

<110> CJ CheilJedang Corporation

<120> VARIANT OF GENUS YARROWIA AND METHOD OF PREPARING FAT USING THE
SAME

<130> OPA20210

<150> KR 10-2020-0029137

<151> 2020-03-09

<160> 82

<170> KoPatentIn 3.0

<210> 1

<211> 2829

<212> DNA

<213> Yarrowia lipolytica

<400> 1

atggccgttc cttctgctgc catcaaggct tccggagtgg atatggggga cctcaagaag 60

agacatgaca ccaagcttga cgtggaggag agtgtgattg acgagaagat caatgagaat 120

gaaagcgacg aaaagctgac cgaaaagctg accgaaaagc tgaccgaaaa gctgactgaa 180

aagacctcca ccgagcccat tgcttacgtt ggcaagtgtc ctgatggaac gacttttatt 240

gtgccagaga cggaggatat gttgaccaac ctgtttgatc ctcgaatcac aaagtcgctg 300

acggacgtga tcacgtatc gattctggc acattcatgg gactctttt tgcgtcccc	360
aagtctgga gtagctct ctatctgtt ctgttgccg catggcgtct ggcctacaac	420
ggaggaatcg gctggctact tcacaaccag tccaactacc acaaactcac caagtgggct	480
ctcaaataca aggtgttga caaggacaac aagacgtgg ggcaccagct gattaagcgg	540
gagttgaga cccggttcca gaaccagccc aactactcgt tctacgaggt acccgtcgag	600
ttcaacacct ggattcttt ccgacatgtg gtcgatctga ttctcatgtc agactttacc	660
tgctacttca tgctggcctg gtcctgcgt ctgtccgtga gaaccaacca gccctgggtg	720
cttgtattg gacgatggct cgccggagct ctaatgctag cctcaacct gtgggctaag	780
actgacgccc accgagtcgt caaggattat gcctggctact ggggagactt cttctctc	840
aaggacatgg agttgactt tgatgggtgc ttgagatgg cccctcatcc catgtactcc	900
attggatacg ctggttcta cgccgcctct ctcatggcct gttcctacac cctgttctg	960
gcctctctgg ccggccacgc tgcccagttt gtgttctat ccatcgttga gaacctcac	1020
attgaaaaga ctacaaccc ccatcagccc aagcagcgac gaaaggcttc tcacgtccga	1080
gaccgatctt ccatccagct ggggctcgat cagaaacaga aggatgagct gtctgctatt	1140

gttgagggcg acgagtccgt ttctattgcc tctactcca ttctactac tttgacgag	1200
ccggagactg tccagaaaca ctcccttcct ccgttggtg tgtttagcaa ctccagatc	1260
actcgagtca cagatatcat gactgtggga gctgcagtct atacaatgct gctctactc	1320
ctccctgcc accgtctgtg gtacactgtg actttttca tggctctgtc tgctcgtctt	1380
ttccacactc tgggtcttg agtcatactg cgacgacagt ccgagcgacg atccttcacc	1440
aagacctcc tcaagtttg aatctacccc ttgaggcat acgagcagtg gcaagtgtgg	1500
tacaacgtct ccaccgtgtg gtcctacacc acattggtc tctttgcct gcgacagtgg	1560
agagctcctt ccaccgatcc tctgtggccc cttaagtaca ttctggcgc tctactatt	1620
gctctgcatg gctggacatc gaagtccatc catgactctc ttgggcattt tggatggtc	1680
tacggtgact tcttcctga ccgaaagcag aacctcactt actccggcat ttacagatac	1740
ctcaacaacc cagagcgatt ttccgtatt gctggcatct ggggtctgc tctgatgacc	1800
aactctccag gtgttggtat ttggccttc ttgtggactc tggagggat ggcattcatc	1860
aagttcgtcg agcagcccca catgcagcga atctacggta ccagtatccg acacgatgct	1920
ggtgtgacca agaccattaa gaactcttc aagttgcctt ctcccttga gaaacgggtt	1980
cgacagtcc agggatccgt tgacaagggt atcaacgata ctctgactgt ggtcgaggag	2040

ttcattggac ttgccaagcc tactctcaac gaagttgtca acgactccaa gatcctgttg	2100
cgacagtacc ctgccaaact tacccttact cgaatgctgg atgttcccga aaacattgac	2160
actgccgatt actctgtgaa gctcgtgggc ggcgagaagt gtgccgattc caaccgaatt	2220
tcgtacgcct ttggaacccc cattcatgtc aagtggcagg cttctccaa cagatcggca	2280
aaggactgga tcggtctgta ccgagtgcac gacaacactt ccctgaggt gacttcttt	2340
ccctcaagg gccgatggc tggaatcgac gagactggcc atgagtcgca tctcgacggt	2400
attgtgtcgt cttctaagac caatggagaa gttgtttcc gaggggacac actcttctgg	2460
gagtgtggag tctacgagtt cagataccac catgctggca agcacactgt gctcagcacc	2520
tcggaacctt tcgagattgt ggctcctaag attgatctat ctggagaggt ggatgcaaag	2580
actctggctc ttgagatcct ccccatcgtc cagcgatgct tctctctatc tatggagttc	2640
cctcctgagg aagtggacga ctactgggct cttgaggaac ccaaggtgat caacagagtg	2700
caggctgccg ttcaggcgta tttaacggt gagctggcgc aggaggtgct tcaatcggat	2760
gagtctgtgg agaatttggc tgagcgactg ctcagaatta gagacgccct taaaggtctt	2820
actgtataa	2829

