Phe Ser Thr Pro Asn
                325                 330                 335

Lys Ser Phe His Thr Gln Tyr Gly Glu Glu Glu Asn Cys His Pro Arg
            340                 345                 350

Gly Glu Lys Ser Ser Met Glu Arg Leu Leu Thr Glu Lys Asn Ala Val
        355                 360                 365

Ile Glu Ser Leu Gln Glu Gln Val Asn Asn Ala Lys Glu Lys Ile Val
    370                 375                 380

Arg Leu Met Ser Ala Glu Cys Thr Tyr Asp Leu Pro Glu Gly Ala Ala
385                 390                 395                 400

Pro Pro Ala Ser Ser Pro Asn Lys Asp Val Gln Ala Val Ala Ser Val
                405                 410                 415

His Thr Leu Ala Ala Ala Gln Gly Pro Ser Gly His Leu Ser Asp Phe
            420                 425                 430

Gln Asn Asp Pro Gly Met Ala Ala Arg Asp Ser Gln Cys Thr Ser Gly
        435                 440                 445

Pro Ser Ser Tyr Ala Gln Ser Leu Glu Gly Pro Gly Lys Asp Ser Ser
    450                 455                 460

Phe Ser Pro Gly Lys Glu Glu Lys Ile Ser Asp Ser Lys Asp Phe Ser
465                 470                 475                 480

Asp His Leu Asp Ser Gly Cys Ser Gln Lys Pro Trp Thr Glu Gln Ser
                485                 490                 495

Leu Gly Pro Glu Arg Gly Asp Gln Val Pro Met Asn Pro Ser Gln Ser
            500                 505                 510

Leu Leu Pro Asp Arg Gly Gly Ser Asp Pro Gln Arg Gln Arg His Leu
        515                 520                 525

Glu Asn Ser Glu Glu Pro Pro Glu Arg Arg Ser Arg Val Ser Ser Val
    530                 535                 540

Ile Arg Glu Lys Leu Gln Glu Val Leu Gln Asp Leu Gly Leu Gly Pro
545                 550                 555                 560

Glu Ala Ser Leu Ser Thr Ala Pro Ser Cys His Gln Gln Thr Trp Lys
                565                 570                 575
```

```
Asn Ser Ala Ala Phe Ser Pro Gln Lys Met Pro Leu Ser Lys Glu Leu
            580                 585                 590

Gly Phe Ser Pro Tyr Met Val Arg Arg Arg Arg Ala Ala Gln Arg Ala
        595                 600                 605

Arg Ser His Phe Pro Gly Ser Ala Pro Ser Ser Val Gly His Arg Ala
    610                 615                 620

Asn Arg Thr Val Pro Gly Ala His Ser Arg Leu His Val Gln Asn Gly
625                 630                 635                 640

Asp Ser Pro Ser Leu Ala Pro Gln Thr Thr Asp Ser Arg Val Arg Arg
                645                 650                 655

Pro Ser Ser Arg Lys Pro Ser Leu Pro Ser Asp Pro Gln Asp Arg Pro
            660                 665                 670

Gly Thr Leu Glu Gly Ser Lys Gln Ser Gln Thr Glu Pro Glu Gly Ala
        675                 680                 685

Arg Gly Ser Lys Ala Ala Phe Leu Arg Gln Pro Ser Gly Ser Gly Arg
    690                 695                 700

Ala Pro Ser Pro Ala Ala Pro Cys Leu Ser Lys Ala Ser Pro Asp Leu
705                 710                 715                 720

Pro Glu Gln Trp Gln Leu Trp Pro Pro Val Pro Ser Gly Cys Ala Ser
                725                 730                 735

Leu Ser Ser Gln His Ser Tyr Phe Asp Thr Glu Ser Ser Ser Ser Asp
            740                 745                 750

Glu Phe Phe Cys Arg Cys His Arg Pro Tyr Cys Glu Ile Cys Phe Gln
        755                 760                 765

Ser Ser Ser Asp Ser Ser Asp Ser Gly Thr Ser Asp Thr Asp Pro Glu
    770                 775                 780

Pro Thr Gly Gly Leu Ala Ser Trp Glu Lys Leu Trp Ala Arg Ser Lys
785                 790                 795                 800

Pro Ile Val Asn Phe Lys Asp Asp Leu Lys Pro Thr Leu Val
                805                 810
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<210> 3
<211> 810
<212> PRT

<213> Homo sapien

<220>
<223> Wild type GPR156 short isoform protein E512 variant

<400> 3

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Met Glu Pro Glu Ile Asn Cys Ser Glu Leu Cys Asp Ser Phe Pro Gly
1               5                  10                  15

Gln Glu Leu Asp Arg Arg Pro Leu His Asp Leu Cys Lys Thr Thr Ile
            20                  25                  30

Thr Ser Ser His His Ser Ser Lys Thr Ile Ser Ser Leu Ser Pro Val
        35                  40                  45

Leu Leu Gly Ile Val Trp Thr Phe Leu Ser Cys Gly Leu Leu Leu Ile
    50                  55                  60

Leu Phe Phe Leu Ala Phe Thr Ile His Cys Arg Lys Asn Arg Ile Val
65                  70                  75                  80

Lys Met Ser Ser Pro Asn Leu Asn Ile Val Thr Leu Leu Gly Ser Cys
                85                  90                  95

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

Gly Ser Ser Met Glu Thr Leu Ile Gln Thr Arg Leu Ser Met Leu Cys
        115                 120                 125

Ile Gly Thr Ser Leu Val Phe Gly Pro Ile Leu Gly Lys Ser Trp Arg
    130                 135                 140

Leu Tyr Lys Val Phe Thr Gln Arg Val Pro Asp Lys Arg Val Ile Ile
145                 150                 155                 160

Lys Asp Leu Gln Leu Leu Gly Leu Val Ala Ala Leu Leu Met Ala Asp
                165                 170                 175

Val Ile Leu Leu Met Thr Trp Val Leu Thr Asp Pro Ile Gln Cys Leu
            180                 185                 190

Gln Ile Leu Ser Val Thr Gly Lys Asp Val Ser Cys Thr Ser Thr Ser
        195                 200                 205

Thr His Phe Cys Ala Ser Arg Tyr Ser Asp Val Trp Ile Ala Leu Ile
    210                 215                 220

Trp Gly Cys Lys Gly Leu Leu Leu Leu Tyr Gly Ala Tyr Leu Ala Gly
```

```
225                 230                 235                 240

Leu Thr Gly His Val Ser Ser Pro Pro Val Asn Gln Ser Leu Thr Ile
                245                 250                 255

Met Val Gly Val Asn Leu Leu Val Leu Ala Ala Gly Leu Leu Phe Val
            260                 265                 270

Val Thr Arg Tyr Leu His Ser Trp Pro Asn Leu Val Phe Gly Leu Thr
        275                 280                 285

Ser Gly Gly Ile Phe Val Cys Thr Thr Thr Ile Asn Cys Phe Ile Phe
    290                 295                 300

Ile Pro Gln Leu Lys Gln Trp Lys Ala Phe Glu Glu Glu Asn Gln Thr
305                 310                 315                 320

