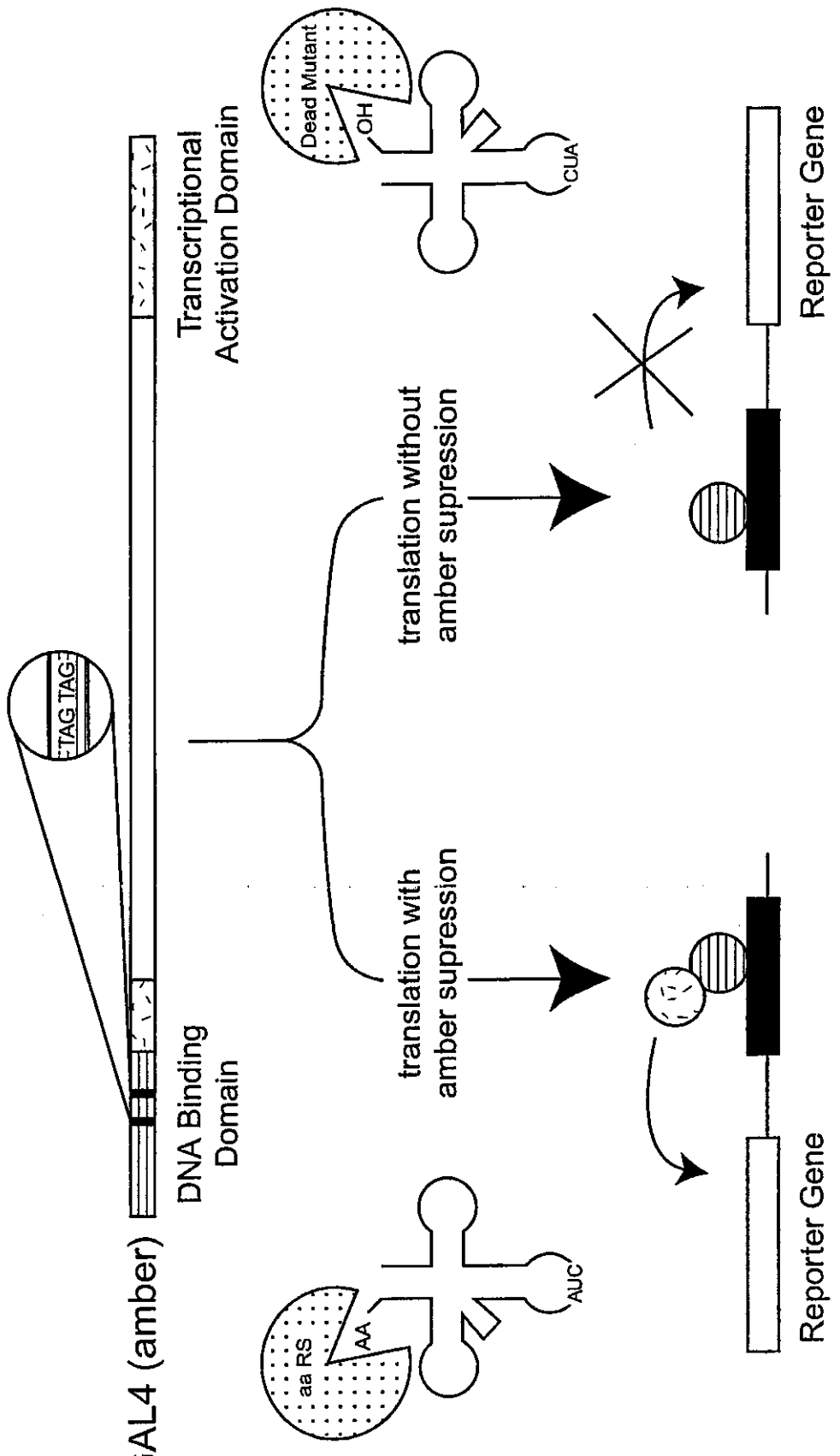

GAL4 (amber)
TAG TAG
DNA Binding Domain
Transcriptional Activation Domain
Dead Mutant
OH
CUA
aa RS
AA
AUC
translation without amber supression
translation with amber supression
Reporter Gene
Reporter Gene

Fig. 1A

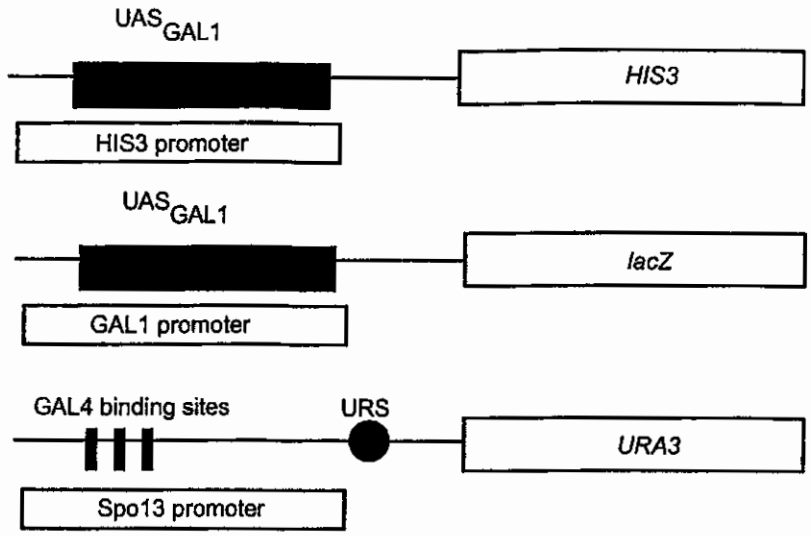

UAS GAL1
HIS3
HIS3 promoter
UAS GAL1
lacZ
GAL1 promoter
GAL4 binding sites
URS
URA3
Spo13 promoter

Fig. 1B

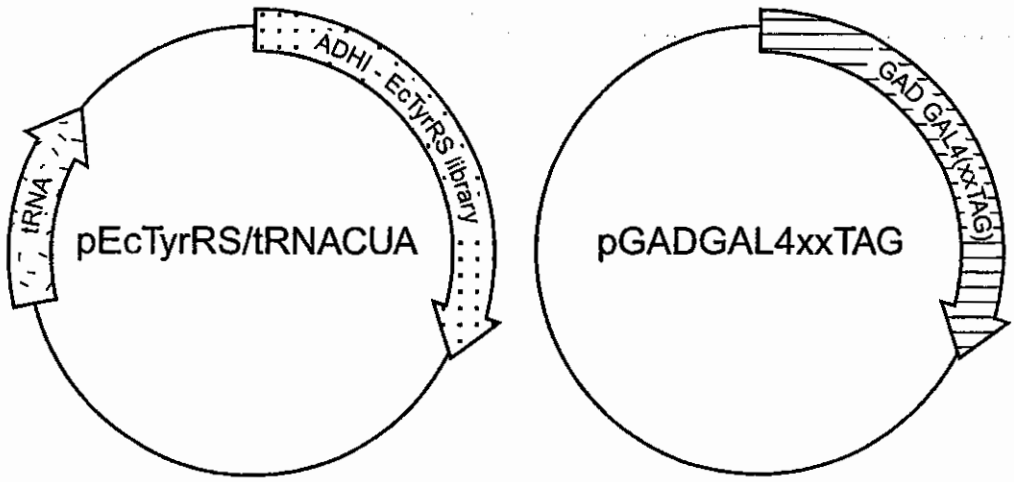

ADHI - EcTyrRS library
tRNA
pEcTyrRS/tRNACUA
GAD GAL4(xxTAG)
pGADGAL4xxTAG

Fig. 1C

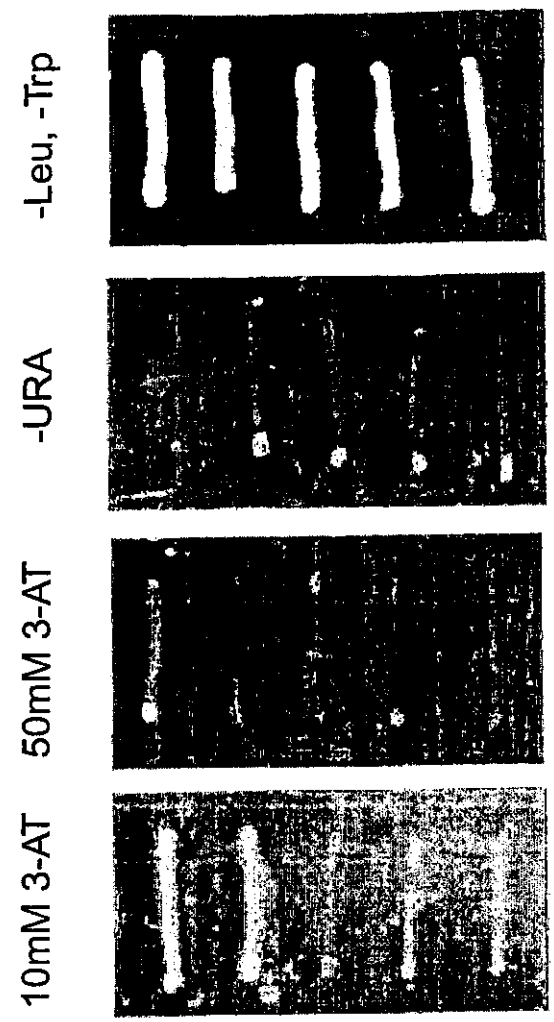

10mM 3-AT
50mM 3-AT
-URA
-Leu, -Trp
DB-AD
DB-TAG-AD + EcYRS + tRNACUA
DB-TAG-AD + EcYRS
DB-TAG-AD + A5 + tRNACUA
DB + AD

Fig. 2

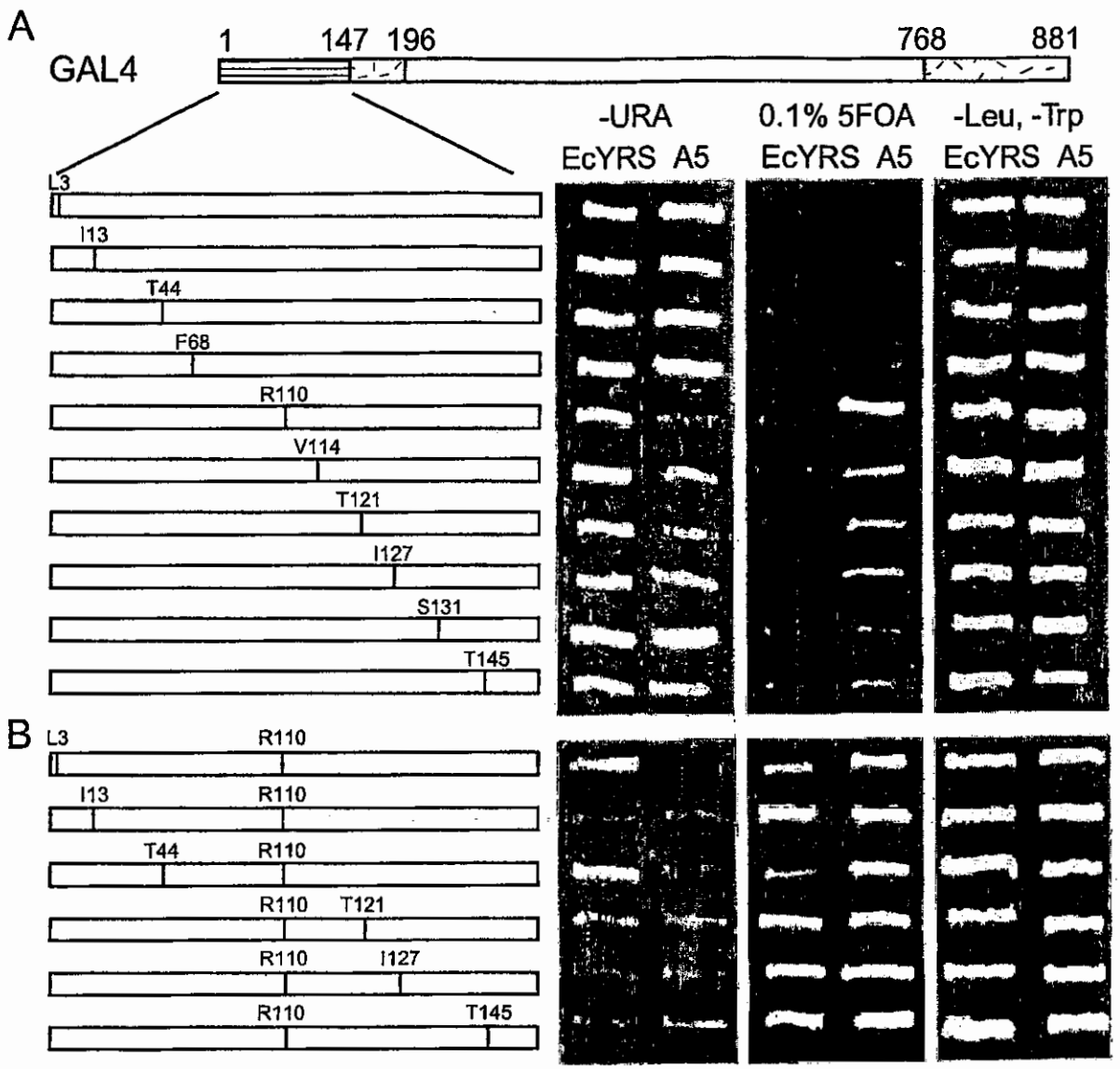

A
GAL4
1
147
196
768
881
-URA
0.1% 5FOA
-Leu, -Trp
EcYRS A5
EcYRS A5
EcYRS A5
L3
I13
T44
F68
R110
V114
T121
I127
S131
T145
B
L3 R110
I13 R110
T44 R110
R110 T121
R110 I127
R110 T145