<210> 2

<211> 942

<212> PRT

<213> Yarrowia lipolytica

<400> 2

Met Ala Val Pro Ser Ala Ala Ile Lys Ala Ser Gly Val Asp Met Gly

1 5 10 15

Asp Leu Lys Lys Arg His Asp Thr Lys Leu Asp Val Glu Glu Ser Val

20 25 30

Ile Asp Glu Lys Ile Asn Glu Asn Glu Ser Asp Glu Lys Leu Thr Glu

35 40 45

Lys Leu Thr Glu Lys Leu Thr Glu Lys Leu Thr Glu Lys Thr Ser Thr

50 55 60

Glu Pro Ile Ala Tyr Val Gly Lys Cys Pro Asp Gly Thr Thr Phe Ile

65 70 75 80

Val Pro Glu Thr Glu Asp Met Leu Thr Asn Leu Phe Asp Pro Arg Ile

85 90 95

Thr Lys Ser Leu Thr Asp Val Ile Ile Val Ser Ile Leu Val Thr Phe

100 105 110

Met Gly Leu Phe Phe Val Val Pro Lys Ser Trp Arg Val Pro Leu Tyr

115	120	125	
Leu Phe Leu Phe Ala Ala Trp Arg Leu Ala Tyr Asn Gly Gly Ile Gly			
130	135	140	
Trp Leu Leu His Asn Gln Ser Asn Tyr His Lys Leu Thr Lys Trp Ala			
145	150	155	160
Leu Lys Tyr Lys Val Phe Asp Lys Asp Asn Lys Thr Trp Trp His Gln			
	165	170	175
Leu Ile Lys Arg Glu Phe Glu Thr Arg Phe Gln Asn Gln Pro Asn Tyr			
	180	185	190
Ser Phe Tyr Glu Val Pro Val Glu Phe Asn Thr Trp Ile Leu Phe Arg			
195	200	205	
His Val Val Asp Leu Ile Leu Met Ser Asp Phe Thr Cys Tyr Phe Met			
210	215	220	
Leu Ala Trp Ser Cys Ala Leu Ser Val Arg Thr Asn Gln Pro Trp Trp			
225	230	235	240
Leu Val Ile Gly Arg Trp Leu Ala Gly Ala Leu Met Leu Ala Phe Asn			
	245	250	255
Leu Trp Ala Lys Thr Asp Ala His Arg Val Val Lys Asp Tyr Ala Trp			
260	265	270	