Ile Arg Arg Met Ala Lys Tyr Phe Ser Thr Pro Asn Lys Ser Phe His
                325                 330                 335

Thr Gln Tyr Gly Glu Glu Glu Asn Cys His Pro Arg Gly Glu Lys Ser
            340                 345                 350

Ser Met Glu Arg Leu Leu Thr Glu Lys Asn Ala Val Ile Glu Ser Leu
        355                 360                 365

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

Ala Glu Cys Thr Tyr Asp Leu Pro Glu Gly Ala Ala Pro Pro Ala Ser
385                 390                 395                 400

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

Ala Ala Gln Gly Pro Ser Gly His Leu Ser Asp Phe Gln Asn Asp Pro
            420                 425                 430

Gly Met Ala Ala Arg Asp Ser Gln Cys Thr Ser Gly Pro Ser Ser Tyr
        435                 440                 445

Ala Gln Ser Leu Glu Gly Pro Gly Lys Asp Ser Ser Phe Ser Pro Gly
    450                 455                 460

Lys Glu Glu Lys Ile Ser Asp Ser Lys Asp Phe Ser Asp His Leu Asp
465                 470                 475                 480

Ser Gly Cys Ser Gln Lys Pro Trp Thr Glu Gln Ser Leu Gly Pro Glu
                485                 490                 495
```

```
Arg Gly Asp Gln Val Pro Met Asn Pro Ser Gln Ser Leu Leu Pro Glu
            500                 505                 510

Arg Gly Gly Ser Asp Pro Gln Arg Gln Arg His Leu Glu Asn Ser Glu
        515                 520                 525

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

Leu Gln Glu Val Leu Gln Asp Leu Gly Leu Gly Pro Glu Ala Ser Leu
545                 550                 555                 560

Ser Thr Ala Pro Ser Cys His Gln Gln Thr Trp Lys Asn Ser Ala Ala
                565                 570                 575

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

Tyr Met Val Arg Arg Arg Arg Ala Ala Gln Arg Ala Arg Ser His Phe
        595                 600                 605

Pro Gly Ser Ala Pro Ser Ser Val Gly His Arg Ala Asn Arg Thr Val
    610                 615                 620

Pro Gly Ala His Ser Arg Leu His Val Gln Asn Gly Asp Ser Pro Ser
625                 630                 635                 640

Leu Ala Pro Gln Thr Thr Asp Ser Arg Val Arg Arg Pro Ser Ser Arg
                645                 650                 655

Lys Pro Ser Leu Pro Ser Asp Pro Gln Asp Arg Pro Gly Thr Leu Glu
            660                 665                 670

Gly Ser Lys Gln Ser Gln Thr Glu Pro Glu Gly Ala Arg Gly Ser Lys
        675                 680                 685

Ala Ala Phe Leu Arg Gln Pro Ser Gly Ser Gly Arg Ala Pro Ser Pro
    690                 695                 700

Ala Ala Pro Cys Leu Ser Lys Ala Ser Pro Asp Leu Pro Glu Gln Trp
705                 710                 715                 720

Gln Leu Trp Pro Pro Val Pro Ser Gly Cys Ala Ser Leu Ser Ser Gln
                725                 730                 735

His Ser Tyr Phe Asp Thr Glu Ser Ser Ser Ser Asp Glu Phe Phe Cys
            740                 745                 750

Arg Cys His Arg Pro Tyr Cys Glu Ile Cys Phe Gln Ser Ser Ser Asp
        755                 760                 765
```

```
Ser Ser Asp Ser Gly Thr Ser Asp Thr Asp Pro Glu Pro Thr Gly Gly
    770                 775                 780

Leu Ala Ser Trp Glu Lys Leu Trp Ala Arg Ser Lys Pro Ile Val Asn
785                 790                 795                 800

Phe Lys Asp Asp Leu Lys Pro Thr Leu Val
                805                 810
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<210> 4
<211> 810
<212> PRT
<213> Homo sapien

<220>
<223> Wild type GPR156 short isoform protein D512 variant

<400> 4

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Met Glu Pro Glu Ile Asn Cys Ser Glu Leu Cys Asp Ser Phe Pro Gly
1               5                   10                  15

Gln Glu Leu Asp Arg Arg Pro Leu His Asp Leu Cys Lys Thr Thr Ile
            20                  25                  30

Thr Ser Ser His His Ser Ser Lys Thr Ile Ser Ser Leu Ser Pro Val
        35                  40                  45

Leu Leu Gly Ile Val Trp Thr Phe Leu Ser Cys Gly Leu Leu Leu Ile
    50                  55                  60

Leu Phe Phe Leu Ala Phe Thr Ile His Cys Arg Lys Asn Arg Ile Val
65                  70                  75                  80

Lys Met Ser Ser Pro Asn Leu Asn Ile Val Thr Leu Leu Gly Ser Cys
                85                  90                  95

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

Gly Ser Ser Met Glu Thr Leu Ile Gln Thr Arg Leu Ser Met Leu Cys
        115                 120                 125

Ile Gly Thr Ser Leu Val Phe Gly Pro Ile Leu Gly Lys Ser Trp Arg
    130                 135                 140

Leu Tyr Lys Val Phe Thr Gln Arg Val Pro Asp Lys Arg Val Ile Ile
```

```
145                 150                 155                 160

Lys Asp Leu Gln Leu Leu Gly Leu Val Ala Ala Leu Leu Met Ala Asp
                165                 170                 175

Val Ile Leu Leu Met Thr Trp Val Leu Thr Asp Pro Ile Gln Cys Leu
            180                 185                 190

Gln Ile Leu Ser Val Thr Gly Lys Asp Val Ser Cys Thr Ser Thr Ser
        195                 200                 205

Thr His Phe Cys Ala Ser Arg Tyr Ser Asp Val Trp Ile Ala Leu Ile
    210                 215                 220

Trp Gly Cys Lys Gly Leu Leu Leu Leu Tyr Gly Ala Tyr Leu Ala Gly
225                 230                 235                 240

Leu Thr Gly His Val Ser Ser Pro Pro Val Asn Gln Ser Leu Thr Ile
                245                 250                 255

Met Val Gly Val Asn Leu Leu Val Leu Ala Ala Gly Leu Leu Phe Val
            260                 265                 270

Val Thr Arg Tyr Leu His Ser Trp Pro Asn Leu Val Phe Gly Leu Thr
        275                 280                 285

Ser Gly Gly Ile Phe Val Cys Thr Thr Thr Ile Asn Cys Phe Ile Phe
    290                 295                 300

Ile Pro Gln Leu Lys Gln Trp Lys Ala Phe Glu Glu Glu Asn Gln Thr
305                 310                 315                 320

Ile Arg Arg Met Ala Lys Tyr Phe Ser Thr Pro Asn Lys Ser Phe His
                325                 330                 335

Thr Gln Tyr Gly Glu Glu Glu Asn Cys His Pro Arg Gly Glu Lys Ser
            340                 345                 350

Ser Met Glu Arg Leu Leu Thr Glu Lys Asn Ala Val Ile Glu Ser Leu
        355                 360                 365