Fig. 3

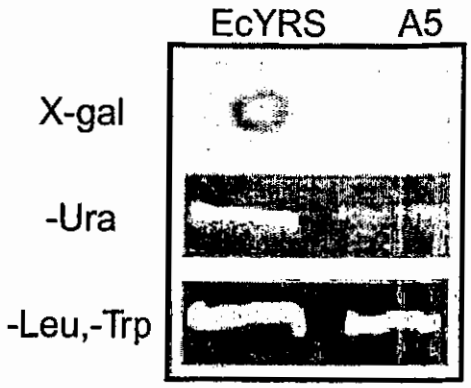


Fig. 4A

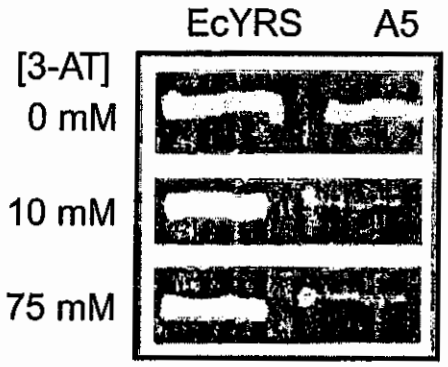


Fig. 4B

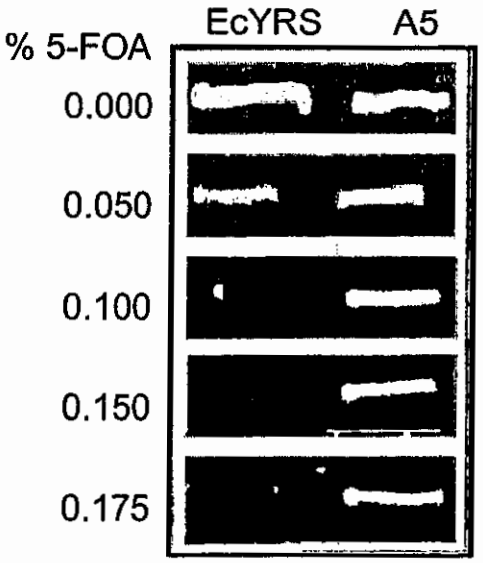


Fig. 4C

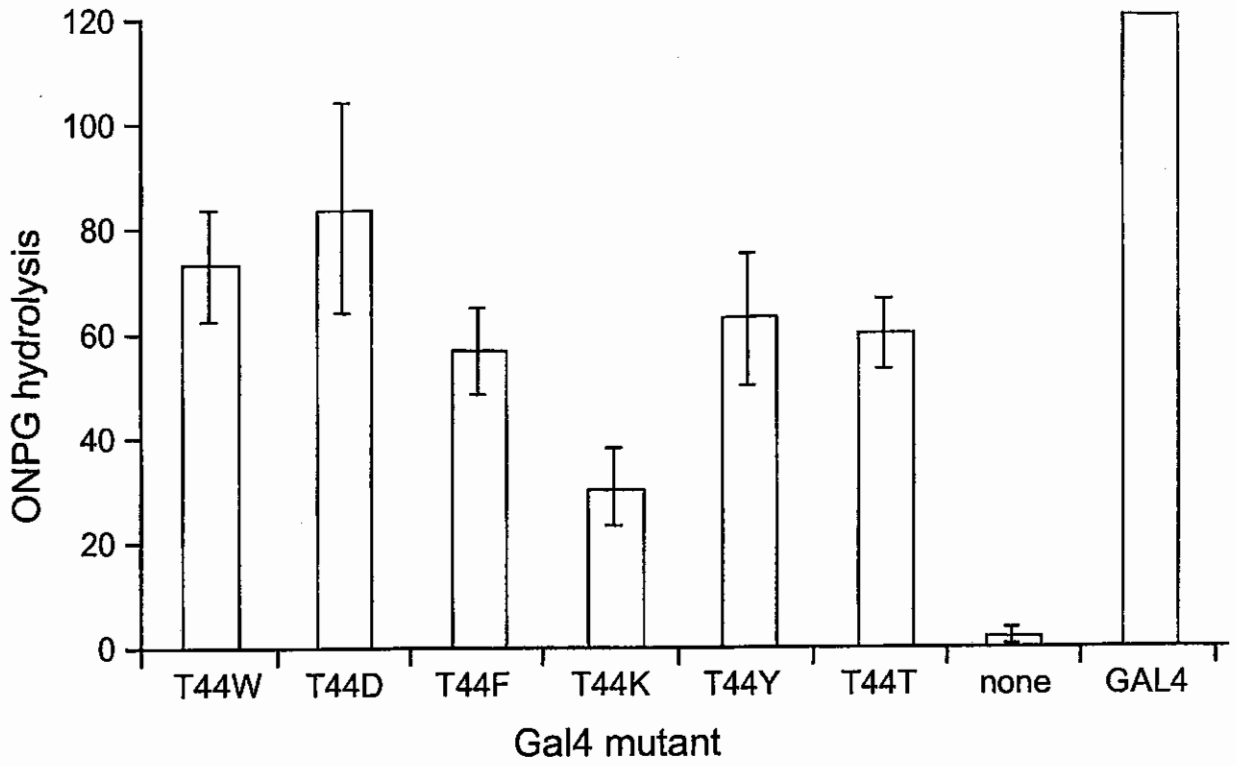

120
100
80
60
40
20
0
ONPG hydrolysis
T44W
T44D
T44F
T44K
T44Y
T44T
none
GAL4
Gal4 mutant

Fig. 5A

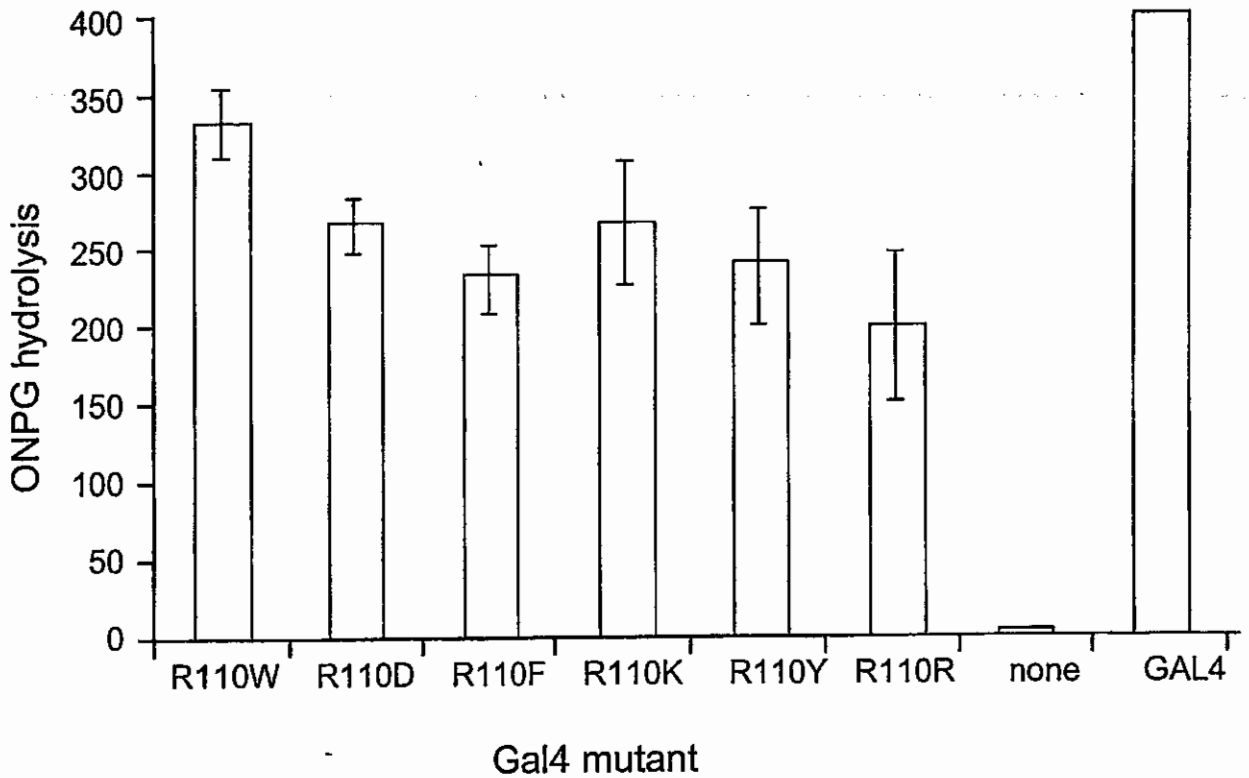

400
350
300
250
200
150
100
50
0
ONPG hydrolysis
R110W
R110D
R110F
R110K
R110Y
R110R
none
GAL4
Gal4 mutant

Fig. 5B

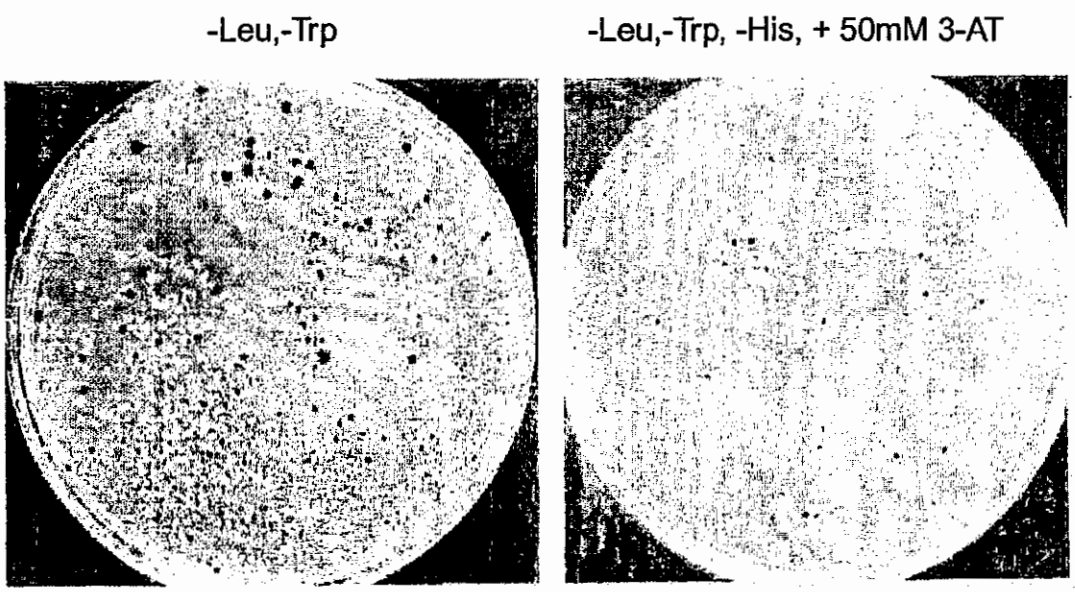


Fig. 6

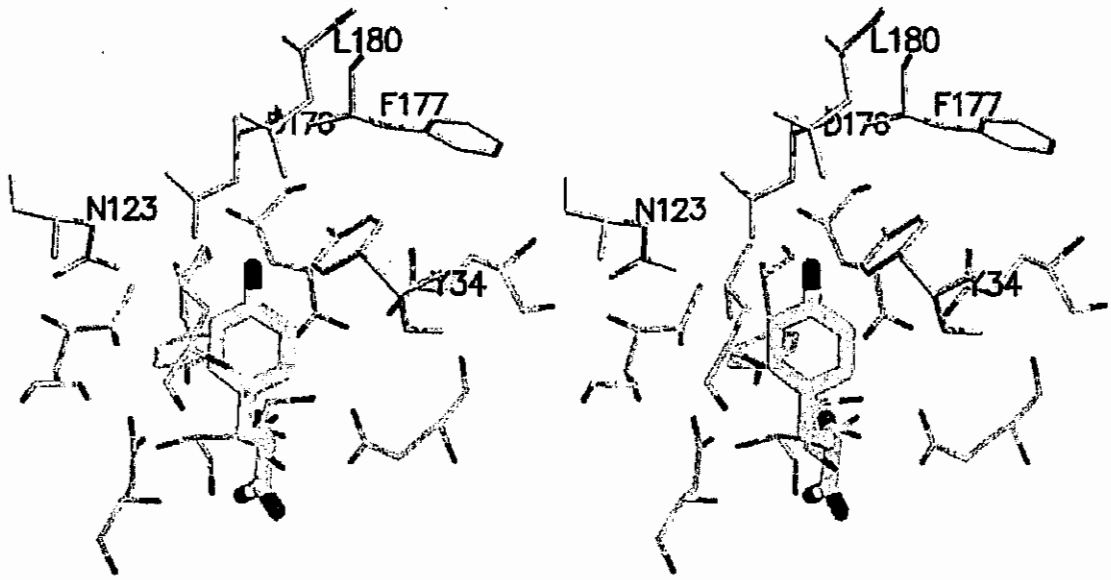
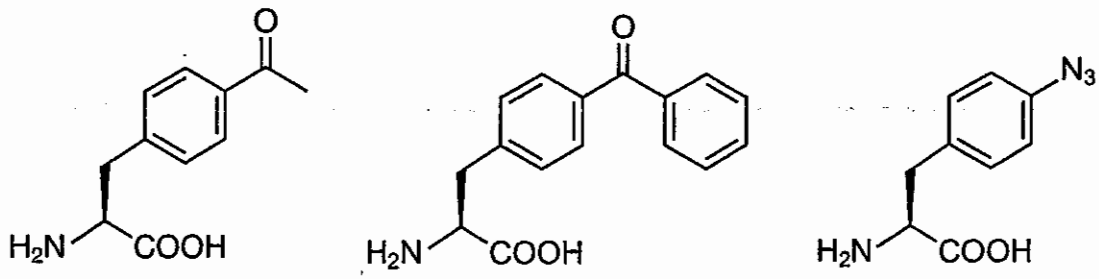
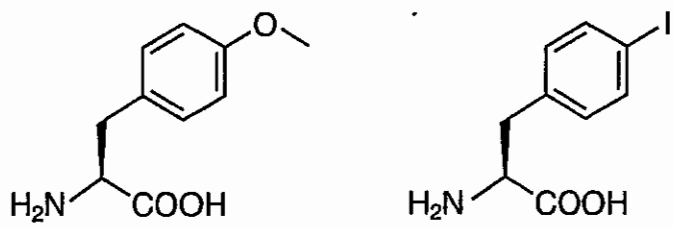