Tyr Trp Gly Asp Phe Phe Phe Leu Lys Asp Met Glu Leu Thr Phe Asp

275

280

285

Gly Val Phe Glu Met Ala Pro His Pro Met Tyr Ser Ile Gly Tyr Ala

290

295

300

Gly Phe Tyr Ala Ala Ser Leu Met Ala Cys Ser Tyr Thr Leu Phe Leu

305

310

315

320

Ala Ser Leu Ala Gly His Ala Ala Gln Phe Val Phe Leu Ser Ile Val

325

330

335

Glu Asn Pro His Ile Glu Lys Thr Tyr Asn Pro His Gln Pro Lys Gln

340

345

350

Arg Arg Lys Ala Ser His Val Arg Asp Arg Ser Ser Ile Gln Leu Gly

355

360

365

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

370

375

380

Glu Ser Val Ser Ile Ala Ser Thr Pro Ile Ser Thr Thr Phe Asp Glu

385

390

395

400

Pro Glu Thr Val Gln Lys His Ser Leu Pro Pro Leu Val Val Phe Ser

405

410

415

Asn Phe Gln Ile Thr Arg Val Thr Asp Ile Met Thr Val Gly Ala Ala

420

425

430

Val Tyr Thr Met Leu Leu Tyr Phe Leu Pro Ala Asn Arg Leu Trp Tyr

435

440

445

Thr Val Thr Phe Phe Met Ala Leu Ser Ala Arg Leu Phe His Thr Leu

450

455

460

Gly Leu Gly Val Ile Leu Arg Arg Gln Ser Glu Arg Arg Ser Phe Thr

465

470

475

480

Lys Thr Phe Leu Lys Phe Gly Ile Tyr Pro Phe Glu Ala Tyr Glu Gln

485

490

495

Trp Gln Val Trp Tyr Asn Val Ser Thr Val Leu Ser Tyr Thr Thr Phe

500

505

510

Gly Leu Phe Cys Leu Arg Gln Trp Arg Ala Pro Ser Thr Asp Pro Leu

515

520

525

Trp Pro Leu Lys Tyr Ile Leu Gly Ala Leu Leu Ile Ala Leu His Gly

530

535

540

Trp Thr Ser Lys Ser Ile His Asp Ser Leu Gly His Phe Gly Trp Phe

545

550

555

560

Tyr Gly Asp Phe Phe Leu Asp Arg Lys Gln Asn Leu Thr Tyr Ser Gly

565

570

575

Ile Tyr Arg Tyr Leu Asn Asn Pro Glu Arg Phe Phe Gly Ile Ala Gly

580	585	590	
Ile Trp Gly Leu Ala Leu Met Thr Asn Ser Pro Gly Val Gly Ile Leu			
595	600	605	
Ala Phe Leu Trp Thr Leu Glu Gly Met Ala Phe Ile Lys Phe Val Glu			
610	615	620	
Gln Pro His Met Gln Arg Ile Tyr Gly Thr Ser Ile Arg His Asp Ala			
625	630	635	640
Gly Val Thr Lys Thr Ile Lys Asn Ser Leu Lys Leu Pro Ser Pro Phe			
645	650	655	
Glu Lys Arg Val Arg Gln Phe Gln Gly Ser Val Asp Lys Val Ile Asn			
660	665	670	
Asp Thr Leu Thr Val Val Glu Glu Phe Ile Gly Leu Ala Lys Pro Thr			
675	680	685	
Leu Asn Glu Val Val Asn Asp Ser Lys Ile Leu Leu Arg Gln Tyr Pro			
690	695	700	
Ala Lys Leu Thr Leu Thr Arg Met Leu Asp Val Pro Glu Asn Ile Asp			
705	710	715	720
Thr Ala Asp Tyr Ser Val Lys Leu Val Gly Gly Glu Lys Cys Ala Asp			
725	730	735	