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

Ala Glu Cys Thr Tyr Asp Leu Pro Glu Gly Ala Ala Pro Pro Ala Ser
385                 390                 395                 400

Ser Pro Asn Lys Asp Val Gln Ala Val Ala Ser Val His Thr Leu Ala
                405                 410                 415
```

```
Ala Ala Gln Gly Pro Ser Gly His Leu Ser Asp Phe Gln Asn Asp Pro
            420                 425                 430

Gly Met Ala Ala Arg Asp Ser Gln Cys Thr Ser Gly Pro Ser Ser Tyr
        435                 440                 445

Ala Gln Ser Leu Glu Gly Pro Gly Lys Asp Ser Ser Phe Ser Pro Gly
    450                 455                 460

Lys Glu Glu Lys Ile Ser Asp Ser Lys Asp Phe Ser Asp His Leu Asp
465                 470                 475                 480

Ser Gly Cys Ser Gln Lys Pro Trp Thr Glu Gln Ser Leu Gly Pro Glu
                485                 490                 495

Arg Gly Asp Gln Val Pro Met Asn Pro Ser Gln Ser Leu Leu Pro Asp
            500                 505                 510

Arg Gly Gly Ser Asp Pro Gln Arg Gln Arg His Leu Glu Asn Ser Glu
        515                 520                 525

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

Leu Gln Glu Val Leu Gln Asp Leu Gly Leu Gly Pro Glu Ala Ser Leu
545                 550                 555                 560

Ser Thr Ala Pro Ser Cys His Gln Gln Thr Trp Lys Asn Ser Ala Ala
                565                 570                 575

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

Tyr Met Val Arg Arg Arg Arg Ala Ala Gln Arg Ala Arg Ser His Phe
        595                 600                 605

Pro Gly Ser Ala Pro Ser Ser Val Gly His Arg Ala Asn Arg Thr Val
    610                 615                 620

Pro Gly Ala His Ser Arg Leu His Val Gln Asn Gly Asp Ser Pro Ser
625                 630                 635                 640

Leu Ala Pro Gln Thr Thr Asp Ser Arg Val Arg Arg Pro Ser Ser Arg
                645                 650                 655

Lys Pro Ser Leu Pro Ser Asp Pro Gln Asp Arg Pro Gly Thr Leu Glu
            660                 665                 670

Gly Ser Lys Gln Ser Gln Thr Glu Pro Glu Gly Ala Arg Gly Ser Lys
        675                 680                 685
```

```
Ala Ala Phe Leu Arg Gln Pro Ser Gly Ser Gly Arg Ala Pro Ser Pro
    690                 695                 700

Ala Ala Pro Cys Leu Ser Lys Ala Ser Pro Asp Leu Pro Glu Gln Trp
705                 710                 715                 720

Gln Leu Trp Pro Pro Val Pro Ser Gly Cys Ala Ser Leu Ser Ser Gln
                725                 730                 735

His Ser Tyr Phe Asp Thr Glu Ser Ser Ser Ser Asp Glu Phe Phe Cys
            740                 745                 750

Arg Cys His Arg Pro Tyr Cys Glu Ile Cys Phe Gln Ser Ser Ser Asp
        755                 760                 765

Ser Ser Asp Ser Gly Thr Ser Asp Thr Asp Pro Glu Pro Thr Gly Gly
    770                 775                 780

Leu Ala Ser Trp Glu Lys Leu Trp Ala Arg Ser Lys Pro Ile Val Asn
785                 790                 795                 800