Fig. 7A



1 2 3



4 5

Fig. 7B

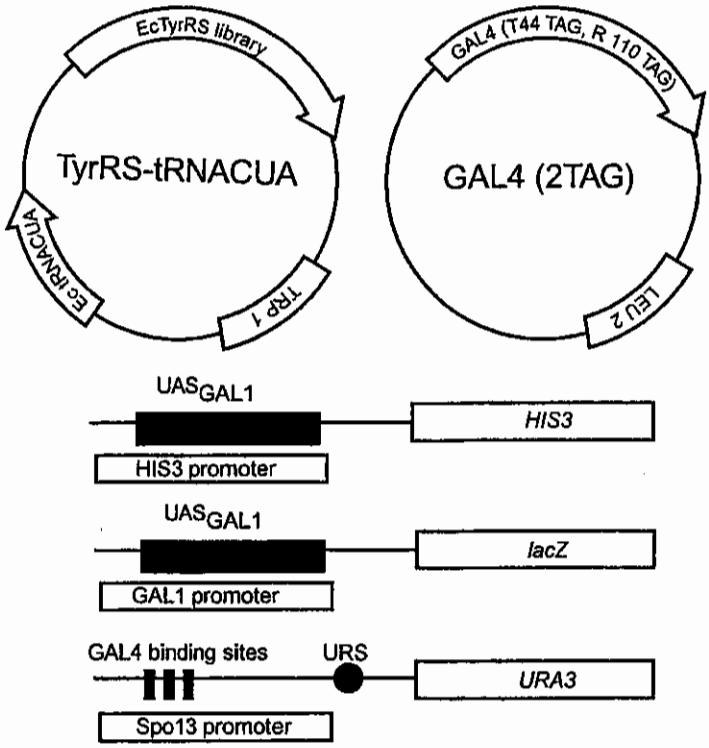


Fig. 8A

aaRS	TyrRS	A5
tRNACUA	+	+
GAL4 (2TAG)	+	+

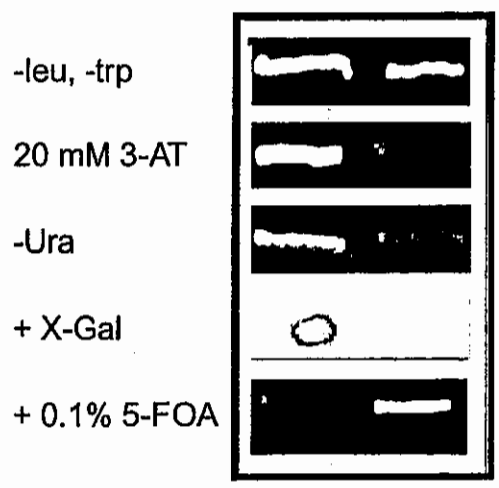


Fig. 8B

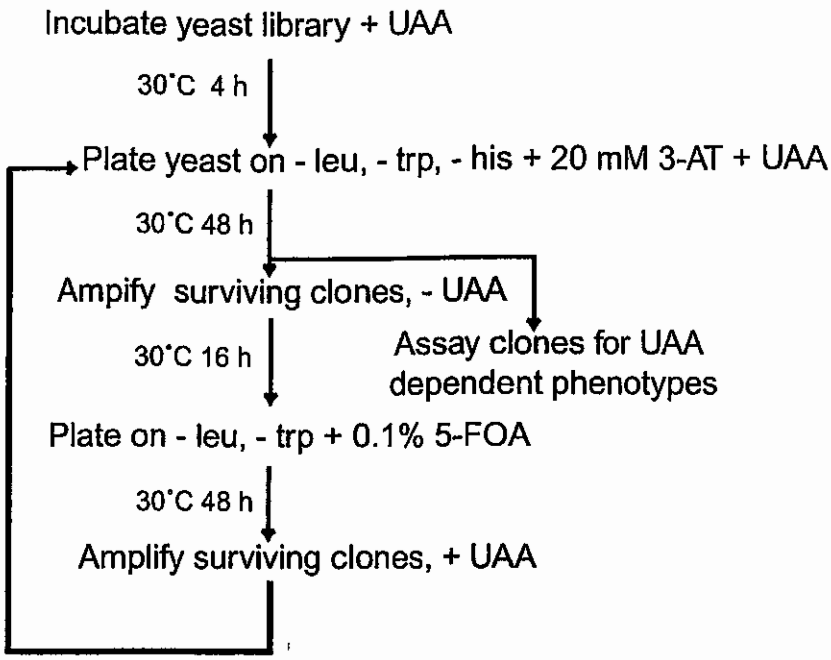

Incubate yeast library + UAA
30°C 4 h
Plate yeast on - leu, - trp, - his + 20 mM 3-AT + UAA
30°C 48 h
Ampify surviving clones, - UAA
30°C 16 h
Assay clones for UAA dependent phenotypes
Plate on - leu, - trp + 0.1% 5-FOA
30°C 48 h
Amplify surviving clones, + UAA

Fig. 8C

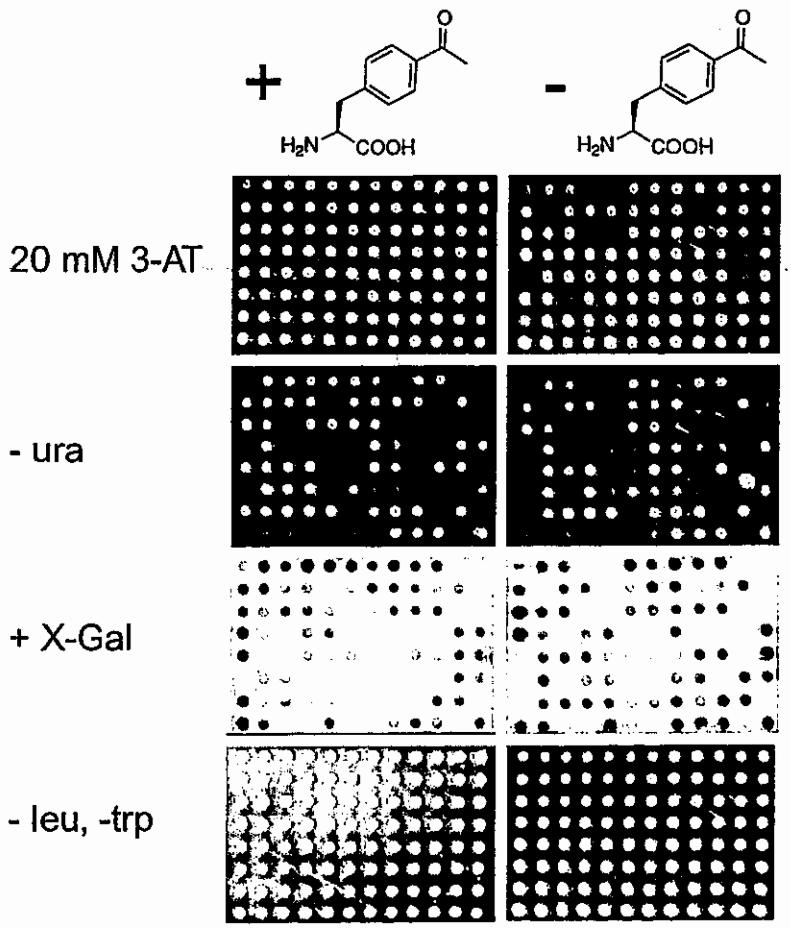

+
-
20 mM 3-AT
- ura
+ X-Gal
- leu, -trp

Fig. 8D

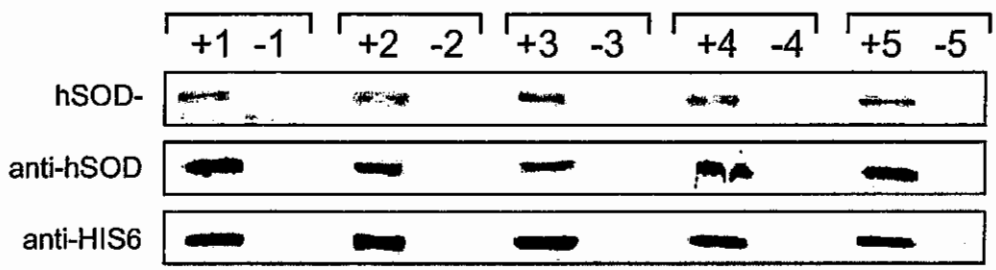


Fig. 9

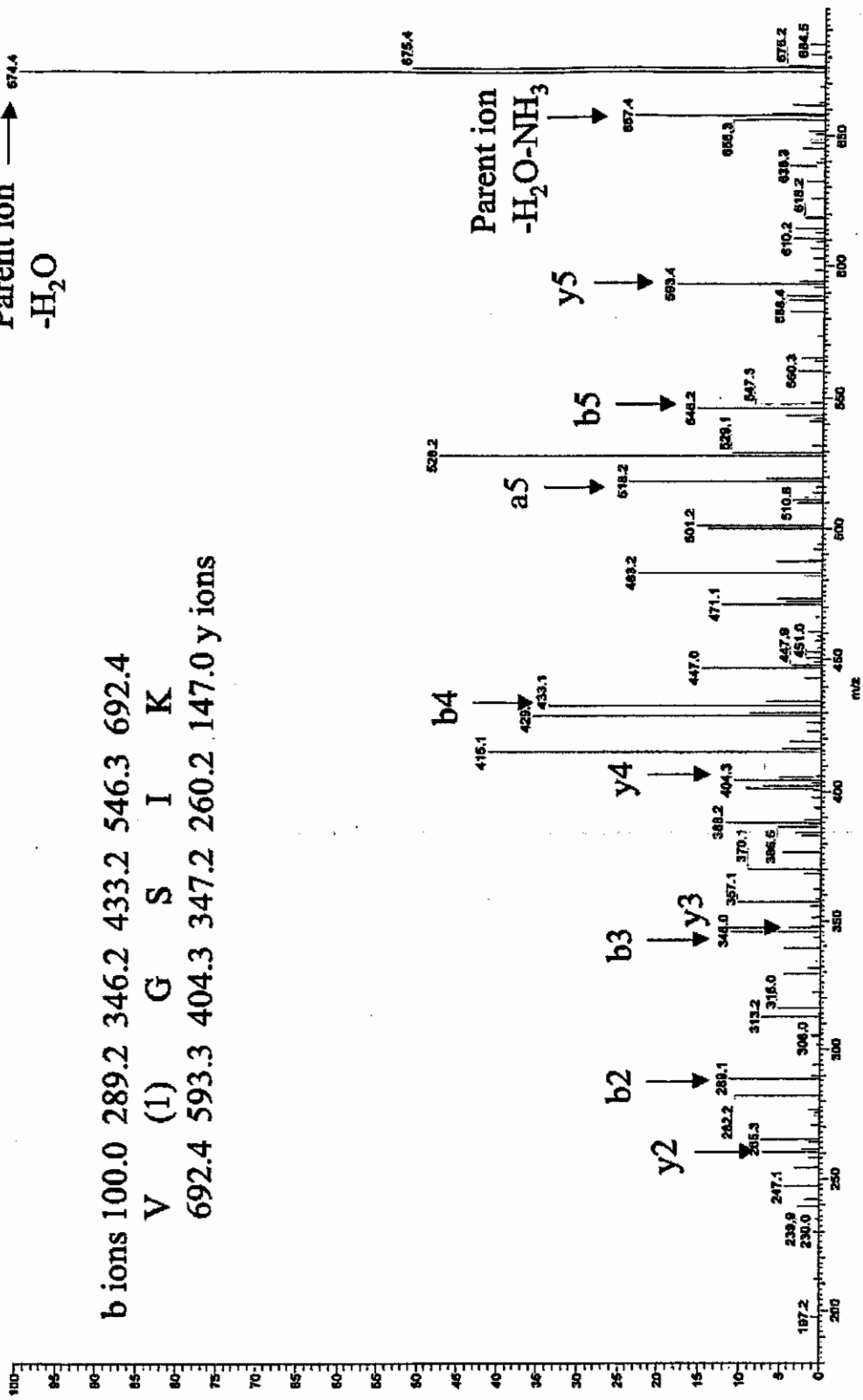

b ions 100.0 289.2 346.2 433.2 546.3 692.4
V (1) G S I K
692.4 593.3 404.3 347.2 260.2 147.0 y ions
Parent ion
-H2O
Parent ion
-H2O-NH3
b2
y2
b3
y3
y4
b4
a5
b5
y5
m/z

Fig. 10A

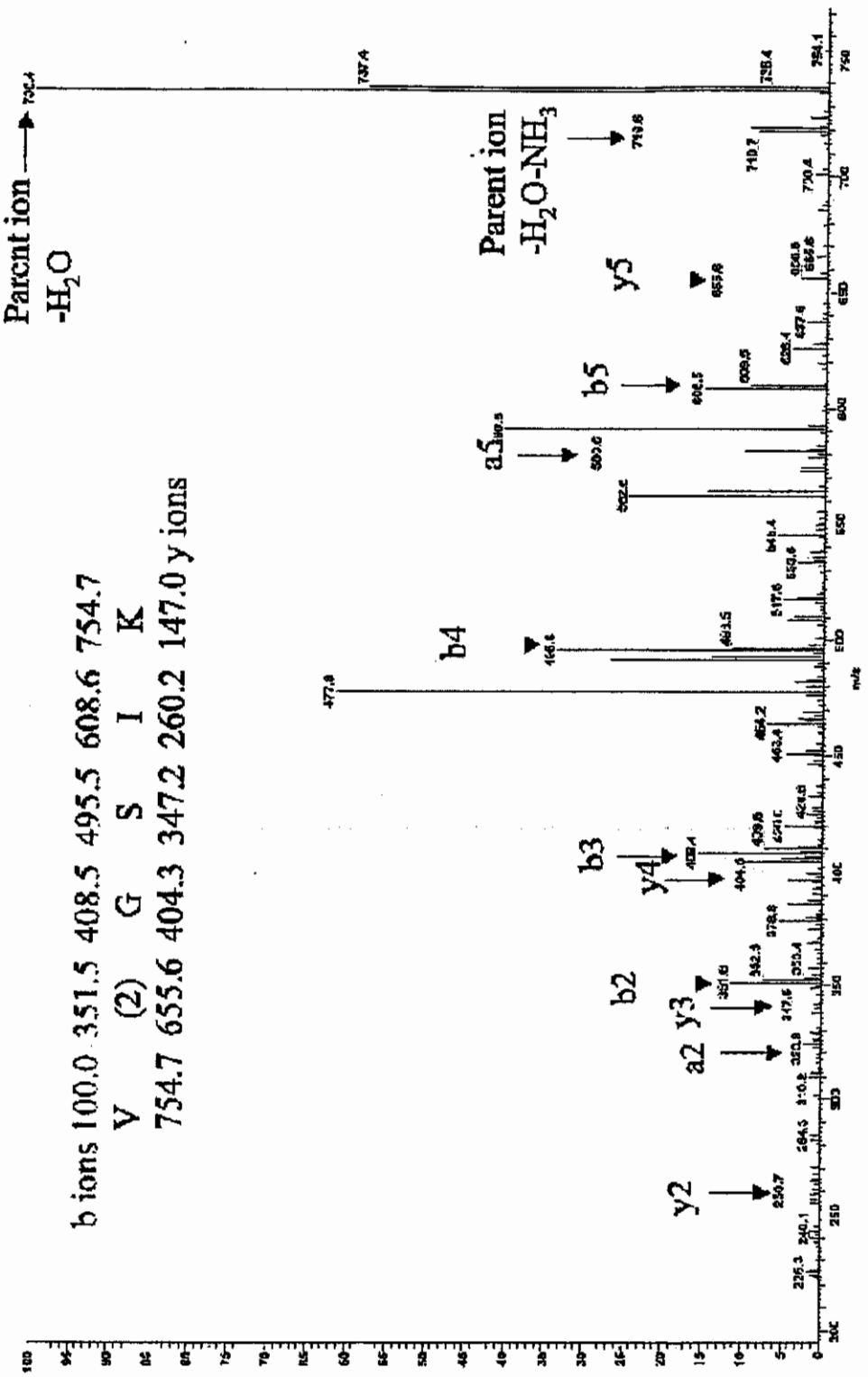

Parent ion
-H2O
Parent ion
-H2O-NH3
b ions 100.0 351.5 408.5 495.5 608.6 754.7
V (2) G S I K
754.7 655.6 404.3 347.2 260.2 147.0 y ions
b4
b5
y5
a5
b3
y4
b2
y3
a2
y2