Ser Asn Arg Ile Ser Tyr Ala Phe Gly Thr Pro Ile His Val Lys Trp

740

745

750

Gln Ala Ser Pro Asn Arg Ser Ala Lys Asp Trp Ile Gly Leu Tyr Arg

755

760

765

Val His Asp Asn Thr Ser Pro Glu Val Thr Ser Leu Pro Ser Lys Gly

770

775

780

Arg Trp Ser Gly Ile Asp Glu Thr Gly His Glu Ser His Leu Asp Gly

785

790

795

800

Ile Val Ser Ser Ser Lys Thr Asn Gly Glu Val Val Phe Arg Gly Asp

805

810

815

Thr Leu Phe Trp Glu Cys Gly Val Tyr Glu Phe Arg Tyr His His Ala

820

825

830

Gly Lys His Thr Val Leu Ser Thr Ser Glu Pro Phe Glu Ile Val Ala

835

840

845

Pro Lys Ile Asp Leu Ser Gly Glu Val Asp Ala Lys Thr Leu Ala Leu

850

855

860

Glu Ile Leu Pro Ile Val Gln Arg Cys Phe Ser Leu Ser Met Glu Phe

865

870

875

880

Pro Pro Glu Glu Val Asp Asp Tyr Trp Ala Leu Glu Glu Pro Lys Val

885

890

895

Ile Asn Arg Val Gln Ala Ala Val Gln Ala Tyr Phe Asn Val Glu Leu

900

905

910

Ala Gln Glu Val Leu Gln Ser Asp Glu Ser Val Glu Asn Leu Ala Glu

915

920

925

Arg Leu Leu Arg Ile Arg Asp Ala Leu Lys Gly Leu Thr Val

930

935

940

<210> 3

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> CHO2_5_For

<400> 3

gtacccgggg atcctctaga gtcacccgca aacacaacac

40

<210> 4

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> CHO2_5_Rev

<400> 4

gcaatgacga gtcagacagg ggtgtttgtg gaagctggtg

40

<210> 5

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> CHO2_URA_For

<400> 5

caccagcttc cacaaacacc cctgtctgac tcgtcattgc

40

<210> 6

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> CHO2_URA_Rev

<400> 6

cgcattctgc gtacatttg ctggtggtat tgtgactggg

40

<210> 7

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> CHO2_5RP_For

<400> 7

cccagtcaca ataccaccag caaaatgtac gcagaatgcg

40

<210> 8

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> CHO2_5RP_Rev

<400> 8

cagatatgct ctctgcaaac ggtgtttgtg gaagctggtg

40

<210> 9

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> CHO2_3_For

<400> 9

caccagcttc cacaaacacc gtttcagag agcatatctg

40

<210> 10

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> CHO2_3_Rev

<400> 10

gcaggctgac tctagagaga ggtctgttca caacatcggc

40

<210> 11

<211> 627

<212> DNA

<213> *Yarrowia lipolytica*

<400> 11

atgtccttct ctgacaagat tgttgccgac ttcaacgtgg attacgacca gaagagcctc 60

tggatcgctc tgggctccat cgccttcaac cccatctttt ggaacattgt tgctcgagcc 120

gagtacaaca cccactttct gactaagctg gctggaggag ccaagaccgg atgctatctg 180

ctggccatca ccattttctc gctcggatc ttccgagact acctttacca ccaggctctt 240

gagcagcagc ccacctccat tctgctgtcg gtcacttacg ttgacattgt caagcctctg 300

gccattgtgc tgttgctgtg tggcaacgtg ctggtcctta cctccatgta cgcctggggc 360

gtcaccggaa cctacctcgg cgactacttt ggcatttca tgaacgagcg agtcaccggc 420

ttccccttca atgtgtccaa caaccccatg taccacggct ccactctgtg ttcctggct 480

tccgctctgt ggtacgcaa gccgcaggc ctgctcatca ccgccttgt gtcgctcatg 540

tactccattg ctctcaagtt cgaggaaccc ttcaccgggt agatctacgc taagcgagac 600

cgggagctcg ctgccaagca gaagtaa 627

<210> 12

<211> 208

<212> PRT

<213> *Yarrowia lipolytica*

<400> 12

Met Ser Phe Pro Asp Lys Ile Val Ala Asp Phe Asn Val Asp Tyr Asp

1 5 10 15

Gln Lys Ser Leu Trp Ile Val Leu Gly Ser Ile Ala Phe Asn Pro Ile

20 25 30

Phe Trp Asn Ile Val Ala Arg Ala Glu Tyr Asn Thr His Phe Leu Thr

35 40 45

Lys Leu Ala Gly Gly Ala Lys Thr Gly Cys Tyr Leu Leu Ala Ile Thr

50 55 60

Ile Phe Ser Leu Gly Ile Phe Arg Asp Tyr Leu Tyr His Gln Ala Leu

65 70 75 80

Glu Gln Gln Pro Thr Ser Ile Leu Leu Ser Val Thr Tyr Val Asp Ile

85 90 95

Val Lys Pro Leu Ala Ile Val Leu Phe Ala Val Gly Asn Val Leu Val

100 105 110

Leu Thr Ser Met Tyr Ala Leu Gly Val Thr Gly Thr Tyr Leu Gly Asp

115	120	125	
Tyr Phe Gly Ile Leu Met Asn Glu Arg Val Thr Gly Phe Pro Phe Asn			
130	135	140	
Val Ser Asn Asn Pro Met Tyr His Gly Ser Thr Leu Cys Phe Leu Ala			
145	150	155	160
Ser Ala Leu Trp Tyr Ala Lys Pro Ala Gly Leu Leu Ile Thr Ala Phe			
	165	170	175
Val Ser Leu Met Tyr Ser Ile Ala Leu Lys Phe Glu Glu Pro Phe Thr			
	180	185	190
Gly Glu Ile Tyr Ala Lys Arg Asp Arg Glu Leu Ala Ala Lys Gln Lys			
195	200	205	