Phe Lys Asp Asp Leu Lys Pro Thr Leu Val
                805                 810
```

<210> 5
<211> 814
<212> PRT
<213> Homo sapien

<220>
<223> Mutant (E533D) full length GPR156 protein E516 variant

<400> 5

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Met Glu Pro Glu Ile Asn Cys Ser Glu Leu Cys Asp Ser Phe Pro Gly
1               5                   10                  15

Gln Glu Leu Asp Arg Arg Pro Leu His Asp Leu Cys Lys Thr Thr Ile
            20                  25                  30

Thr Ser Ser His His Ser Ser Lys Thr Ile Ser Ser Leu Ser Pro Val
        35                  40                  45

Leu Leu Gly Ile Val Trp Thr Phe Leu Ser Cys Gly Leu Leu Leu Ile
    50                  55                  60
```

```
Leu Phe Phe Leu Ala Phe Thr Ile His Cys Arg Lys Asn Arg Ile Val
65                  70                  75                  80

Lys Met Ser Ser Pro Asn Leu Asn Ile Val Thr Leu Leu Gly Ser Cys
                85                  90                  95

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

Gly Ser Ser Met Glu Thr Leu Ile Gln Thr Arg Leu Ser Met Leu Cys
        115                 120                 125

Ile Gly Thr Ser Leu Val Phe Gly Pro Ile Leu Gly Lys Ser Trp Arg
    130                 135                 140

Leu Tyr Lys Val Phe Thr Gln Arg Val Pro Asp Lys Arg Val Ile Ile
145                 150                 155                 160

Lys Asp Leu Gln Leu Leu Gly Leu Val Ala Ala Leu Leu Met Ala Asp
                165                 170                 175

Val Ile Leu Leu Met Thr Trp Val Leu Thr Asp Pro Ile Gln Cys Leu
            180                 185                 190

Gln Ile Leu Ser Val Ser Met Thr Val Thr Gly Lys Asp Val Ser Cys
        195                 200                 205

Thr Ser Thr Ser Thr His Phe Cys Ala Ser Arg Tyr Ser Asp Val Trp
    210                 215                 220

Ile Ala Leu Ile Trp Gly Cys Lys Gly Leu Leu Leu Leu Tyr Gly Ala
225                 230                 235                 240

Tyr Leu Ala Gly Leu Thr Gly His Val Ser Ser Pro Pro Val Asn Gln
                245                 250                 255

Ser Leu Thr Ile Met Val Gly Val Asn Leu Leu Val Leu Ala Ala Gly
            260                 265                 270

Leu Leu Phe Val Val Thr Arg Tyr Leu His Ser Trp Pro Asn Leu Val
        275                 280                 285

Phe Gly Leu Thr Ser Gly Gly Ile Phe Val Cys Thr Thr Thr Ile Asn
    290                 295                 300

Cys Phe Ile Phe Ile Pro Gln Leu Lys Gln Trp Lys Ala Phe Glu Glu
305                 310                 315                 320

Glu Asn Gln Thr Ile Arg Arg Met Ala Lys Tyr Phe Ser Thr Pro Asn
                325                 330                 335
```

```
Lys Ser Phe His Thr Gln Tyr Gly Glu Glu Glu Asn Cys His Pro Arg
            340                 345                 350

Gly Glu Lys Ser Ser Met Glu Arg Leu Leu Thr Glu Lys Asn Ala Val
        355                 360                 365

Ile Glu Ser Leu Gln Glu Gln Val Asn Asn Ala Lys Glu Lys Ile Val
    370                 375                 380

Arg Leu Met Ser Ala Glu Cys Thr Tyr Asp Leu Pro Glu Gly Ala Ala
385                 390                 395                 400

Pro Pro Ala Ser Ser Pro Asn Lys Asp Val Gln Ala Val Ala Ser Val
                405                 410                 415

His Thr Leu Ala Ala Ala Gln Gly Pro Ser Gly His Leu Ser Asp Phe
            420                 425                 430

Gln Asn Asp Pro Gly Met Ala Ala Arg Asp Ser Gln Cys Thr Ser Gly
        435                 440                 445

Pro Ser Ser Tyr Ala Gln Ser Leu Glu Gly Pro Gly Lys Asp Ser Ser
    450                 455                 460

Phe Ser Pro Gly Lys Glu Glu Lys Ile Ser Asp Ser Lys Asp Phe Ser
465                 470                 475                 480

Asp His Leu Asp Ser Gly Cys Ser Gln Lys Pro Trp Thr Glu Gln Ser
                485                 490                 495

Leu Gly Pro Glu Arg Gly Asp Gln Val Pro Met Asn Pro Ser Gln Ser
            500                 505                 510

Leu Leu Pro Glu Arg Gly Gly Ser Asp Pro Gln Arg Gln Arg His Leu
        515                 520                 525

Glu Asn Ser Glu Asp Pro Pro Glu Arg Arg Ser Arg Val Ser Ser Val
    530                 535                 540

Ile Arg Glu Lys Leu Gln Glu Val Leu Gln Asp Leu Gly Leu Gly Pro
545                 550                 555                 560

Glu Ala Ser Leu Ser Thr Ala Pro Ser Cys His Gln Gln Thr Trp Lys
                565                 570                 575

Asn Ser Ala Ala Phe Ser Pro Gln Lys Met Pro Leu Ser Lys Glu Leu
            580                 585                 590

Gly Phe Ser Pro Tyr Met Val Arg Arg Arg Arg Ala Ala Gln Arg Ala
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595 600 605

Arg Ser His Phe Pro Gly Ser Ala Pro Ser Ser Val Gly His Arg Ala
610 615 620

Asn Arg Thr Val Pro Gly Ala His Ser Arg Leu His Val Gln Asn Gly
625 630 635 640

Asp Ser Pro Ser Leu Ala Pro Gln Thr Thr Asp Ser Arg Val Arg Arg
645 650 655

Pro Ser Ser Arg Lys Pro Ser Leu Pro Ser Asp Pro Gln Asp Arg Pro
660 665 670

Gly Thr Leu Glu Gly Ser Lys Gln Ser Gln Thr Glu Pro Glu Gly Ala
675 680 685

Arg Gly Ser Lys Ala Ala Phe Leu Arg Gln Pro Ser Gly Ser Gly Arg
690 695 700

Ala Pro Ser Pro Ala Ala Pro Cys Leu Ser Lys Ala Ser Pro Asp Leu
705 710 715 720

Pro Glu Gln Trp Gln Leu Trp Pro Pro Val Pro Ser Gly Cys Ala Ser
725 730 735

Leu Ser Ser Gln His Ser Tyr Phe Asp Thr Glu Ser Ser Ser Ser Asp
740 745 750

Glu Phe Phe Cys Arg Cys His Arg Pro Tyr Cys Glu Ile Cys Phe Gln
755 760 765

Ser Ser Ser Asp Ser Ser Asp Ser Gly Thr Ser Asp Thr Asp Pro Glu
770 775 780

Pro Thr Gly Gly Leu Ala Ser Trp Glu Lys Leu Trp Ala Arg Ser Lys
785 790 795 800

Pro Ile Val Asn Phe Lys Asp Asp Leu Lys Pro Thr Leu Val
805 810

<210> 6
<211> 814
<212> PRT
<213> Homo sapien

<220>
<223> Mutant (E533D) full length GPR156 protein D516 variant

<400> 6

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Gln Glu Leu Asp Arg Arg Pro Leu His Asp Leu Cys Lys Thr Thr Ile
            20                  25                  30

Thr Ser Ser His His Ser Ser Lys Thr Ile Ser Ser Leu Ser Pro Val
        35                  40                  45

Leu Leu Gly Ile Val Trp Thr Phe Leu Ser Cys Gly Leu Leu Leu Ile
    50                  55                  60

Leu Phe Phe Leu Ala Phe Thr Ile His Cys Arg Lys Asn Arg Ile Val
65                  70                  75                  80

Lys Met Ser Ser Pro Asn Leu Asn Ile Val Thr Leu Leu Gly Ser Cys
                85                  90                  95

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

Gly Ser Ser Met Glu Thr Leu Ile Gln Thr Arg Leu Ser Met Leu Cys
        115                 120                 125

Ile Gly Thr Ser Leu Val Phe Gly Pro Ile Leu Gly Lys Ser Trp Arg
    130                 135                 140

Leu Tyr Lys Val Phe Thr Gln Arg Val Pro Asp Lys Arg Val Ile Ile
145                 150                 155                 160

Lys Asp Leu Gln Leu Leu Gly Leu Val Ala Ala Leu Leu Met Ala Asp
                165                 170                 175

Val Ile Leu Leu Met Thr Trp Val Leu Thr Asp Pro Ile Gln Cys Leu
            180                 185                 190

Gln Ile Leu Ser Val Ser Met Thr Val Thr Gly Lys Asp Val Ser Cys
        195                 200                 205

Thr Ser Thr Ser Thr His Phe Cys Ala Ser Arg Tyr Ser Asp Val Trp
    210                 215                 220

Ile Ala Leu Ile Trp Gly Cys Lys Gly Leu Leu Leu Leu Tyr Gly Ala
225                 230                 235                 240

Tyr Leu Ala Gly Leu Thr Gly His Val Ser Ser Pro Pro Val Asn Gln
                245                 250                 255
```

```
Ser Leu Thr Ile Met Val Gly Val Asn Leu Leu Val Leu Ala Ala Gly
            260                 265                 270

Leu Leu Phe Val Val Thr Arg Tyr Leu His Ser Trp Pro Asn Leu Val
        275                 280                 285

Phe Gly Leu Thr Ser Gly Gly Ile Phe Val Cys Thr Thr Thr Ile Asn
    290                 295                 300

Cys Phe Ile Phe Ile Pro Gln Leu Lys Gln Trp Lys Ala Phe Glu Glu
305                 310                 315                 320

Glu Asn Gln Thr Ile Arg Arg Met Ala Lys Tyr Phe Ser Thr Pro Asn
                325                 330                 335

Lys Ser Phe His Thr Gln Tyr Gly Glu Glu Glu Asn Cys His Pro Arg
            340                 345                 350

Gly Glu Lys Ser Ser Met Glu Arg Leu Leu Thr Glu Lys Asn Ala Val
        355                 360                 365

Ile Glu Ser Leu Gln Glu Gln Val Asn Asn Ala Lys Glu Lys Ile Val
    370                 375                 380

Arg Leu Met Ser Ala Glu Cys Thr Tyr Asp Leu Pro Glu Gly Ala Ala
385                 390                 395                 400

Pro Pro Ala Ser Ser Pro Asn Lys Asp Val Gln Ala Val Ala Ser Val
                405                 410                 415

His Thr Leu Ala Ala Ala Gln Gly Pro Ser Gly His Leu Ser Asp Phe
            420                 425                 430

Gln Asn Asp Pro Gly Met Ala Ala Arg Asp Ser Gln Cys Thr Ser Gly
        435                 440                 445

Pro Ser Ser Tyr Ala Gln Ser Leu Glu Gly Pro Gly Lys Asp Ser Ser
    450                 455                 460

Phe Ser Pro Gly Lys Glu Glu Lys Ile Ser Asp Ser Lys Asp Phe Ser
465                 470                 475                 480

Asp His Leu Asp Ser Gly Cys Ser Gln Lys Pro Trp Thr Glu Gln Ser
                485                 490                 495

Leu Gly Pro Glu Arg Gly Asp Gln Val Pro Met Asn Pro Ser Gln Ser
            500                 505                 510

Leu Leu Pro Asp Arg Gly Gly Ser Asp Pro Gln Arg Gln Arg His Leu
```

```
        515                 520                 525

Glu Asn Ser Glu Asp Pro Pro Glu Arg Arg Ser Arg Val Ser Ser Val
    530                 535                 540

Ile Arg Glu Lys Leu Gln Glu Val Leu Gln Asp Leu Gly Leu Gly Pro
545                 550                 555                 560

Glu Ala Ser Leu Ser Thr Ala Pro Ser Cys His Gln Gln Thr Trp Lys
                565                 570                 575

Asn Ser Ala Ala Phe Ser Pro Gln Lys Met Pro Leu Ser Lys Glu Leu
            580                 585                 590

Gly Phe Ser Pro Tyr Met Val Arg Arg Arg Arg Ala Ala Gln Arg Ala
        595                 600                 605

Arg Ser His Phe Pro Gly Ser Ala Pro Ser Ser Val Gly His Arg Ala
    610                 615                 620

Asn Arg Thr Val Pro Gly Ala His Ser Arg Leu His Val Gln Asn Gly
625                 630                 635                 640

Asp Ser Pro Ser Leu Ala Pro Gln Thr Thr Asp Ser Arg Val Arg Arg
                645                 650                 655

Pro Ser Ser Arg Lys Pro Ser Leu Pro Ser Asp Pro Gln Asp Arg Pro
            660                 665                 670

Gly Thr Leu Glu Gly Ser Lys Gln Ser Gln Thr Glu Pro Glu Gly Ala
        675                 680                 685

Arg Gly Ser Lys Ala Ala Phe Leu Arg Gln Pro Ser Gly Ser Gly Arg
    690                 695                 700

Ala Pro Ser Pro Ala Ala Pro Cys Leu Ser Lys Ala Ser Pro Asp Leu
705                 710                 715                 720

Pro Glu Gln Trp Gln Leu Trp Pro Pro Val Pro Ser Gly Cys Ala Ser
                725                 730                 735

Leu Ser Ser Gln His Ser Tyr Phe Asp Thr Glu Ser Ser Ser Ser Asp
            740                 745                 750

Glu Phe Phe Cys Arg Cys His Arg Pro Tyr Cys Glu Ile Cys Phe Gln
        755                 760                 765

Ser Ser Ser Asp Ser Ser Asp Ser Gly Thr Ser Asp Thr Asp Pro Glu
    770                 775                 780
```