Fig. 10B

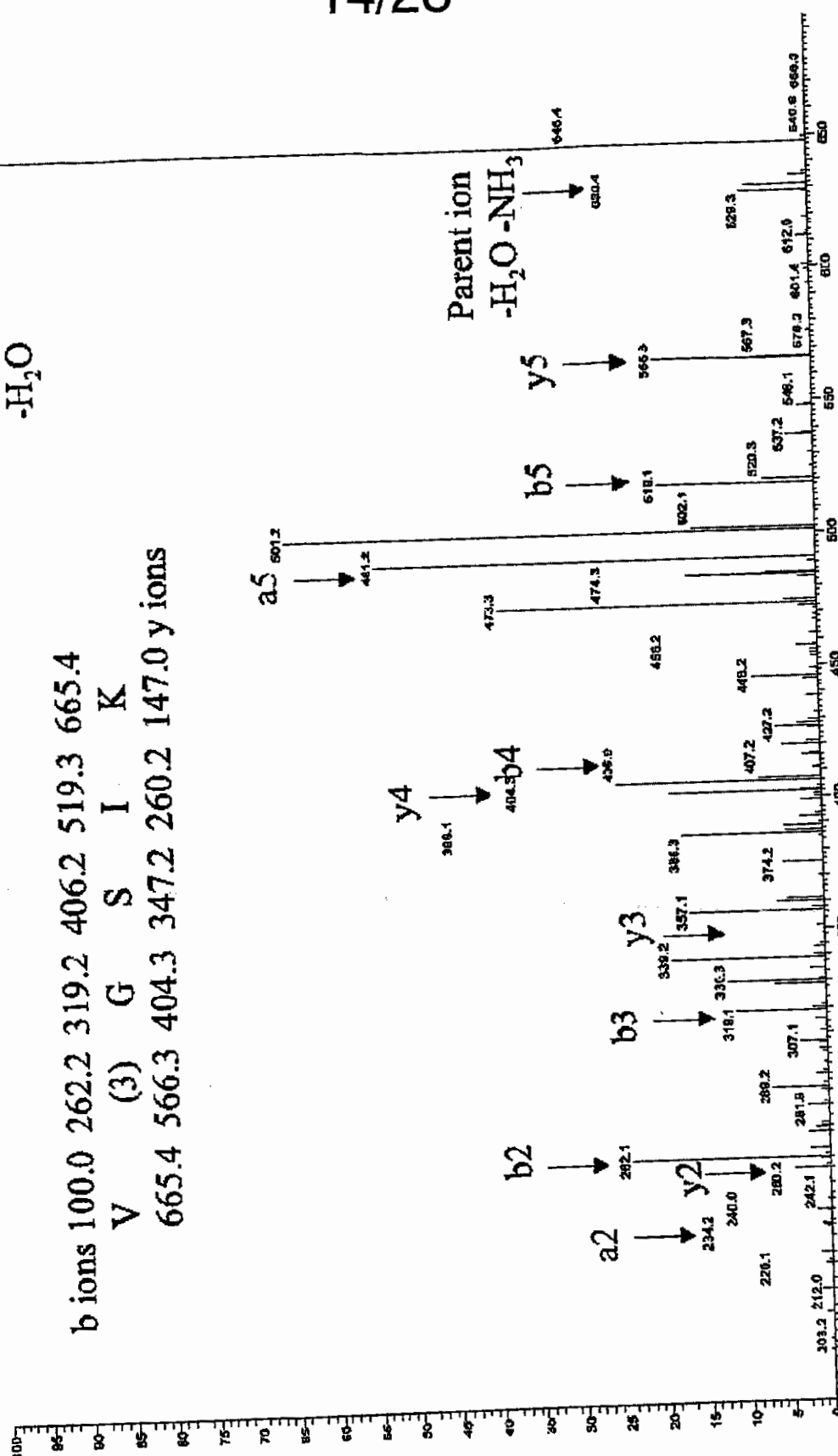

Parent ion
-H2O
Parent ion
-H2O -NH3
b ions 100.0 262.2 319.2 406.2 519.3 665.4
V (3) G S I K
665.4 566.3 404.3 347.2 260.2 147.0 y ions
a5
b5
y5
y4
b4
b3
y3
b2
y2
a2
m/z

Fig. 10C

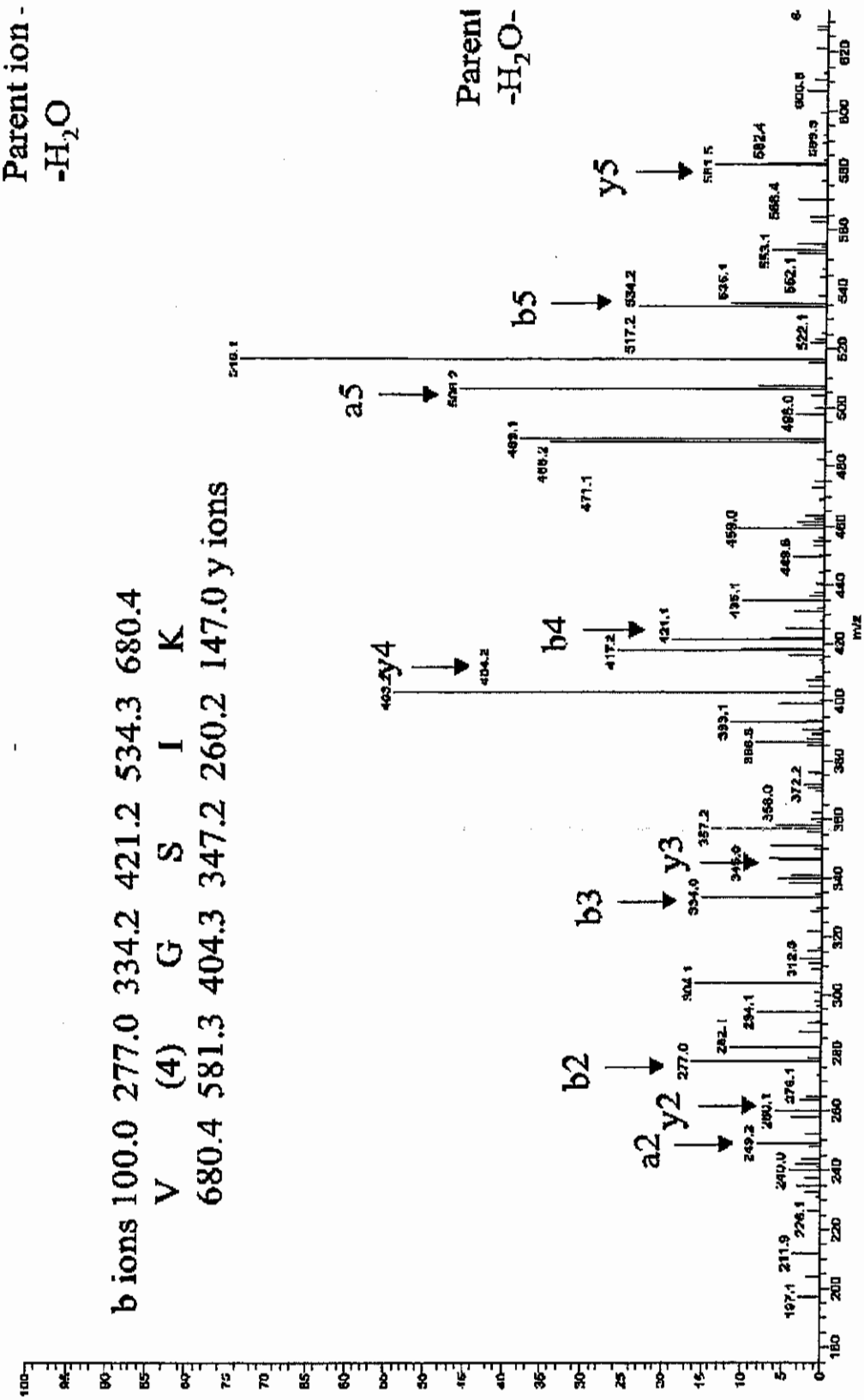

Parent ion -
-H2O
Parent
-H2O-
b ions 100.0 277.0 334.2 421.2 534.3 680.4
V (4) G S I K
680.4 581.3 404.3 347.2 260.2 147.0 y ions
a2
b2
y2
b3
y3
b4
y4
a5
b5
y5
m/z

Fig. 10D

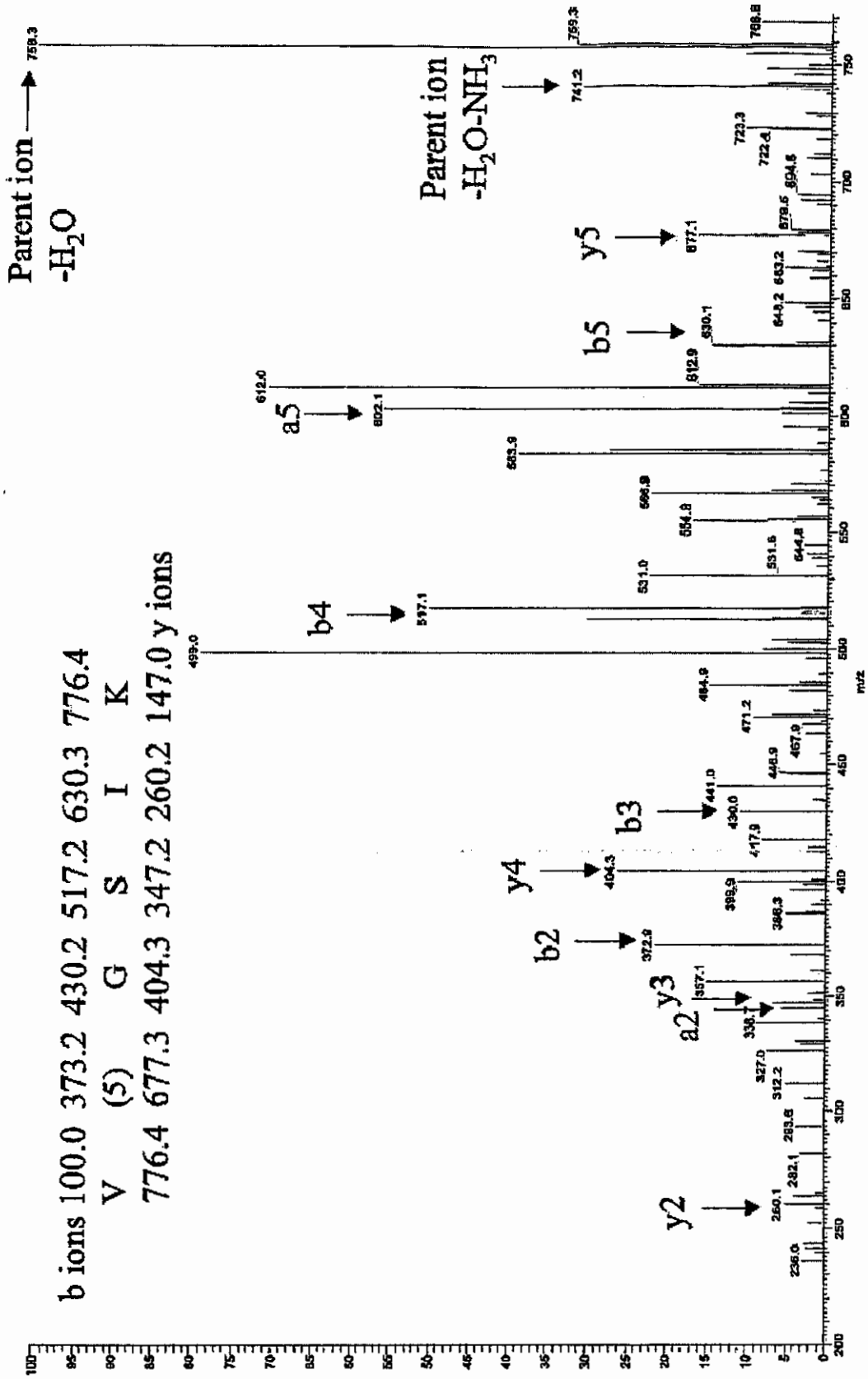

Parent ion
-H2O
Parent ion
-H2O-NH3
y5
b5
a5
b4
b3
y4
b2
y3
a2
y2
b ions 100.0 373.2 430.2 517.2 630.3 776.4
V (5) G S I K
776.4 677.3 404.3 347.2 260.2 147.0 y ions
m/z