<210> 13

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> OPI3_5_For

<400> 13

gtacccgggg atcctctaga caccaacatt cgacatggac

40

<210> 14

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> OPI3_5_Rev

<400> 14

gcaatgacga gtcagacagg gagttttcca gagagccaac

40

<210> 15

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> OPI3_URA_For

<400> 15

gttggtcttc tggaaaactc cctgtctgac tcgtcattgc

40

<210> 16
<211> 40
<212> DNA
<213> Artificial Sequence

<220>
<223> OPI3_URA_Rev

<400> 16
cagtccttaa tcaacggtgg ctggtggtat tgtgactggg 40

<210> 17
<211> 40
<212> DNA
<213> Artificial Sequence

<220>
<223> OPI3_5RP_For

<400> 17
cccagtcaca ataccaccag ccaccgttga ttaaggactg 40

<210> 18
<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> OPI3_5RP_Rev

<400> 18

cgtaggccgt ttctgttgc gagttttcca gagagccaac

40

<210> 19

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> OPI3_3_For

<400> 19

gttggctctc tggaaaactc gcaacagaaa acggcctacg

40

<210> 20

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> OPI3_3_Rev

<400> 20

gcaggtcgac tctagagagt gccgtctcga ttgtcacagg 40

<210> 21

<211> 2103

<212> DNA

<213> Yarrowia lipolytica

<400> 21

atgaacccca acaacactgg caccattgaa atcaacggtg aggagtacaa caccttcacc 60

gagccccccg tggccatggc tcaggagcga gccaaagacct ccttccccgt gcgagagatg 120

acctactcc tcgacggtgg cgagaagaac accctcaaaa acgagcagat catggaggag 180

attgagcgag accctctttt caacaacgac aactactacg atctcaacaa ggagcagatc 240

cgagagctca ccatggagcg agtcgccaag ctgtctctgt ttgtgctga tcagcccgag 300

gacgacatca agaagcgatt tgctctcatt ggtatgccg atatgggaac ctacacccga 360

cttggtgtcc actacggcct cttcttggc gccgtccgag gtaccggaac tgccgagcag 420

tttgccact ggatctccaa gggagccgga gacctgcgaa agttctacgg atgtttctcc 480

atgaccgagc tgggcatgg ctccaacctg gctgggtctg agaccaccgc catctacgat	540
gaggagaccg acgagttcat catcaacacc cctcacattg ccgccaccaa gtggtggatt	600
ggaggagccg cccacaccgc caccacact gtcgtgttcg cccgactcat tgtcaagggc	660
aaggactacg gtgtcaagac cttgtgttc cagctgcgaa acatcaacga ccacagcctc	720
aaggtcggta tctctattgg tgatatcgga aagaagatgg gccgagacgg tatcgataac	780
ggatggatcc agttcaccaa cgtgcgaatc ccccgacaga acctgctcat gaagtacaca	840
aaggtcgacc gagagggtaa cgtgaccag cctcctctgg ctacgcttac ctacggttct	900
cttatcactg gtcgagtctc catggcctct gattctcacc aggtcggaaa gcgattcatc	960
accattgctc tgcgatacgc ctgcattcga cgacagtctt ccaccacccc cggccagccc	1020
gagaccaaga tcatcgacta cccctacat cagcgacgac ttctgcctct tctggcctat	1080
gtctatgctc ttaagatgac tgccgatgag gttggagctc tcttctccc aaccatgctt	1140
aagatggacg acctcaagcc cgacgacaag gccggcctca atgaggttgt ttccgacgtc	1200
aaggagctct tctccgtctc cgccggtctc aaggccttct ccacctgggc ttgtgccgac	1260
gtcattgaca agaccgaca ggcttgcggt ggccacggtt actctggata caacggtttc	1320

ggccaggcct acgccgactg ggtgtccag tgcacctggg agggtgacaa caacattctc	1380
accctttctg ccggccgagc tctatccag tctgccgttg ctctgcgaaa gggcgagcct	1440
gttggtaacg ccgtttctta cctgaagcga tacaaggatc tggccaacgc taagctcaat	1500
ggccgatctc tcaccgaccc caaggtctc gtcgaggcct gggaggttg tgccggtaac	1560
atcatcaacc gagccaccga ccagtagcag aagctcattg gcgagggctt taacgccgac	1620
caggccttg aggttctgtc tcagcagcga ttccaggccg ccaaggtcca cacacgacga	1680
cacctcattg ccgtttctt ctcccgaatt gacaccgagg ctggcgaggc catcaagcag	1740
cccctgcta acctggctct gctgttgcc ctgtggtcca tcgaagagga ctctggtctg	1800
ttctgcgag agggcttctt cgagcccaag gatatcgaca ccgtcaccga gctcgtcaac	1860
aagtactgca cactgtgcg agaggaggtc attggctaca ccgatgcctt caacctgtcc	1920
gactactca tcaacgtcc tattggatgc tacgatggtg acgcttaccg acactacttc	1980
cagaaggta acgagcagaa ccctgccga gacccccgac ctcttacta cgccttact	2040
ctcaagccct tcctttccg agaggaggag gatgatgaca ttgagagct tgataggaa	2100
tag	2103