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Pro Thr Gly Gly Leu Ala Ser Trp Glu Lys Leu Trp Ala Arg Ser Lys
785                 790                 795                 800

Pro Ile Val Asn Phe Lys Asp Asp Leu Lys Pro Thr Leu Val
                805                 810
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<212> PRT
<213> Homo sapien

<220>
<223> Mutant (E529D) GPR156 short isoform protein E512 variant

<400> 7

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Gln Glu Leu Asp Arg Arg Pro Leu His Asp Leu Cys Lys Thr Thr Ile
            20                  25                  30

Thr Ser Ser His His Ser Ser Lys Thr Ile Ser Ser Leu Ser Pro Val
        35                  40                  45

Leu Leu Gly Ile Val Trp Thr Phe Leu Ser Cys Gly Leu Leu Leu Ile
    50                  55                  60

Leu Phe Phe Leu Ala Phe Thr Ile His Cys Arg Lys Asn Arg Ile Val
65                  70                  75                  80

Lys Met Ser Ser Pro Asn Leu Asn Ile Val Thr Leu Leu Gly Ser Cys
                85                  90                  95

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

Gly Ser Ser Met Glu Thr Leu Ile Gln Thr Arg Leu Ser Met Leu Cys
        115                 120                 125

Ile Gly Thr Ser Leu Val Phe Gly Pro Ile Leu Gly Lys Ser Trp Arg
    130                 135                 140

Leu Tyr Lys Val Phe Thr Gln Arg Val Pro Asp Lys Arg Val Ile Ile
145                 150                 155                 160

Lys Asp Leu Gln Leu Leu Gly Leu Val Ala Ala Leu Leu Met Ala Asp
                165                 170                 175
```

```
Val Ile Leu Leu Met Thr Trp Val Leu Thr Asp Pro Ile Gln Cys Leu
            180                 185                 190

Gln Ile Leu Ser Val Thr Gly Lys Asp Val Ser Cys Thr Ser Thr Ser
        195                 200                 205

Thr His Phe Cys Ala Ser Arg Tyr Ser Asp Val Trp Ile Ala Leu Ile
    210                 215                 220

Trp Gly Cys Lys Gly Leu Leu Leu Leu Tyr Gly Ala Tyr Leu Ala Gly
225                 230                 235                 240

Leu Thr Gly His Val Ser Ser Pro Pro Val Asn Gln Ser Leu Thr Ile
                245                 250                 255

Met Val Gly Val Asn Leu Leu Val Leu Ala Ala Gly Leu Leu Phe Val
            260                 265                 270

Val Thr Arg Tyr Leu His Ser Trp Pro Asn Leu Val Phe Gly Leu Thr
        275                 280                 285

Ser Gly Gly Ile Phe Val Cys Thr Thr Thr Ile Asn Cys Phe Ile Phe
    290                 295                 300

Ile Pro Gln Leu Lys Gln Trp Lys Ala Phe Glu Glu Glu Asn Gln Thr
305                 310                 315                 320

Ile Arg Arg Met Ala Lys Tyr Phe Ser Thr Pro Asn Lys Ser Phe His
                325                 330                 335

Thr Gln Tyr Gly Glu Glu Glu Asn Cys His Pro Arg Gly Glu Lys Ser
            340                 345                 350

Ser Met Glu Arg Leu Leu Thr Glu Lys Asn Ala Val Ile Glu Ser Leu
        355                 360                 365

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

Ala Glu Cys Thr Tyr Asp Leu Pro Glu Gly Ala Ala Pro Pro Ala Ser
385                 390                 395                 400

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

Ala Ala Gln Gly Pro Ser Gly His Leu Ser Asp Phe Gln Asn Asp Pro
            420                 425                 430

Gly Met Ala Ala Arg Asp Ser Gln Cys Thr Ser Gly Pro Ser Ser Tyr
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```
        435                 440                 445

Ala Gln Ser Leu Glu Gly Pro Gly Lys Asp Ser Ser Phe Ser Pro Gly
    450                 455                 460