Fig. 10E

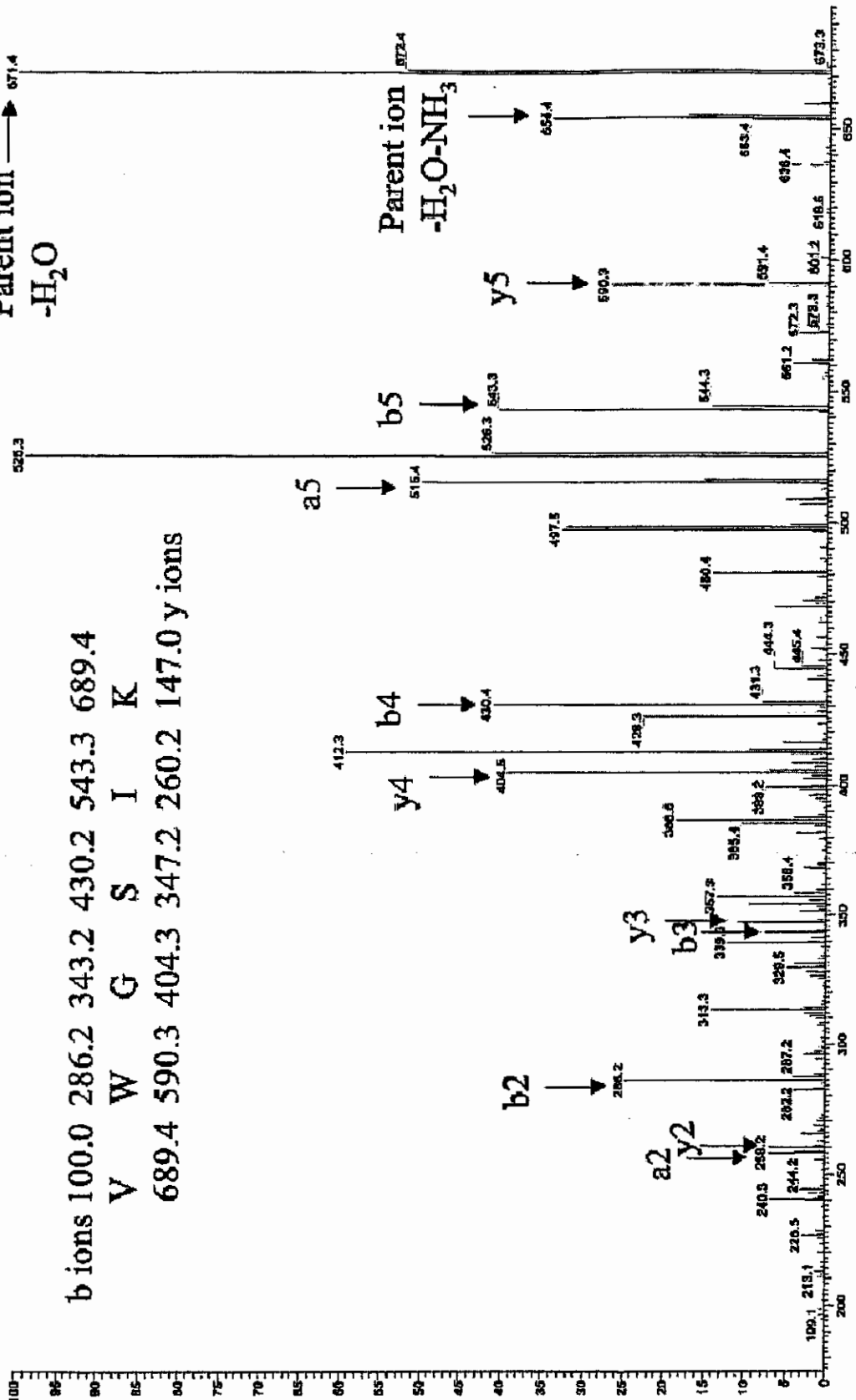

b ions 100.0 286.2 343.2 430.2 543.3 689.4
V W G S I K
689.4 590.3 404.3 347.2 260.2 147.0 y ions
Parent ion
-H2O
Parent ion
-H2O-NH3
a5
b5
y5
b4
y4
b2
y3
b3
a2
y2
m/z

Fig. 10F

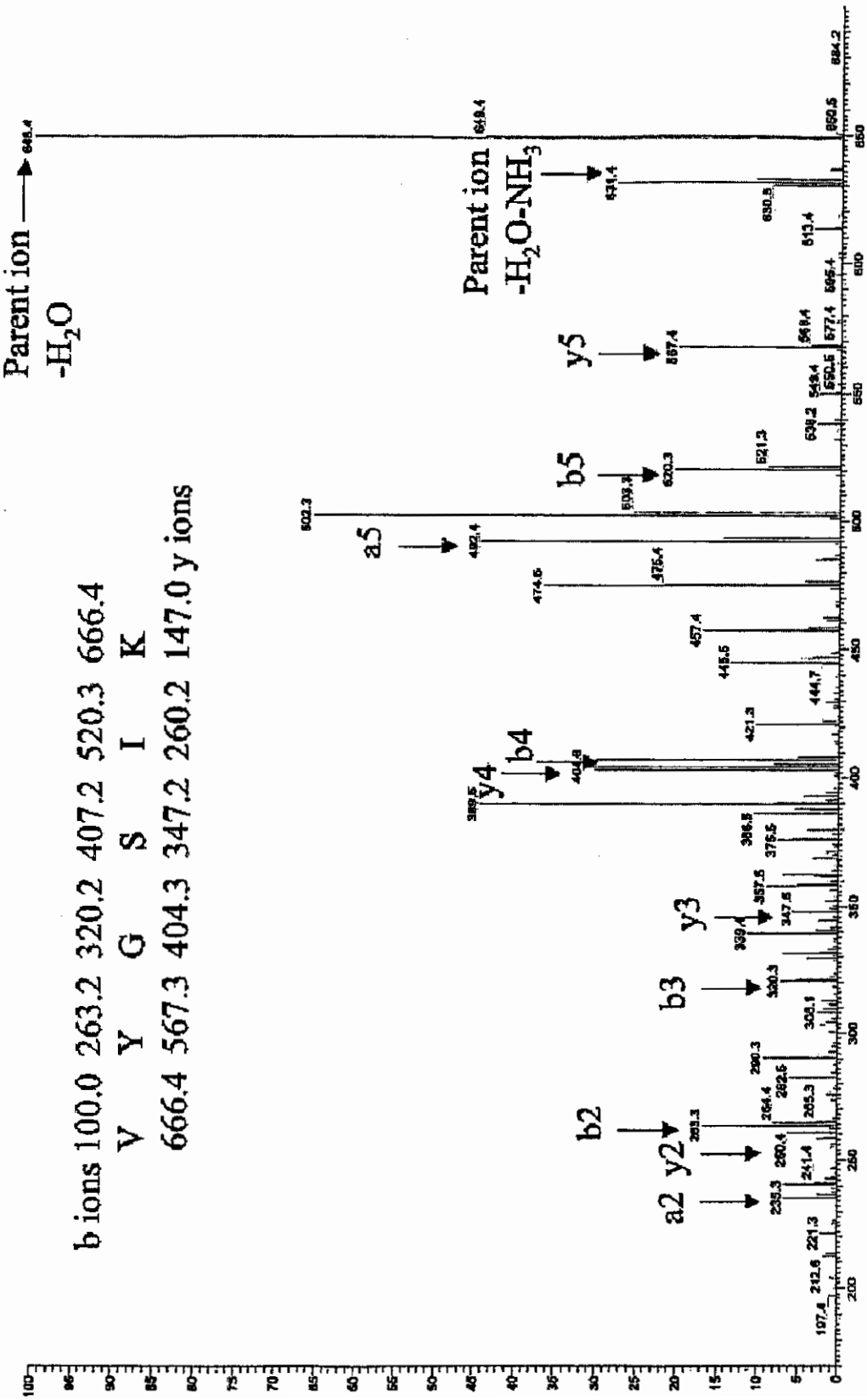

b ions 100.0 263.2 320.2 407.2 520.3 666.4
V Y G S I K
666.4 567.3 404.3 347.2 260.2 147.0 y ions
Parent ion
-H2O
Parent ion
-H2O-NH3
a2 y2 b2 b3 y3 b4 y4 a5 b5 y5
m/z

Fig. 10G

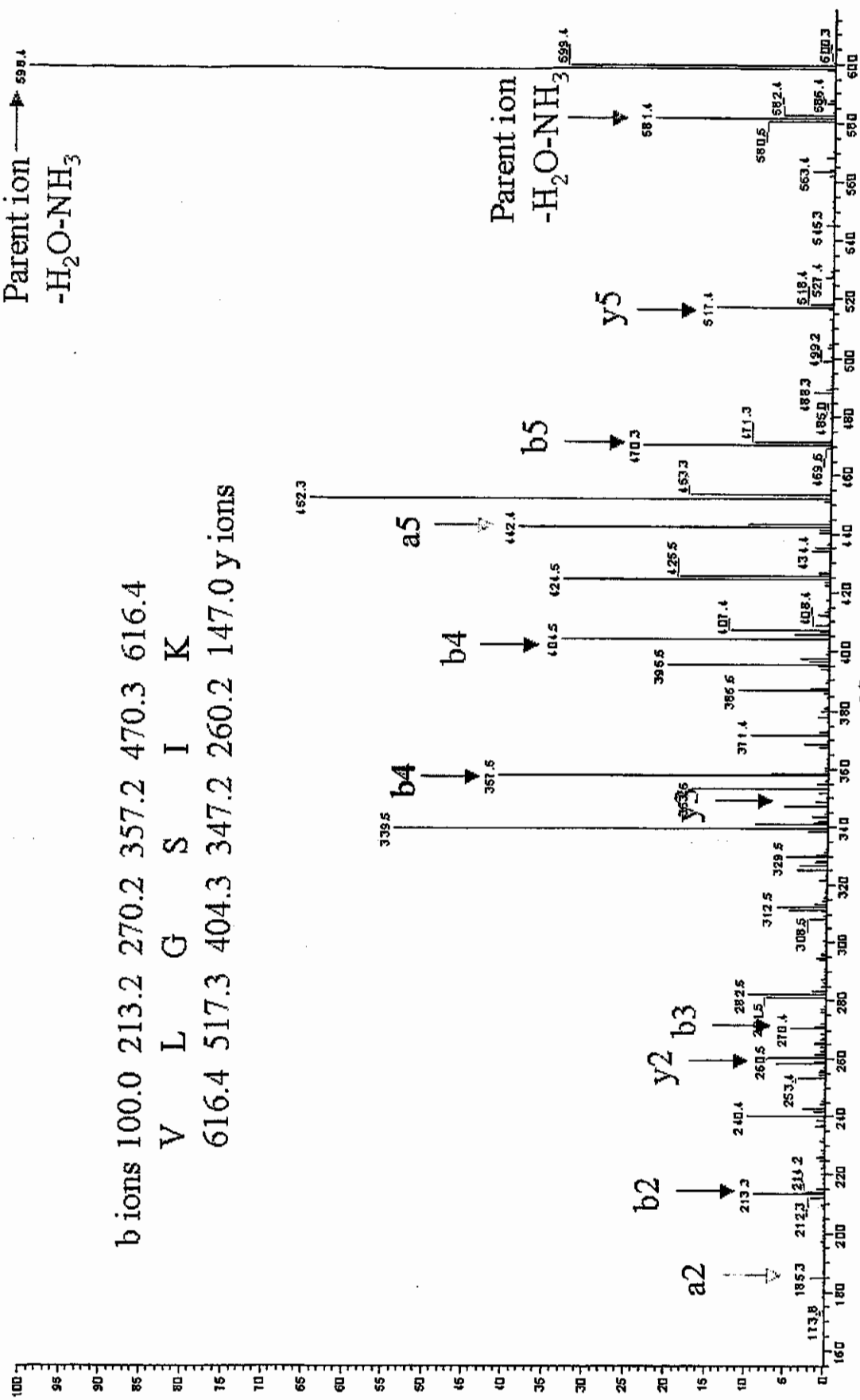
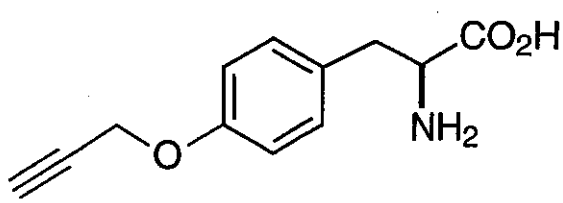
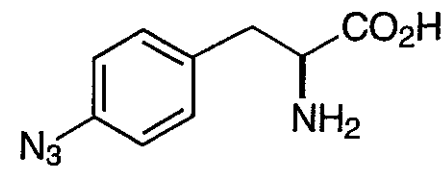

b ions 100.0 213.2 270.2 357.2 470.3 616.4
V L G S I K
616.4 517.3 404.3 347.2 260.2 147.0 y ions
Parent ion
-H2O-NH3
Parent ion
-H2O-NH3
a2
b2
y2
b3
b4
y3
b4
a5
b5
y5
m/z

Fig. 10H



1



2

Fig. 11

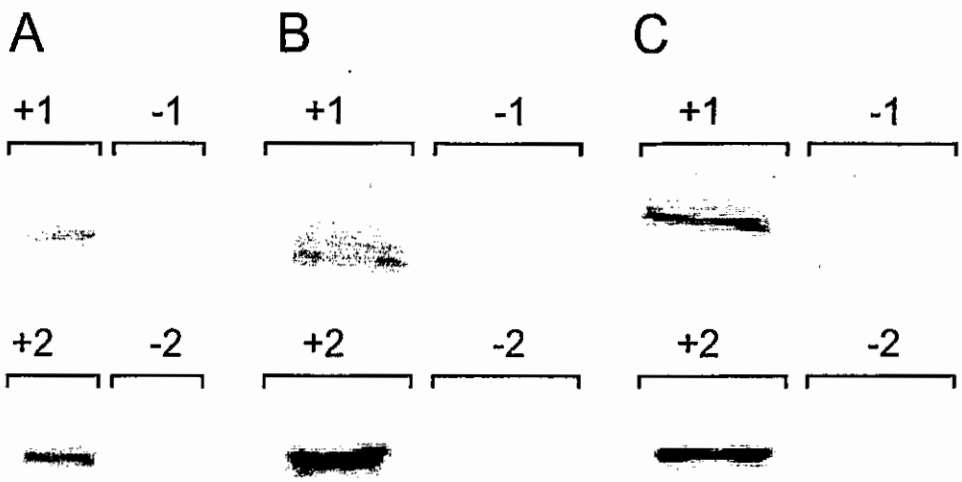
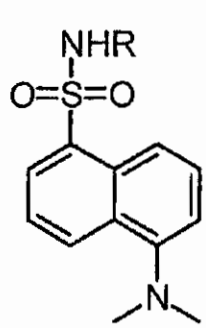
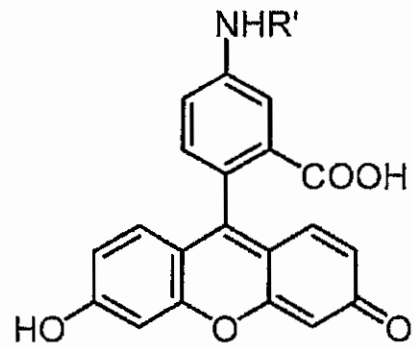