<210> 22

<211> 700

<212> PRT

<213> Yarrowia lipolytica

<400> 22

Met Asn Pro Asn Asn Thr Gly Thr Ile Glu Ile Asn Gly Lys Glu Tyr

1 5 10 15

Asn Thr Phe Thr Glu Pro Pro Val Ala Met Ala Gln Glu Arg Ala Lys

20 25 30

Thr Ser Phe Pro Val Arg Glu Met Thr Tyr Phe Leu Asp Gly Gly Glu

35 40 45

Lys Asn Thr Leu Lys Asn Glu Gln Ile Met Glu Glu Ile Glu Arg Asp

50 55 60

Pro Leu Phe Asn Asn Asp Asn Tyr Tyr Asp Leu Asn Lys Glu Gln Ile

65 70 75 80

Arg Glu Leu Thr Met Glu Arg Val Ala Lys Leu Ser Leu Phe Val Arg

85 90 95

Asp Gln Pro Glu Asp Asp Ile Lys Lys Arg Phe Ala Leu Ile Gly Ile

100 105 110

Ala Asp Met Gly Thr Tyr Thr Arg Leu Gly Val His Tyr Gly Leu Phe

115 120 125

Phe Gly Ala Val Arg Gly Thr Gly Thr Ala Glu Gln Phe Gly His Trp

130

135

140

Ile Ser Lys Gly Ala Gly Asp Leu Arg Lys Phe Tyr Gly Cys Phe Ser

145

150

155

160

Met Thr Glu Leu Gly His Gly Ser Asn Leu Ala Gly Leu Glu Thr Thr

165

170

175

Ala Ile Tyr Asp Glu Glu Thr Asp Glu Phe Ile Ile Asn Thr Pro His

180

185

190

Ile Ala Ala Thr Lys Trp Trp Ile Gly Gly Ala Ala His Thr Ala Thr

195

200

205

His Thr Val Val Phe Ala Arg Leu Ile Val Lys Gly Lys Asp Tyr Gly

210

215

220

Val Lys Thr Phe Val Val Gln Leu Arg Asn Ile Asn Asp His Ser Leu

225

230

235

240

Lys Val Gly Ile Ser Ile Gly Asp Ile Gly Lys Lys Met Gly Arg Asp

245

250

255

Gly Ile Asp Asn Gly Trp Ile Gln Phe Thr Asn Val Arg Ile Pro Arg

260

265

270

Gln Asn Leu Leu Met Lys Tyr Thr Lys Val Asp Arg Glu Gly Asn Val

275	280	285	
Thr Gln Pro Pro Leu Ala Gln Leu Thr Tyr Gly Ser Leu Ile Thr Gly			
290	295	300	
Arg Val Ser Met Ala Ser Asp Ser His Gln Val Gly Lys Arg Phe Ile			
305	310	315	320
Thr Ile Ala Leu Arg Tyr Ala Cys Ile Arg Arg Gln Phe Ser Thr Thr			
	325	330	335
Pro Gly Gln Pro Glu Thr Lys Ile Ile Asp Tyr Pro Tyr His Gln Arg			
	340	345	350
Arg Leu Leu Pro Leu Leu Ala Tyr Val Tyr Ala Leu Lys Met Thr Ala			
	355	360	365
Asp Glu Val Gly Ala Leu Phe Ser Arg Thr Met Leu Lys Met Asp Asp			
	370	375	380
Leu Lys Pro Asp Asp Lys Ala Gly Leu Asn Glu Val Val Ser Asp Val			
385	390	395	400
Lys Glu Leu Phe Ser Val Ser Ala Gly Leu Lys Ala Phe Ser Thr Trp			
	405	410	415
Ala Cys Ala Asp Val Ile Asp Lys Thr Arg Gln Ala Cys Gly Gly His			
	420	425	430