Lys Glu Glu Lys Ile Ser Asp Ser Lys Asp Phe Ser Asp His Leu Asp
465                 470                 475                 480

Ser Gly Cys Ser Gln Lys Pro Trp Thr Glu Gln Ser Leu Gly Pro Glu
                485                 490                 495

Arg Gly Asp Gln Val Pro Met Asn Pro Ser Gln Ser Leu Leu Pro Glu
            500                 505                 510

Arg Gly Gly Ser Asp Pro Gln Arg Gln Arg His Leu Glu Asn Ser Glu
        515                 520                 525

Asp Pro Pro Glu Arg Arg Ser Arg Val Ser Ser Val Ile Arg Glu Lys
    530                 535                 540

Leu Gln Glu Val Leu Gln Asp Leu Gly Leu Gly Pro Glu Ala Ser Leu
545                 550                 555                 560

Ser Thr Ala Pro Ser Cys His Gln Gln Thr Trp Lys Asn Ser Ala Ala
                565                 570                 575

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

Tyr Met Val Arg Arg Arg Arg Ala Ala Gln Arg Ala Arg Ser His Phe
        595                 600                 605

Pro Gly Ser Ala Pro Ser Ser Val Gly His Arg Ala Asn Arg Thr Val
    610                 615                 620

Pro Gly Ala His Ser Arg Leu His Val Gln Asn Gly Asp Ser Pro Ser
625                 630                 635                 640

Leu Ala Pro Gln Thr Thr Asp Ser Arg Val Arg Arg Pro Ser Ser Arg
                645                 650                 655

Lys Pro Ser Leu Pro Ser Asp Pro Gln Asp Arg Pro Gly Thr Leu Glu
            660                 665                 670

Gly Ser Lys Gln Ser Gln Thr Glu Pro Glu Gly Ala Arg Gly Ser Lys
        675                 680                 685

Ala Ala Phe Leu Arg Gln Pro Ser Gly Ser Gly Arg Ala Pro Ser Pro
    690                 695                 700
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Ala Ala Pro Cys Leu Ser Lys Ala Ser Pro Asp Leu Pro Glu Gln Trp
705                 710                 715                 720

Gln Leu Trp Pro Pro Val Pro Ser Gly Cys Ala Ser Leu Ser Ser Gln
                725                 730                 735

His Ser Tyr Phe Asp Thr Glu Ser Ser Ser Ser Asp Glu Phe Phe Cys
            740                 745                 750

Arg Cys His Arg Pro Tyr Cys Glu Ile Cys Phe Gln Ser Ser Ser Asp
        755                 760                 765

Ser Ser Asp Ser Gly Thr Ser Asp Thr Asp Pro Glu Pro Thr Gly Gly
    770                 775                 780

Leu Ala Ser Trp Glu Lys Leu Trp Ala Arg Ser Lys Pro Ile Val Asn
785                 790                 795                 800

Phe Lys Asp Asp Leu Lys Pro Thr Leu Val
                805                 810
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<212> PRT
<213> Homo sapien

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<223> Mutant (E529D) GPR156 short isoform protein D512 variant

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

Thr Ser Ser His His Ser Ser Lys Thr Ile Ser Ser Leu Ser Pro Val
        35                  40                  45

Leu Leu Gly Ile Val Trp Thr Phe Leu Ser Cys Gly Leu Leu Leu Ile
    50                  55                  60

Leu Phe Phe Leu Ala Phe Thr Ile His Cys Arg Lys Asn Arg Ile Val
65                  70                  75                  80

Lys Met Ser Ser Pro Asn Leu Asn Ile Val Thr Leu Leu Gly Ser Cys
                85                  90                  95
```

```
Leu Thr Tyr Ser Ser Ala Tyr Leu Phe Gly Ile Gln Asp Val Leu Val
            100                 105                 110

Gly Ser Ser Met Glu Thr Leu Ile Gln Thr Arg Leu Ser Met Leu Cys
        115                 120                 125

Ile Gly Thr Ser Leu Val Phe Gly Pro Ile Leu Gly Lys Ser Trp Arg
    130                 135                 140

Leu Tyr Lys Val Phe Thr Gln Arg Val Pro Asp Lys Arg Val Ile Ile
145                 150                 155                 160

Lys Asp Leu Gln Leu Leu Gly Leu Val Ala Ala Leu Leu Met Ala Asp
                165                 170                 175

Val Ile Leu Leu Met Thr Trp Val Leu Thr Asp Pro Ile Gln Cys Leu
            180                 185                 190

Gln Ile Leu Ser Val Thr Gly Lys Asp Val Ser Cys Thr Ser Thr Ser
        195                 200                 205

Thr His Phe Cys Ala Ser Arg Tyr Ser Asp Val Trp Ile Ala Leu Ile
    210                 215                 220

Trp Gly Cys Lys Gly Leu Leu Leu Leu Tyr Gly Ala Tyr Leu Ala Gly
225                 230                 235                 240

Leu Thr Gly His Val Ser Ser Pro Pro Val Asn Gln Ser Leu Thr Ile
                245                 250                 255

Met Val Gly Val Asn Leu Leu Val Leu Ala Ala Gly Leu Leu Phe Val
            260                 265                 270

Val Thr Arg Tyr Leu His Ser Trp Pro Asn Leu Val Phe Gly Leu Thr
        275                 280                 285

Ser Gly Gly Ile Phe Val Cys Thr Thr Thr Ile Asn Cys Phe Ile Phe
    290                 295                 300

Ile Pro Gln Leu Lys Gln Trp Lys Ala Phe Glu Glu Glu Asn Gln Thr
305                 310                 315                 320

Ile Arg Arg Met Ala Lys Tyr Phe Ser Thr Pro Asn Lys Ser Phe His
                325                 330                 335

Thr Gln Tyr Gly Glu Glu Glu Asn Cys His Pro Arg Gly Glu Lys Ser
            340                 345                 350

Ser Met Glu Arg Leu Leu Thr Glu Lys Asn Ala Val Ile Glu Ser Leu
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```
        355                 360                 365

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

Ala Glu Cys Thr Tyr Asp Leu Pro Glu Gly Ala Ala Pro Pro Ala Ser
385                 390                 395                 400

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

Ala Ala Gln Gly Pro Ser Gly His Leu Ser Asp Phe Gln Asn Asp Pro
            420                 425                 430

Gly Met Ala Ala Arg Asp Ser Gln Cys Thr Ser Gly Pro Ser Ser Tyr
        435                 440                 445

Ala Gln Ser Leu Glu Gly Pro Gly Lys Asp Ser Ser Phe Ser Pro Gly
    450                 455                 460

Lys Glu Glu Lys Ile Ser Asp Ser Lys Asp Phe Ser Asp His Leu Asp
465                 470                 475                 480

Ser Gly Cys Ser Gln Lys Pro Trp Thr Glu Gln Ser Leu Gly Pro Glu
                485                 490                 495

Arg Gly Asp Gln Val Pro Met Asn Pro Ser Gln Ser Leu Leu Pro Asp
            500                 505                 510