Fig. 12





3: R = CH_2—≡

4: R = $(CH_2)_3N_3$

5: R' = $CO(CH_2)_8$—≡

6: R' = $CO(CH_2)_3CONH(CH_2)_3N_3$

Fig. 13A

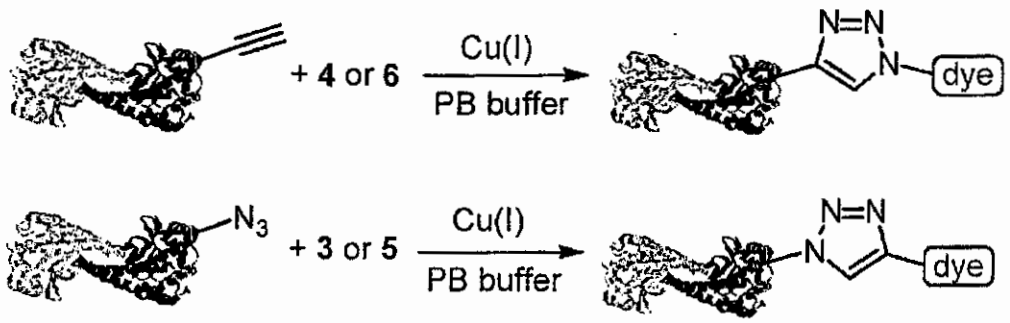


Fig. 13B

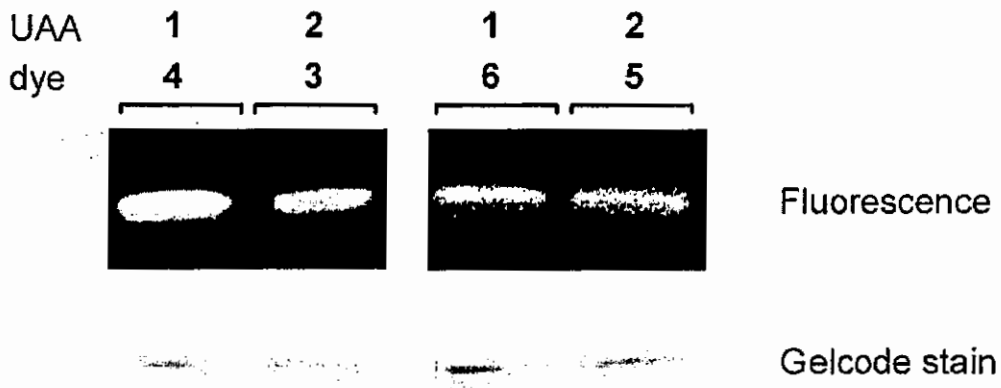


Fig. 13C

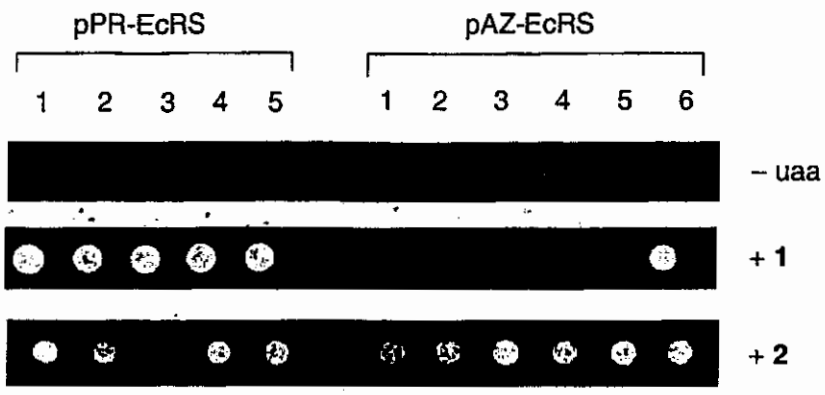


Fig. 14

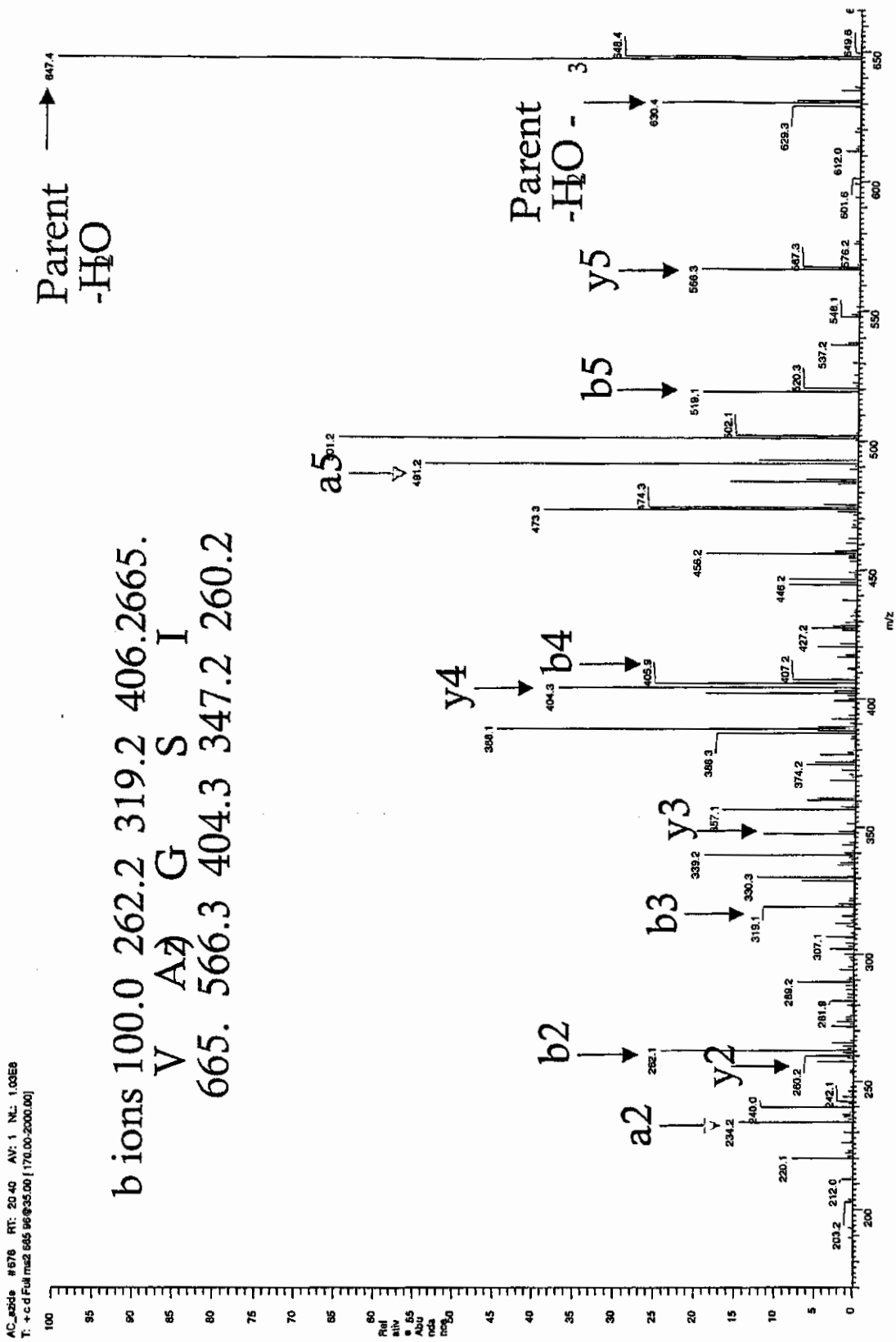

b ions 100.0 262.2 319.2 406.2665.
V A G S I
665. 566.3 404.3 347.2 260.2
Parent -H2O
Parent -H2O - 3
a2
b2
y2
b3
y3
y4
b4
a5
b5
y5
m/z
Relative Abundance

Fig. 15A

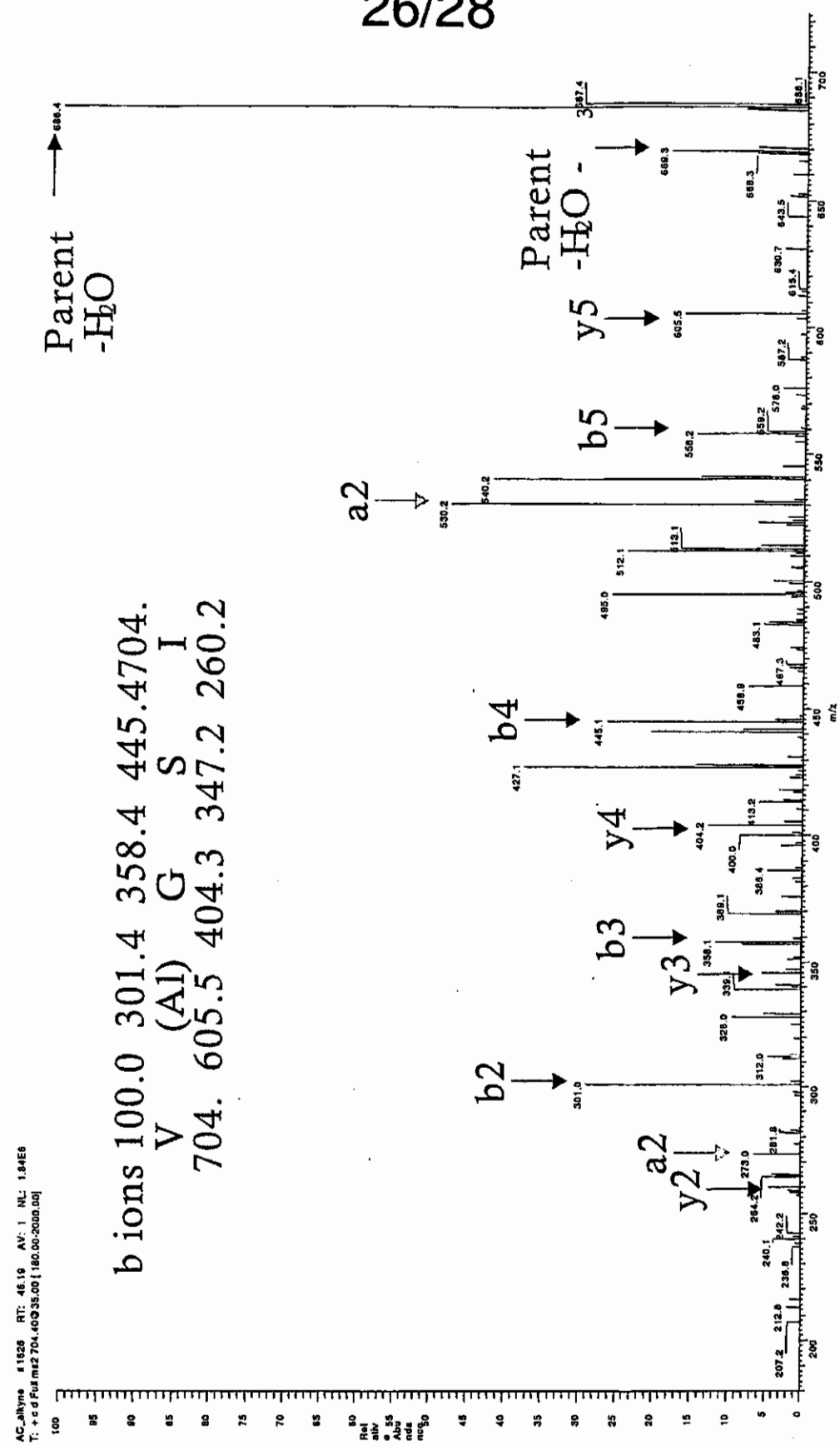

b ions 100.0 301.4 358.4 445.4704.
V (Al) G S I
704. 605.5 404.3 347.2 260.2
Parent -H2O
Parent -H2O -
a2
b2
b3
b4
b5
y2
y3
y4
y5
m/z

Fig. 15B

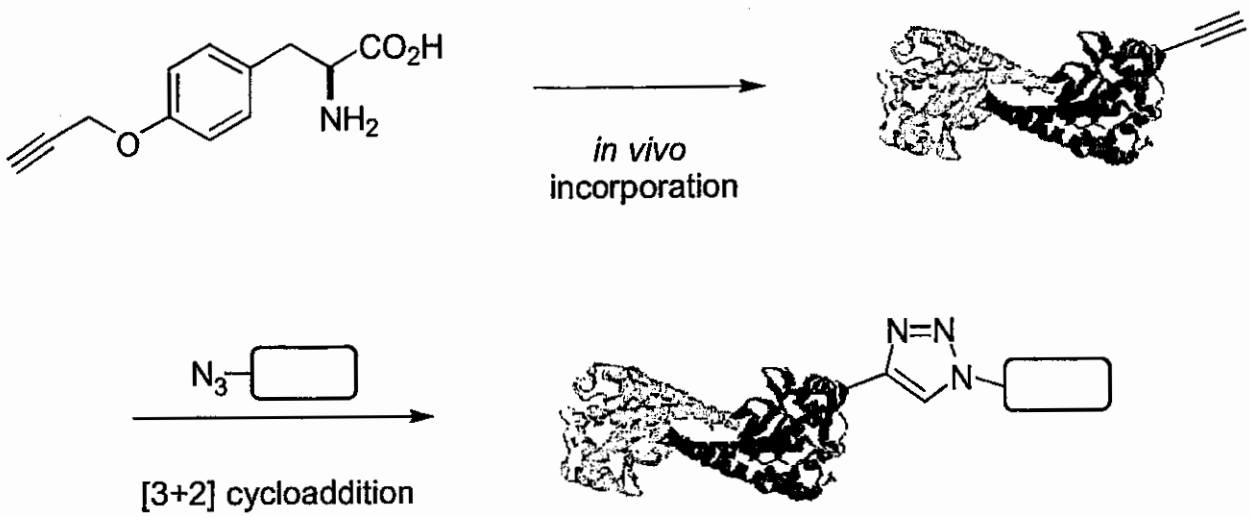


Fig. 16

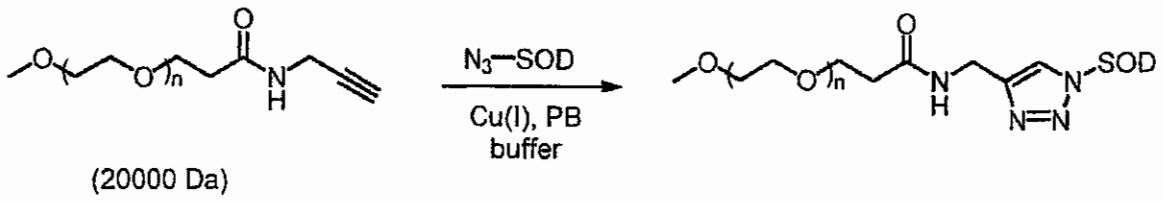


Fig. 17A

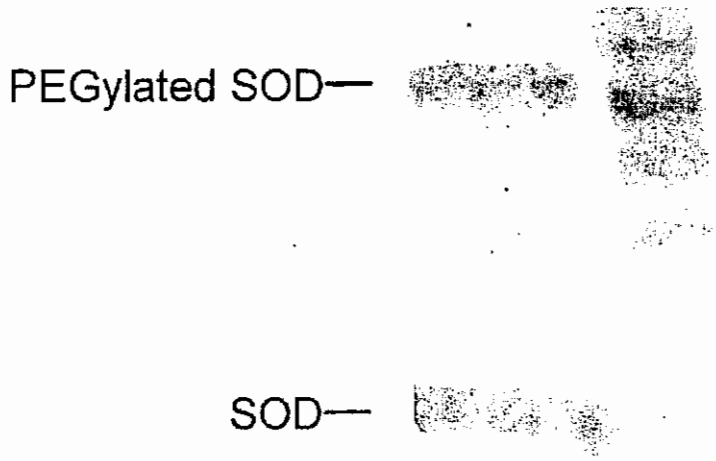


Fig. 17B

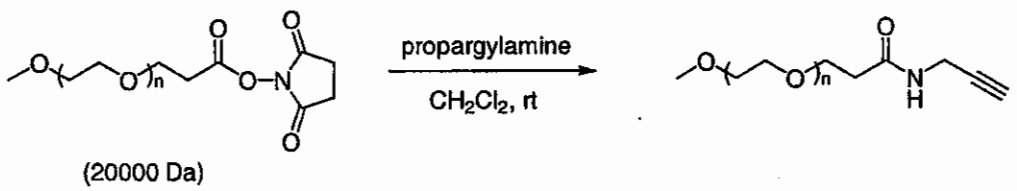


Fig. 17C

SEQUENCE LISTING

<110> The Scripps Research Institute
Chin, Jason W
Cropp, T Ashton
Anderson, J Christopher
Schultz, Peter G