Gly Tyr Ser Gly Tyr Asn Gly Phe Gly Gln Ala Tyr Ala Asp Trp Val

435

440

445

Val Gln Cys Thr Trp Glu Gly Asp Asn Asn Ile Leu Thr Leu Ser Ala

450

455

460

Gly Arg Ala Leu Ile Gln Ser Ala Val Ala Leu Arg Lys Gly Glu Pro

465

470

475

480

Val Gly Asn Ala Val Ser Tyr Leu Lys Arg Tyr Lys Asp Leu Ala Asn

485

490

495

Ala Lys Leu Asn Gly Arg Ser Leu Thr Asp Pro Lys Val Leu Val Glu

500

505

510

Ala Trp Glu Val Ala Ala Gly Asn Ile Ile Asn Arg Ala Thr Asp Gln

515

520

525

Tyr Glu Lys Leu Ile Gly Glu Gly Leu Asn Ala Asp Gln Ala Phe Glu

530

535

540

Val Leu Ser Gln Gln Arg Phe Gln Ala Ala Lys Val His Thr Arg Arg

545

550

555

560

His Leu Ile Ala Ala Phe Phe Ser Arg Ile Asp Thr Glu Ala Gly Glu

565

570

575

Ala Ile Lys Gln Pro Leu Leu Asn Leu Ala Leu Leu Phe Ala Leu Trp

580

585

590

Ser Ile Glu Glu Asp Ser Gly Leu Phe Leu Arg Glu Gly Phe Leu Glu

595

600

605

Pro Lys Asp Ile Asp Thr Val Thr Glu Leu Val Asn Lys Tyr Cys Thr

610

615

620

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

625

630

635

640

Asp Tyr Phe Ile Asn Ala Pro Ile Gly Cys Tyr Asp Gly Asp Ala Tyr

645

650

655

Arg His Tyr Phe Gln Lys Val Asn Glu Gln Asn Pro Ala Arg Asp Pro

660

665

670

Arg Pro Pro Tyr Tyr Ala Ser Thr Leu Lys Pro Phe Leu Phe Arg Glu

675

680

685

Glu Glu Asp Asp Asp Ile Cys Glu Leu Asp Glu Glu

690

695

700

<210> 23

<211> 2706

<212> DNA

<213> Yarrowia lipolytica

<400> 23

atgtctggag aactaagata cgacggaaaag gtcgtcattg ttaccggtgc cggtaggcggt	60
ctcggtaagg catacgcctt ttctacggc tctcgaggag cctctgtgtg tgtcaacgat	120
cttggtggcg acttcaaggg cgacggtgcc caggctggca gtggcaagcg agttgccgat	180
gttgtcgtcg acgagattgt ttcaaggga ggcaaggctg ttgctaacta cgactctgtc	240
gagaacggtg acaagattgt cgagactgcc gtcaaggctt ttggctccgt ccacattgtc	300
atcaacaacg ccggtattct ccgagatatt tcctcaaga agatgaccga caaggactgg	360
gatctgtct acaaggcca cgtttcggg gcctacaagg ttacccgagc tgcttggcct	420
tactccgaa agcagaagta cggtcgagtt atctctacct ctccgctgc tggctttac	480
ggaaactcg gccagaccaa ctactccgt gccaaagctg ccctggttg ttcggtgag	540
actctgccca aggaggggtc caagtacaac attactcca acgtcatcgc tcctctgct	600
gcttccgaa tgaccgagac agtcatgcc gaggatatcc tcaagctcct caagcctgag	660
tacgtgttc ctctggtcgg ctacctacc cagactctg tcaccgagtc ttatggtatt	720
tacgaggtcg gtgctggtta catggctaaa atccgatggg agcgaggcaa cggctgtgtt	780
ttcaaggcg acgacactt caccctgtct gctattctga agcgatggga tgaggtcacc	840
tttttgaga gcccaccta ccctaacggc cctgctgact tctcaaata cgctgaggag	900

tctgttaagc gacccgagaa cccccagga cccaccgtct cctcaagga ccaggtgtc	960
attgtcactg gagccggtgc tggcattggc cgagcttact ctcacctct tgctaagctt	1020
ggtgccaagg tcgttgtaa cgatttcggt aaccctcaga aggtgtcga tgaaattaag	1080
gccctcgggtg gtatcgccgt cgctgacaag aacaacgtca tccacggtga gaaggtgtt	1140
cagaccgcta tcgacgcctt cgggtgtgtc cagccggtg tcaacaacgc tggattctc	1200
cgagacaagt ctttcgcaa catggatgat gagatgtggc agctgatctt tgatgtccac	1260
ctcaacggta ctactccgt taccaaggcc gcgtggcccc acttcctaa gcagaagtac	1320
ggccgtgtca tcaacaccac ctcaactct ggtatctacg gtaactcgg ccaggccaac	1380
tactctgccg ccaaggctgg tatcctcgggt ttctcccag ctcttgctcg agagggtgag	1440
aagtacaaca ttctgtcaa caccattgcc ctaacgctg gtactgcat gactgtctt	1500
gtcttactg aggagatgct cgagctcttc aagcccgatt tcatgcacc catcaccgtc	1560
ctgcttgctt ccgatcaggc tcccgtcacc ggtgatctgt ttgagactgg ttctgcttg	1620
atcggacaga ctgatggca gcgagctggt ggtaaggcct tcaacaccaa gaagggtgtc	1680
acccccgaaa tggttcgaga cagctgggct aagatcgtcg acttcgatga tgtaactcc	1740

acccatccca ccactccctc cgagtctact actcagattc ttgagaacat cttcaacgtg	1800
cctgatgagg aggttgagga gactgctctc gttgctggc ccggtgggcc cggtatcctc	1860
aacaaggagg gcgaacctt cgactacact tacactacc gagacctcat tctttacaac	1920
cttggtctcg gtgccaaggc taatgagctc aagtatgtct tcgagggtga tgatgacttc	1980
cagaccgtgc ccacttcgg tgttatccct tacatgggtg gcctcatcac taccaactat	2040
ggcgacttcg ttcctaact caaccctatg atgcttctcc acggtgagca gtacctgaa	2100
atccgacagt ggctattcc taccaatgct acattggaga acaaggctaa ggtcatcgat	2160
gtcgttgaca agggcaaggc tgcctcctt gtcactgcta ccaccaccac gaacaaggag	2220
actggtgagg aggttttcta caacgagtct tctcttca tccgaggctc tgggtgttc	2280
gggtgtaagt ctaccggtac tgaccgtggc gctgccactg ctgccaacaa gcccctgct	2340
cgagctcctg acttcgttaa ggagatcaag atccaggagg accaggctgc cattaccga	2400
ctttcgttg attacaacc tctcacatc gacctgctt ttgctgctg ttgtaactt	2460
gaccgaccta ttctccacg tctctgctt ttggtgtct ccgtaaggc tctttacgat	2520
cagtttggc cttcaagaa cgctaaggc cgatttgctg gtcacgtct cctggtgag	2580
accctgaagg ttgagggtg gaaggagggc aacaaggta tttccagac caaggtgtt	2640