Arg Gly Gly Ser Asp Pro Gln Arg Gln Arg His Leu Glu Asn Ser Glu
        515                 520                 525

Asp Pro Pro Glu Arg Arg Ser Arg Val Ser Ser Val Ile Arg Glu Lys
    530                 535                 540

Leu Gln Glu Val Leu Gln Asp Leu Gly Leu Gly Pro Glu Ala Ser Leu
545                 550                 555                 560

Ser Thr Ala Pro Ser Cys His Gln Gln Thr Trp Lys Asn Ser Ala Ala
                565                 570                 575

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

Tyr Met Val Arg Arg Arg Arg Ala Ala Gln Arg Ala Arg Ser His Phe
        595                 600                 605

Pro Gly Ser Ala Pro Ser Ser Val Gly His Arg Ala Asn Arg Thr Val
    610                 615                 620
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Pro Gly Ala His Ser Arg Leu His Val Gln Asn Gly Asp Ser Pro Ser
625                 630                 635                 640

Leu Ala Pro Gln Thr Thr Asp Ser Arg Val Arg Arg Pro Ser Ser Arg
                645                 650                 655

Lys Pro Ser Leu Pro Ser Asp Pro Gln Asp Arg Pro Gly Thr Leu Glu
            660                 665                 670

Gly Ser Lys Gln Ser Gln Thr Glu Pro Glu Gly Ala Arg Gly Ser Lys
        675                 680                 685

Ala Ala Phe Leu Arg Gln Pro Ser Gly Ser Gly Arg Ala Pro Ser Pro
    690                 695                 700

Ala Ala Pro Cys Leu Ser Lys Ala Ser Pro Asp Leu Pro Glu Gln Trp
705                 710                 715                 720

Gln Leu Trp Pro Pro Val Pro Ser Gly Cys Ala Ser Leu Ser Ser Gln
                725                 730                 735

His Ser Tyr Phe Asp Thr Glu Ser Ser Ser Ser Asp Glu Phe Phe Cys
            740                 745                 750

Arg Cys His Arg Pro Tyr Cys Glu Ile Cys Phe Gln Ser Ser Ser Asp
        755                 760                 765

Ser Ser Asp Ser Gly Thr Ser Asp Thr Asp Pro Glu Pro Thr Gly Gly
    770                 775                 780

Leu Ala Ser Trp Glu Lys Leu Trp Ala Arg Ser Lys Pro Ile Val Asn
785                 790                 795                 800

Phe Lys Asp Asp Leu Lys Pro Thr Leu Val
                805                 810
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<221> variation
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<223> n is a or g

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35 40 45

Leu Leu Gly Val Ile Trp Thr Phe Leu Ser Cys Gly Leu Leu Leu Val
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Leu Phe Phe Leu Ala Phe Thr Ile Arg Cys Arg Lys Asn Arg Ile Val
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Lys Met Ser Ser Pro Asn Leu Asn Ile Val Thr Leu Leu Gly Ser Cys
85 90 95

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

Gly Ser Ser Val Glu Ala Leu Ile Gln Thr Arg Leu Ser Leu Leu Cys
115 120 125

Ile Gly Thr Thr Leu Val Phe Gly Pro Ile Leu Gly Lys Ser Trp Arg
130 135 140

Leu Tyr Lys Val Phe Thr Gln Arg Val Pro Asp Lys Arg Val Ile Ile
145 150 155 160

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Lys Asp Leu Gln Leu Leu Gly Leu Val Ala Ala Leu Val Val Ala Asp
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Val Ile Leu Leu Val Thr Trp Val Leu Thr Asp Pro Ile Gln Cys Leu
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Gln Ile Leu Gly Val Ser Met Lys Val Thr Gly Arg Asp Val Ser Cys
        195                 200                 205

Ser Leu Thr Asn Thr His Phe Cys Ala Ser Arg Tyr Ser Asp Val Trp
    210                 215                 220

Ile Ala Leu Val Leu Gly Cys Lys Gly Leu Leu Leu Leu Tyr Gly Ala
225                 230                 235                 240

Tyr Leu Ala Gly Leu Thr Asn His Val Ser Ser Pro Pro Val Asn Gln
                245                 250                 255

Ser Leu Thr Ile Met Val Gly Val Asn Leu Leu Leu Leu Thr Ala Gly
            260                 265                 270

Leu Leu Phe Val Val Thr Arg Tyr Leu His Ser Trp Pro Asn Leu Val
        275                 280                 285

Phe Gly Leu Thr Ser Gly Gly Ile Phe Val Cys Thr Thr Thr Val Asn
    290                 295                 300

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

Glu Asn Gln Thr Ile Arg His Met Ala Lys Tyr Phe Ser Thr Pro Ser
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Lys Thr Phe Arg Ser Lys Phe Asp Glu Asp Gln Ser Cys His Leu Arg
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Asp Glu Xaa Ser Cys Met Glu Arg Leu Leu Thr Glu Lys Asn Ala Val
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        355                 360                 365

Ile Glu Ser Leu Gln Glu Gln Val Ser Asn Ala Lys Glu Lys Leu Val
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Lys Leu Met Ser Ala Glu Cys Ala Leu Asp Ser Pro Glu Trp Ala Val
385                 390                 395                 400

Pro Ala Ala Ala Ser Ala Gly Gly Pro Ala Glu Cys Xaa Ala Thr Ser
                405                 410                 415

Glu Lys Glu Ser Gly Ala Ala Ala Glu Asp Ser Leu Pro Ala Ser Ala
            420                 425                 430

Ala Ser Gln His Met Gln Gly Pro Gly Ala Ser Arg Arg Asp Xaa Ser
        435                 440                 445

Pro Ser Pro Asp Gln Lys Tyr Asp Met Pro Leu Lys Gln Phe Cys Asp
    450                 455                 460

His Leu Asp Met Gly Cys Ser Gln Lys Pro Lys Ala Glu Gln Ser Glu
465                 470                 475                 480

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

Met Thr Asp Gly Val Ala Cys Glu Pro His Arg Pro Arg Gln Asn Ser
            500                 505                 510

Glu Val Leu Pro Glu Arg Leu Pro Arg Val Ser Ser Val Val Arg Glu
        515                 520                 525

Lys Leu Gln Glu Val Leu Gln Glu Leu Asp Leu Gly Thr Glu Ala Pro
    530                 535                 540

Leu Ser Pro Leu Pro Cys Pro Gln Gln Pro Trp Lys Ser Asn Thr Ser
545                 550                 555                 560
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Gly Ser Pro Gln Lys Leu Ser Pro Ser Lys Leu Gly Phe Ser Pro Tyr
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Val Val Arg Arg Arg Arg Ala Ala Gln Arg Ala Arg Ser Arg Ile Pro
            580                 585                 590

Gly Ser Val Gly Leu Lys Met Gly His Gln Ala Asn Asn Thr Val Ser
        595                 600                 605

Gly Ser Gln Asn Gly Leu Ile Val Gln Asn Arg Asp Ser Pro Arg Leu
    610                 615                 620

Asp His His Asn Ala Arg Ser Lys Glu Pro Arg Ser Ser Ser Val Lys
625                 630                 635                 640