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gctatcgcgg cgaacaacta tgactggttc ggcaatatga atgtgctgac cttcctgcgc 420

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<220>
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<400> 16
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ccgatcgcac tctggtgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180

ggcggcgcga cgggtctgat tggcgacccg agcttcaagg ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaatt gttatgactg gttcggcaat 360

atgaatgtgc tgaccttcct gcgcgatatt ggcaaacact tctccgttaa ccagatgatc 420

aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480

ttttcctaca acctgctgca gggttatatg cgtgcctgtg agaacaaaca gtacggtgtg 540

<210> 17
<211> 624
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<400> 17
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ccgatcgcac tcatttgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180

ggcggcgcga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360

atgaatgtgc tgaccttcct gcgcgatatt ggcaaacact tctccgttaa ccagatgatc 420

aacaaagaag cggttaagca gcgtctcaac cgtgaaggtc aggggatttc gttcactgag 480

ttttcctaca acctgctgca gggttatggt atggcctgtg ctaacaaaca gtacggtgtg 540

gtgctgcaaa ttggtggttc tgaccaatgg ggtaacatca cttctggtat cgacctgacc 600

cgtcgtctgc atcagaatca ggtg 624

<210> 18
<211> 609
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<400> 18
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tgtggcttcg atcctaccgc tgacagcttg catttggggc atcttgttcc attgttatgc 120

ctgaaacgct tccagcaggc gggccacaag ccggttgcgc tggtaggcgg cgcgacgggt 180

ctgattggcg acccgagctt caaagctgcc gagcgtaagc tgaacaccga agaaactgtt 240

caggagtggg tggacaaaat ccgtaagcag gttgccccgt tcctcgattt cgactgtgga 300

gaaaactctg ctatcgcggc caataattat gactggttcg gcaatatgaa tgtgctgacc 360

ttcctgcgcg atattggcaa acacttctcc gttaaccaga tgatcaacaa agaagcggtt 420

aagcagcgtc tcaaccgtga agatcagggg atttcgttca ctgagttttc ctacaacctg 480

ctgcagggtt atggttttgc ctgtttgaac aaacagtacg gtgtggtgct gcaaattggt 540

ggttctgacc agtggggtaa catcacttct ggtatcgacc tgacccgtcg tctgcatcag 600

aatcaggtg 609

<210> 19
<211> 591
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<400> 19
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gctgacagct tgcatttggg gcatcttgtt ccattgttat gcctgaaacg cttccagcag 120

gcgggccaca agccggttgc gctggtaggc ggcgcgacgg gtctgattgg cgacccgagc 180

ttcaaagctg ccgagcgtaa gctgaacacc gaagaaactg ttcaggagtg ggtggacaaa 240

atccgtaagc aggttgcccc gttcctcgat ttcgactgtg gagaaaactc tgctatcgcg 300

gccaataatt atgactggtt cggcaatatg aatgtgctga ccttcctgcg cgatattggc 360

aaacacttct ccgttaacca gatgatcaac aaagaagcgg ttaagcagcg tctcaaccgt 420

gaagatcagg ggatttcgtt cactgagttt tcctacaacc tgctgcaggg ttatggttat 480

gcctgtatga acaaacagta cggtgtggtg ctgcaaattg gtggttctga ccagtggggt 540

aacatcactt ctggtatcga cctgacccgt cgtctgcatc agaatcaggt g 591

<210> 20
<211> 621
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<220>
<221> misc_feature
<222> (26)..(26)
<223> n is a, c, g, or t

<220>
<221> misc_feature
<222> (612)..(612)
<223> n is a, c, g, or t

<220>
<221> misc_feature
<222> (618)..(618)
<223> n is a, c, g, or t

<400> 20
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atcgcactcc tttgtggctt cgatcctacc gctgacagct tgcatttggg gcatcttgtt 120

ccattgttat gcctgaaacg cttccagcag gcgggccaca agccggttgc gctggtaggc 180

ggcgcgacgg gtctgattgg cgacccgagc ttcaaagctg ccgagcgtaa gctgaacacc 240

gaagaaactg ttcaggagtg ggtggacaaa atccgtaagc aggttgcccc gttcctcgat 300

ttcgactgtg gagaaaactc tgctatcgcg gccaataatt atgactggtt cggcaatatg 360

aatgtgctga ccttcctgcg cgatattggc aaacacttct ccgttaacca gatgatcaac 420

aaagaagcgg ttaagcagcg tctcaaccgt gaagatcagg ggatttcgtt cactgagttt 480

tcctacaacc tgctgcaggg ttattctatg gcctgtgcga acaaacagta cggtgtggtg 540

ctgcaaattg gtggttctga ccagtggggt aacatcactt ctggtatcga cctgacccgt 600

cgtctgcatc anaatcangt g 621

<210> 21
<211> 588
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<400> 21
ttagcagagc gactggcgca aggcccgatc gcactcgttt gtggcttcga tcctaccgct 60

gacagcttgc atttggggca tcttgttcca ttgttatgcc tgaaacgctt ccagcaggcg 120

ggccacaagc cggttgcgct ggtaggcggc gcgacgggtc tgattggcga cccgagcttc 180

aaagctgccg agcgtaagct gaacaccgaa gaaactgttc aggagtgggt ggacaaaatc 240

cgtaagcagg ttgccccgtt cctcgatttc gactgtggag aaaactctgc tatcgcggcc 300

aataattatg actggttcgg caatatgaat gtgctgacct tcctgcgcga tattggcaaa 360

cacttctccg ttaaccagat gatcaacaaa gaagcggtta agcagcgtct caaccgtgaa 420

gatcagggga tttcgttcac tgagttttcc tacaacctgc tgcagggtta ttctgcggcc 480

tgtgcgaaca aacagtacgg tgtggtgctg caaattggtg gttctgacca gtggggtaac 540

atcacttctg gtatcgacct gacccgtcgt ctgcatcaga atcaggtg 588

<210> 22
<211> 600
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<220>
<221> misc_feature
<222> (403)..(403)
<223> n is a, c, g, or t

<220>
<221> misc_feature
<222> (513)..(513)
<223> n is a, c, g, or t

<220>
<221> misc_feature
<222> (515)..(515)
<223> n is a, c, g, or t

<220>
<221> misc_feature
<222> (518)..(518)
<223> n is a, c, g, or t

<220>
<221> misc_feature
<222> (531)..(531)
<223> n is a, c, g, or t

<400> 22
gacgaggaag cgttagcaga gcgactggcg caaggcccga tcgcactcct gtgtggcttc 60

gatcctaccg ctgacagctt gcatttgggg catcttgttc cattgttatg cctgaaacgc 120

ttccagcagg cgggccacaa gccggttgcg ctggtaggcg gcgcgacggg tctgattggc 180

gacccgagct tcaaagctgc cgagcgtaag ctgaacaccg aagaaactgt tcaggagtgg 240

gtggacaaaa tccgtaagca ggttgccccg ttcctcgatt tcgactgtgg agaaaactct 300

gctatcgcgg ccaataatta tgactggttc ggcaatatga atgtgctgac cttcctgcgc 360

gatattggca aacacttctc cgttaaccag atgatcaaca aanaagcggt taagcagcgt 420

ctcaaccgtg aagatcaggg gatttcgttc actgagtttt cctacaacct gctgcagggt 480

tattcggctg cctgtgcgaa caaacagtac ggngnggngc tgcaaattgg nggttctgac 540

caggggggta acatcacttc tggtatcgac ctgacccgtc gtctgcatca aaatcaggtg 600

<210> 23
<211> 591
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<220>
<221> misc_feature
<222> (588)..(588)
<223> n is a, c, g, or t

<400> 23
gcgttagcag agcgactggc gcaaggcccg atcgcactcg tttgtggctt cgatcctacc 60

gctgacagct tgcatttggg gcatcttgtt ccattgttgt gcctgaaacg cttccagcag 120

gcgggccaca agccggttgc gctggtaggc ggcgcgacgg gtctgattgg cgacccgagc 180

ttcaaagctg ccgagcgtaa gctgaacacc gaagaaactg ttcaggagtg ggtggacaaa 240

atccgtaagc aggttgcccc gttcctcgat ttcgactgtg gagaaaactc tgctatcgcg 300

gccaataatt atgactggtt cggcaatatg aatgtgctga ccttcctgcg cgatattggc 360

aaacacttct ccgttaacca gatgatcaac aaagaagcgg ttaagcagcg tctcaaccgt 420

gaagatcagg ggatttcgtt cactgagttt tcctacaacc tgctgcaggg ttatagtgcg 480

gcctgtgtta acaaacagta cggtgtggtg ctgcaaattg gtggttctga ccagtggggt 540

aacatcactt ctggtatcga cctgacccgt cgtctgcatc agaatcangt g 591

<210> 24
<211> 600
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<400> 24
gacgaggaag cgttagcaga gcgactggcg caaggcccga tcgcactcat ttgtggcttc 60

gatcctaccg ctgacagctt gcatttgggg catcttgttc cattgttatg cctgaaacgc 120

ttccagcagg cgggccacaa gccggttgcg ctggtaggcg gcgcgacggg tctgattggc 180

gacccgagct tcaaagctgc cgagcgtaag ctgaacaccg aagaaactgt tcaggagtgg 240

gtggacaaaa tccgtaagca ggttgccccg ttcctcgatt tcgactgtgg agaaaactct 300

gctatcgcgg ccaatgatta tgactggttc ggcaatatga atgtgctgac cttcctgcgc 360

gatattggca aacacttctc cgttaaccag atgatcaaca aagaagcggt taagcagcgt 420

ctcaaccgtg aagatcaggg gatttcgttc actgagtttt cctacaacct gctgcagggt 480

tataattttg cctgtgtgaa caaacagtac ggtgtggtgc tgcaaattgg tggttctgac 540

cagtggggta acatcacttc tggtatcgac ctgacccgtc gtctgcatca gaatcaggtg 600

<210> 25
<211> 579
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<400> 25
cgactggcgc aaggcccgat cgcactcacg tgtggcttcg atcctaccgc tgacagcttg 60

catttggggc atcttgttcc attgttatgc ctgaaacgct tccagcaggc gggccacaag 120

ccggttgcgc tggtaggcgg cgcgacgggt ctgattggcg acccgagctt caaagctgcc 180

gagcgtaagc tgaacaccga agaaactgtt caggagtggg tggacaaaat ccgtaagcag 240

gttgccccgt tcctcgattt cgactgtgga gaaaactctg ctatcgcggc caataattat 300

gactggttcg gcaatatgaa tgtgctgacc ttcctgcgcg atattggcaa acacttctcc 360

gttaaccaga tgatcaacaa agaagcggtt aagcagcgtc tcaaccgtga agatcagggg 420

atttcgttca ctgagttttc ctacaatctg ctgcagggtt attcggctgc ctgtcttaac 480

aaacagtacg gtgtggtgct gcaaattggt ggttctgacc agtggggtaa catcacttct 540

ggtatcgacc tgacccgtcg tctgcatcag aatcaggtg 579

<210> 26
<211> 624
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<220>
<221> misc_feature
<222> (13)..(13)

<223> n is a, c, g, or t

<220>
<221> misc_feature
<222> (599)..(599)
<223> n is a, c, g, or t

<400> 26
cgggggctgg tancccaggt gacggacgag gaagcgttag cagagcgact ggcgcaaggc 60

ccgatcgcac tcgggtgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180

ggcggcgcga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360

atgaatgtgc tgaccttcct gcgcgatatt ggcaaacact tctccgttaa ccagatgatc 420

aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480

ttttcctaca acctgctgca gggttattct atggcctgtt tgaacaaaca gtacggtgtg 540

gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctganc 600

cgtcgtctgc atcagaatca ggtg 624

<210> 27
<211> 625
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<220>
<221> misc_feature
<222> (600)..(600)
<223> n is a, c, g, or t

<400> 27
cgggggctgg tagcccaggt gacggacgag gaagcgttag cagagcgact ggcgcaaggc 60

ccgatcgcac tcacgtgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180

ggcggcgcga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360

atgaatgtgc tgaccttcct gcgcgatatt ggcaaacact tctccgttaa ccagatgatc 420

aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480

ttttcctaca atctgctgca gggttattcg gctgcctgtc ttaacaaaca gtacggtgtg 540

gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgaacctgan 600

ccgtcgtctg catcaaaatc aagtg 625

<210> 28
<211> 624
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<400> 28
cgggggctgg taccccaagt gacggacgag gaaacgttag cagagcgact ggcgcaaggc 60

ccgatcgcac tctcttgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttccag caggcaggcc acaagccggt tgcgctggta 180

ggcggcgcga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata ttatgactg gttcggcaat 360

atgaatgtgc tgaccttcct gcgcgatatt ggcaaacact tctccgttaa ccagatgatc 420

aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480

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gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600

cgtcgtctgc atcagaatca ggtg 624

<210> 29
<211> 624
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<400> 29
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ccgatcgcac tcgcgtgcgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180

ggcggcgcga cgggtctgat tggcgacccg agcttcaagg ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata ttatgactg gttcggcaat 360

atgaatgtgc tgaccttcct gcgcgatatt ggcaaacact tctccgttaa ccagatgatc 420

aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480

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gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600

cgtcgtctgc atcagaatca ggtg 624

<210> 30
<211> 624
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<400> 30
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ccgatcgcac tcgcgtgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180

ggcggcgcga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360

atgaatgtgc tgaccttcct gcgcgatatt ggcaaacact tctccgttaa ccagatgatc 420

aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480

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gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600

cgtcgtctgc atcagaatca ggtg 624

<210> 31
<211> 624
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<400> 31
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ccgatcgcac tcacgtgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180

ggcggcgcga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360

atgaatgtgc tgaccttcct gcgcgatatt ggcaaacact tctccgttaa ccagatgatc 420

aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcgctgag 480

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cgtcgtctgc atcagaatca ggtg 624