Pro Ser Pro Ile Ser Ala Pro His Gln Arg Arg Gly Ser Leu Glu Gly
                645                 650                 655

Ser Lys Gln Cys Glu Thr Glu Pro Gln Glu Ala Arg Gly Tyr Ser Val
            660                 665                 670

Ala Phe Pro Arg Gln Pro Ser Ala Ser Ala Pro Ala Gln Ser Ser Thr
        675                 680                 685

Ala Pro Cys Leu Ser Ser Xaa Pro Ala Leu Pro Arg Gln Arg Gln Pro
    690                 695                 700

Leu Pro Leu Leu Ser Pro Gly Cys Pro Ser Leu Ser Ser Gly Cys Tyr
705                 710                 715                 720

Asn Leu Asp Ser Glu Ser Ser Ser Ser Asp Glu Phe Phe Cys Arg Cys
                725                 730                 735

His Arg Pro Tyr Cys Glu Ile Cys Phe Gln Ser Ser Leu Asp Ser Asn
            740                 745                 750

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

Leu Leu Gly Ile Met Trp Thr Phe Leu Ser Cys Gly Leu Leu Leu Val
50 55 60

Leu Phe Phe Leu Ala Phe Thr Ile Arg Cys Arg Lys Asn Arg Ile Val
65 70 75 80

Lys Met Ser Ser Pro Asn Leu Asn Val Val Thr Leu Leu Gly Ser Cys
85 90 95

Leu Thr Tyr Ile Ser Ala Tyr Leu Phe Gly Ile Gln Asp Ala Leu Glu
100 105 110

Gly Ser Ser Val Glu Ala Leu Ile Gln Thr Arg Leu Ser Leu Leu Cys
115 120 125

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Ile Gly Thr Ser Leu Val Phe Gly Pro Ile Leu Gly Lys Ser Trp Arg
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Leu Tyr Lys Val Phe Thr Gln Arg Val Pro Asp Lys Arg Val Ile Ile
145                 150                 155                 160

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

Val Ile Leu Leu Val Thr Trp Val Leu Thr Asp Pro Ile Gln Cys Leu
            180                 185                 190

Gln Met Leu Gly Val Ser Met Lys Val Thr Gly Arg Asp Val Ser Cys
        195                 200                 205

Ser Leu Thr Asn Thr His Phe Cys Ala Ser Arg Tyr Ser Asp Val Trp
    210                 215                 220

Ile Ala Leu Val Leu Gly Cys Lys Gly Leu Leu Leu Leu Tyr Gly Ala
225                 230                 235                 240

Tyr Leu Ala Gly Leu Thr Asn His Val Ser Ser Pro Pro Val Asn Gln
                245                 250                 255

Ser Leu Thr Ile Met Val Gly Val Asn Leu Leu Leu Leu Thr Ala Gly
            260                 265                 270

Leu Leu Phe Val Val Thr Arg Tyr Leu His Ser Trp Pro Asn Leu Val
        275                 280                 285

Phe Gly Leu Thr Ser Gly Gly Ile Phe Val Cys Thr Thr Thr Val Asn
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Cys Cys Val Phe Ile Pro Gln Leu Lys Gln Trp Lys Ala Phe Glu Gly
305                 310                 315                 320

Glu Asn Gln Thr Met Arg His Met Ala Lys Tyr Phe Ser Thr Pro Ser
                325                 330                 335
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Lys Ser Phe His Gly Gln Phe Asp Glu Asp Pro Ser Cys His Leu Arg
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Asp Glu Lys Ser Cys Met Glu Arg Leu Leu Thr Glu Lys Asn Ala Val
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Ile Glu Ser Leu Gln Glu Gln Val Ser Asn Ala Lys Glu Lys Leu Val
    370                 375                 380

Lys Leu Met Ser Ala Glu Cys Thr Tyr Asp Ser Pro Glu Trp Ala Val
385                 390                 395                 400

Pro Asp Ala Ala Ser Ala Arg Gly Leu Ala Leu Pro Gly Pro Ser Glu
                405                 410                 415

Cys Pro Ala Val Ser Glu Asn Glu Ser Gly Ala Ala Ala Arg Asp Ser
            420                 425                 430

Leu His Val Pro Ala Ala Cys Gln His Val Gln Gly Pro Gly Ala Ser
        435                 440                 445

Arg Arg Asp Thr Ser Pro Ser Pro Ala Gln Gln Asp Asn Met Pro Leu
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Lys Gln Tyr Cys Asp His Leu Asp Thr Gly Cys Asn Gln Lys Pro Lys
465                 470                 475                 480

Ala Glu Gln Ser Glu Gly Pro Glu Arg Gly Asp Gln Glu Pro Met Ala
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Pro Ser Gln Arg Leu Met Ala Asp Gly Val Ala Cys Glu Pro His Lys
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Pro Arg Gln Ser Pro Glu Gly Leu Pro Lys Lys Leu Pro Gly Val Ser
        515                 520                 525
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Ser Val Val Arg Glu Lys Leu Gln Glu Val Leu Gln Glu Leu Asp Leu
    530                 535                 540

Gly Ser Glu Ala Pro Leu Ser Pro Leu Pro Cys Pro Gln Gln Leu Trp
545                 550                 555                 560

Lys Ser Thr Thr Ser Arg Ser Pro Gln Lys Leu Ser Pro Ser Lys Leu
                565                 570                 575

Gly Phe Ser Pro Tyr Val Val Arg Arg Arg Ala Ala Gln Arg Ala
            580                 585                 590

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

Asn Ser Thr Val Ser Ser Ser Gln Ser Gly Leu Ile Val Gln Asn Arg
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Asp Ser Pro Arg Leu Asp His Asn Asn Ala Arg Ser Lys Val Pro Arg
625                 630                 635                 640

Ser Ser Ser Val Lys Pro Ser Pro Leu Ser Glu Pro Arg Arg Lys Gln
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Gly Thr Leu Glu Gly Ser Lys Gln Cys Glu Thr Glu Pro Gln Glu Ala
            660                 665                 670

Gly Gly Ala Cys Asn Val Ala Phe Pro Cys Gln Ser Ser Ala Ser Val
        675                 680                 685

Gln Ala Gln Ser Pro Ala Ala Pro Cys Leu Pro Ser Ser Pro Ala Leu
    690                 695                 700

Pro Arg Gln Arg Gln Pro Arg Pro Arg Leu Ser Pro Gly Cys Pro Ser
705                 710                 715                 720

Leu Ser Ser Gly Cys Tyr Asn Leu Asp Ser Glu Ser Ser Ser Ser Asp
                725                 730                 735
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Glu Phe Phe Cys Arg Cys His Arg Pro Tyr Cys Glu Ile Cys Phe Gln
            740                 745                 750

Ser Ser Leu Asp Ser Asn Asp Ser Asp Thr Ser Asp Ser Asp Leu Glu
        755                 760                 765

Gln Ala Ser Gly Leu Ala Ser Trp Gly Lys Leu Trp Ala Arg Ser Lys
    770                 775                 780

Pro Val Val Asn Phe Lys Asp Asp Leu Lys Pro Thr Leu Val
785                 790                 795
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