<210> 32
<211> 606
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<400> 32
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ggcttcgatc ctaccgctga cagcttgcat ttggggcatc ttgttccatt gttatgcctg 120

aaacgcttcc agcaggcggg ccacaagccg gttgcgctgg taggcggcgc gacgggtctg 180

attggcgacc cgagcttcaa agctgccgag cgtaagctga acaccgaaga aactgttcag 240

gagtgggtgg acaaaatccg taagcaggtt gccccgttcc tcgatttcga ctgtggagaa 300

aactctgcta tcgcggccaa taattatgac tggttcggca atatgaatgt gctgaccttc 360

ctgcgcgata ttggcaaaca cttctccgtt aaccagatga tcaacaaaga agcggttaag 420

cagcgtctca accgtgaaga tcaggggatt tcgttcactg agttttccta caatctgctg 480

cagggttatt cggctgcctg tcttaacaaa cagtacggtg tggtgctgca aattggtggt 540

tctgaccagt ggggtaacat cacttctggt atcgacctga cccgtcgtct gcatcagaat 600

caggtg 606

<210> 33
<211> 624
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<400> 33
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ccgatcgcac tcgtttgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180

ggcggcgcga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360

atgaatgtgc tgaccttcct gcgcgatatt ggcaaacact tctccgttaa ccagatgatc 420

aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480

ttttcctaca acctgctgca gggttattcg atggcctgta cgaacaaaca gtacggtgtg 540

gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600

cgtcgtctgc atcagaatca ggtg 624

<210> 34
<211> 624
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<220>
<221> misc_feature
<222> (13)..(13)
<223> n is a, c, g, or t

<400> 34
cgggggctgg tancccaagt gacggacggg gaagcgttag cagagcgact ggcgcaaggc 60

ccgatcgcac tcagttgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180

ggcggcgcga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatctcgact gtggagaaaa ctctgctatc gcggccaata ttatgactg gttcggcaat 360

atgaatgtgc tgaccttcct gcgcgatatt ggcaaacact tctccgttaa ccagatgatc 420

aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480

ttttcctaca acctgctgca gggttatagt tttgcctgtc tgaacaaaca gtacggtgtg 540

gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600

cgtcgtctgc atcagaatca ggtg 624

<210> 35
<211> 624
<212> DNA
<213> artificial

<220>
<223> artificial synthetase

<400> 35
cgggggctgg tagcccaggt gacggacgag gaagcgttag cagagcgact ggcgcaaggc 60

ccgatcgcac tcacgtgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180

ggcggcgcga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata ttatgactg gttcggcaat 360

atgaatgtgc tgaccttcct gcgcgatatt ggcaaacact tctccgttaa ccagatgatc 420

aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480

ttttcctaca acctgctgca gggttatacg tttgcctgta ctaacaaaca gtacggtgtg 540

gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600

cgtcgtctgc atcagaatca ggtg 624

<210> 36
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 36

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Ser Tyr Ala Cys Leu Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly

195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 37
<211> 424
<212> PRT
<213> artificial

<220>

<223> artificial synthetase

<400> 37

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Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1               5                  10                  15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
            20                  25                  30

Pro Ile Ala Leu Ile Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
        35                  40                  45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
    50                  55                  60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65                  70                  75                  80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
                85                  90                  95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
            100                 105                 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
        115                 120                 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
    130                 135                 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145                 150                 155                 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
                165                 170                 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Leu Asn Lys Gln Tyr Gly Val
            180                 185                 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
        195                 200                 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
    210                 215                 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
```

245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 38
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 38

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

```
Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
        35                  40                  45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
    50                  55                  60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65                  70                  75                  80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
                85                  90                  95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
            100                 105                 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
        115                 120                 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
    130                 135                 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145                 150                 155                 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
                165                 170                 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Ala Asn Lys Gln Tyr Gly Val
            180                 185                 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
        195                 200                 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
    210                 215                 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
            260                 265                 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
        275                 280                 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala
```

290 295 300

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 39
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 39

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

```
Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
                85                  90                  95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
            100                 105                 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
        115                 120                 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
    130                 135                 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145                 150                 155                 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
                165                 170                 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Leu Asn Lys Gln Tyr Gly Val
            180                 185                 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
        195                 200                 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
    210                 215                 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
            260                 265                 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
        275                 280                 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
                325                 330                 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
```

340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 40
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 40

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Thr Met Ala Cys Leu Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu

385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 41
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 41

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Thr Tyr Ala Cys Leu Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 42

<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 42

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Leu Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Ser Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 43
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 43

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

```
Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
            20                  25                  30

Pro Ile Ala Leu Leu Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
        35                  40                  45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
    50                  55                  60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65                  70                  75                  80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
                85                  90                  95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
            100                 105                 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
        115                 120                 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
    130                 135                 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145                 150                 155                 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
                165                 170                 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Ala Asn Lys Gln Tyr Gly Val
            180                 185                 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
        195                 200                 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
    210                 215                 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
            260                 265                 270
```

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 44
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 44

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

```
Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65                  70                  75                  80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
                85                  90                  95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
            100                 105                 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
        115                 120                 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
    130                 135                 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145                 150                 155                 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
                165                 170                 175

Leu Leu Gln Gly Tyr Arg Met Ala Cys Leu Asn Lys Gln Tyr Gly Val
            180                 185                 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
        195                 200                 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
    210                 215                 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
            260                 265                 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
        275                 280                 285

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

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala
305                 310                 315                 320
```

```
Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
                325                 330                 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
            340                 345                 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
    370                 375                 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385                 390                 395                 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
                405                 410                 415

Asn Tyr Cys Leu Ile Cys Trp Lys
            420
```

<210> 45
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 45

```
Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1               5                   10                  15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
            20                  25                  30

Pro Ile Ala Leu Ile Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
        35                  40                  45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
    50                  55                  60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65                  70                  75                  80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
                85                  90                  95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
            100                 105                 110
```

```
Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
        115                 120                 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
    130                 135                 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145                 150                 155                 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
                165                 170                 175

Leu Leu Gln Gly Tyr Gly Met Ala Cys Ala Asn Lys Gln Tyr Gly Val
            180                 185                 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
        195                 200                 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
    210                 215                 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
            260                 265                 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
        275                 280                 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
                325                 330                 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
            340                 345                 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 46
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 46

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Gly Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Gly Phe Ala Cys Ala Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 47
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 47

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Gly Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Gly Tyr Ala Cys Met Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

```
Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
    210                 215                 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
            260                 265                 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
        275                 280                 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
                325                 330                 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
            340                 345                 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
    370                 375                 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385                 390                 395                 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
                405                 410                 415

Asn Tyr Cys Leu Ile Cys Trp Lys
            420
```

<210> 48
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 48

```
Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1               5                  10                  15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
            20                  25                  30

Pro Ile Ala Leu Leu Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
        35                  40                  45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
    50                  55                  60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65                  70                  75                  80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
                85                  90                  95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
            100                 105                 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
        115                 120                 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
    130                 135                 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145                 150                 155                 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
                165                 170                 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Ala Asn Lys Gln Tyr Gly Val
            180                 185                 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
        195                 200                 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
    210                 215                 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255
```

```
Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
            260                 265                 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
        275                 280                 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
                325                 330                 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
            340                 345                 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
    370                 375                 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385                 390                 395                 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
                405                 410                 415

Asn Tyr Cys Leu Ile Cys Trp Lys
            420
```

<210> 49
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 49

```
Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1               5                   10                  15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
            20                  25                  30

Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
        35                  40                  45
```

```
Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
    50                  55                  60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65                  70                  75                  80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
                85                  90                  95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
            100                 105                 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
        115                 120                 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
    130                 135                 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145                 150                 155                 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
                165                 170                 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Ala Asn Lys Gln Tyr Gly Val
            180                 185                 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
        195                 200                 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
    210                 215                 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
            260                 265                 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
        275                 280                 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala
    290                 295                 300
```

```
Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala
305                 310                 315                 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
                325                 330                 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
            340                 345                 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
    370                 375                 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385                 390                 395                 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
                405                 410                 415

Asn Tyr Cys Leu Ile Cys Trp Lys
            420

<210>  50
<211>  424
<212>  PRT
<213>  artificial

<220>
<223>  artificial synthetase

<400>  50

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1               5                   10                  15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
            20                  25                  30

Pro Ile Ala Leu Leu Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
        35                  40                  45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
    50                  55                  60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65                  70                  75                  80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
                85                  90                  95
```

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Ala Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 51
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 51

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

```
His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145                 150                 155                 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
                165                 170                 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Val Asn Lys Gln Tyr Gly Val
            180                 185                 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
        195                 200                 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
    210                 215                 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
            260                 265                 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
        275                 280                 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
                325                 330                 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
            340                 345                 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
    370                 375                 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385                 390                 395                 400
```

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 52
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 52

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Ile Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asp Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Asn Phe Ala Cys Val Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 53
<211> 424
<212> PRT

<213> artificial

<220>
<223> artificial synthetase

<400> 53

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Leu Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

```
Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
            260                 265                 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
        275                 280                 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
                325                 330                 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
            340                 345                 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
    370                 375                 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385                 390                 395                 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
                405                 410                 415

Asn Tyr Cys Leu Ile Cys Trp Lys
            420
```

<210> 54
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 54

```
Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1               5                   10                  15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
```

20 25 30

Pro Ile Ala Leu Gly Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Leu Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

```
Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala
    290                 295                 300

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
                325                 330                 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
            340                 345                 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
    370                 375                 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385                 390                 395                 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
                405                 410                 415

Asn Tyr Cys Leu Ile Cys Trp Lys
            420

<210>  55
<211>  424
<212>  PRT
<213>  artificial

<220>
<223>  artificial synthetase

<400>  55

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1               5                   10                  15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
            20                  25                  30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
        35                  40                  45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
    50                  55                  60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
```

65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Leu Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

```
Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
            340                 345                 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
    370                 375                 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385                 390                 395                 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
                405                 410                 415

Asn Tyr Cys Leu Ile Cys Trp Lys
            420
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<210> 56
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 56

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Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1               5                   10                  15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
            20                  25                  30

Pro Ile Ala Leu Ser Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
        35                  40                  45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
    50                  55                  60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65                  70                  75                  80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
                85                  90                  95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
            100                 105                 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
```

115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Thr Met Ala Cys Val Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 57
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 57

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Ala Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn

165 170 175

Leu Leu Gln Gly Tyr Ser Tyr Ala Cys Leu Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 58
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 58

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Ala Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Thr Met Ala Cys Cys Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr

210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 59
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 59

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Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1               5                  10                  15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
            20                  25                  30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
        35                  40                  45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
    50                  55                  60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65                  70                  75                  80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
                85                  90                  95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
            100                 105                 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
        115                 120                 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
    130                 135                 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145                 150                 155                 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
                165                 170                 175

Leu Leu Gln Gly Tyr Thr Phe Ala Cys Met Asn Lys Gln Tyr Gly Val
            180                 185                 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
        195                 200                 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
    210                 215                 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
```

260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 60
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 60

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

```
Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
    50                  55                  60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65                  70                  75                  80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
                85                  90                  95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
            100                 105                 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
        115                 120                 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
    130                 135                 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145                 150                 155                 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
                165                 170                 175

Leu Leu Gln Gly Tyr Ser Val Ala Cys Leu Asn Lys Gln Tyr Gly Val
            180                 185                 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
        195                 200                 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
    210                 215                 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
            260                 265                 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
        275                 280                 285

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

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala
```

305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 61
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 61

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Thr Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu

355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 62
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 62

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Ser Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

```
His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145                 150                 155                 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
                165                 170                 175

Leu Leu Gln Gly Tyr Ser Phe Ala Cys Leu Asn Lys Gln Tyr Gly Val
            180                 185                 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
        195                 200                 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
    210                 215                 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
            260                 265                 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
        275                 280                 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
                325                 330                 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
            340                 345                 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
    370                 375                 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385                 390                 395                 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
```

405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 63
<211> 424
<212> PRT
<213> artificial

<220>
<223> artificial synthetase

<400> 63

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Thr Phe Ala Cys Thr Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
275 280 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
340 345 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys
420

<210> 64
<211> 129
<212> DNA
<213> Escherichia coli

<400> 64
agcttcccga taagggagca ggccagtaaa aagcattacc ccgtggtggg gttcccgagc 60

ggccaaaggg agcagactct aaatctgccg tcatcgacct cgaaggttcg aatccttccc 120

ccaccacca 129

<210> 65
<211> 129
<212> RNA
<213> Escherichia coli

<400> 65
agcuucccga uaagggagca ggccaguaaa aagcauuacc ccgugguggg guucccgagc 60

ggccaaaggg agcagacucu aaaucugccg ucaucgaccu cgaagguucg aauccuuccc 120

ccaccacca 129

<210> 66
<211> 34
<212> DNA
<213> artificial

<220>
<223> oligonucleotide primer

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1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly
20 25 30

Pro Ile Ala Leu Ile Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg
145 150 155 160

Leu Asn Arg Glu Gly Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn
165 170 175

Leu Leu Gln Gly Tyr Gly Met Ala Cys Ala Asn Lys Gln Tyr Gly Val
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr
210 215 220

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Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu
225                 230                 235                 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe
                245                 250                 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu
            260                 265                 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu
        275                 280                 285

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

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

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser
                325                 330                 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu
            340                 345                 350

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

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile
    370                 375                 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu
385                 390                 395                 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys
                405                 410                 415

Asn Tyr Cys Leu Ile Cys Trp Lys
            420

<210>  87
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<212>  PRT
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<220>
<223>  tryptic peptide including unnatural amino acids

<220>
<221>  MISC_FEATURE
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<222> (2)..(2)
<223> X is an unnatural amino acid (p-acetyl-L-phenylalanine, p-benzoyl-L-phenylalanine, p-azido-L-phenylalanine, O-methyl-L-tyrosine, or p-iodo-L-phenylalanine) or trypotophan, tyrosine, or leucine

<400> 87

Val Xaa Gly Ser Ile Lys
1 5

<210> 88
<211> 11
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<213> artificial

<220>
<223> B box

<220>
<221> misc_feature
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<223> n is a, c, g, or t

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ggttcgantc c 11

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ttaccccgtg gtgggttccc ga 82

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ttttgaaaaa aatggtggtg ggggaaggat 90

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<220>
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<220>
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<223> n=I

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aatcaagg 68

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ac 62

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gagaattcat ggcaagcagt aacttg 86

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agcaaatcag ac 72

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<210> 104
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