gagcgaggta ctaccgccat cagcaatgcc gccattgagc tctccccaa ggatgctaag 2700

ctctaa 2706

<210> 24

<211> 901

<212> PRT

<213> Yarrowia lipolytica

<400> 24

Met Ser Gly Glu Leu Arg Tyr Asp Gly Lys Val Val Ile Val Thr Gly

1 5 10 15

Ala Gly Gly Gly Leu Gly Lys Ala Tyr Ala Leu Phe Tyr Gly Ser Arg

20 25 30

Gly Ala Ser Val Val Val Asn Asp Leu Gly Gly Asp Phe Lys Gly Asp

35 40 45

Gly Ala Gln Ala Gly Ser Gly Lys Arg Val Ala Asp Val Val Val Asp

50 55 60

Glu Ile Val Ser Lys Gly Gly Lys Ala Val Ala Asn Tyr Asp Ser Val

65 70 75 80

Glu Asn Gly Asp Lys Ile Val Glu Thr Ala Val Lys Ala Phe Gly Ser

85 90 95

Val His Ile Val Ile Asn Asn Ala Gly Ile Leu Arg Asp Ile Ser Phe

100

105

110

Lys Lys Met Thr Asp Lys Asp Trp Asp Leu Val Tyr Lys Val His Val

115

120

125

Phe Gly Ala Tyr Lys Val Thr Arg Ala Ala Trp Pro Tyr Phe Arg Lys

130

135

140

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

145

150

155

160

Gly Asn Phe Gly Gln Thr Asn Tyr Ser Ala Ala Lys Leu Ala Leu Val

165

170

175

Gly Phe Gly Glu Thr Leu Ala Lys Glu Gly Ala Lys Tyr Asn Ile Thr

180

185

190

Ser Asn Val Ile Ala Pro Leu Ala Ala Ser Arg Met Thr Glu Thr Val

195

200

205

Met Pro Glu Asp Ile Leu Lys Leu Leu Lys Pro Glu Tyr Val Val Pro

210

215

220

Leu Val Gly Tyr Leu Thr His Asp Ser Val Thr Glu Ser Tyr Gly Ile

225

230

235

240

Tyr Glu Val Gly Ala Gly Tyr Met Ala Lys Ile Arg Trp Glu Arg Gly

	245	250	255
Asn Gly Ala Val Phe Lys Gly Asp Asp Thr Phe Thr Pro Ser Ala Ile			
	260	265	270
Leu Lys Arg Trp Asp Glu Val Thr Ser Phe Glu Ser Pro Thr Tyr Pro			
	275	280	285
Asn Gly Pro Ala Asp Phe Phe Lys Tyr Ala Glu Glu Ser Val Lys Arg			
	290	295	300
Pro Glu Asn Pro Gln Gly Pro Thr Val Ser Phe Lys Asp Gln Val Val			
305	310	315	320
Ile Val Thr Gly Ala Gly Ala Gly Ile Gly Arg Ala Tyr Ser His Leu			
	325	330	335
Leu Ala Lys Leu Gly Ala Lys Val Val Val Asn Asp Phe Gly Asn Pro			
	340	345	350
Gln Lys Val Val Asp Glu Ile Lys Ala Leu Gly Gly Ile Ala Val Ala			
	355	360	365
Asp Lys Asn Asn Val Ile His Gly Glu Lys Val Val Gln Thr Ala Ile			
	370	375	380
Asp Ala Phe Gly Ala Val His Ala Val Val Asn Asn Ala Gly Ile Leu			
385	390	395	400

Arg Asp Lys Ser Phe Ala Asn Met Asp Asp Glu Met Trp Gln Leu Ile

405

410

415

Phe Asp Val His Leu Asn Gly Thr Tyr Ser Val Thr Lys Ala Ala Trp

420

425

430

Pro His Phe Leu Lys Gln Lys Tyr Gly Arg Val Ile Asn Thr Thr Ser

435

440

445

Thr Ser Gly Ile Tyr Gly Asn Phe Gly Gln Ala Asn Tyr Ser Ala Ala

450

455

460

Lys Ala Gly Ile Leu Gly Phe Ser Arg Ala Leu Ala Arg Glu Gly Glu

465

470

475

480

Lys Tyr Asn Ile Leu Val Asn Thr Ile Ala Pro Asn Ala Gly Thr Ala

485

490

495

Met Thr Ala Ser Val Phe Thr Glu Glu Met Leu Glu Leu Phe Lys Pro

500

505

510

Asp Phe Ile Ala Pro Ile Thr Val Leu Leu Ala Ser Asp Gln Ala Pro

515

520

525

Val Thr Gly Asp Leu Phe Glu Thr Gly Ser Ala Trp Ile Gly Gln Thr

530

535

540

Arg Trp Gln Arg Ala Gly Gly Lys Ala Phe Asn Thr Lys Lys Gly Val

545

550

555

560

Thr Pro Glu Met Val Arg Asp Ser Trp Ala Lys Ile Val Asp Phe Asp
565 570 575

Asp Gly Asn Ser Thr His Pro Thr Thr Pro Ser Glu Ser Thr Thr Gln
580 585 590

Ile Leu Glu Asn Ile Phe Asn Val Pro Asp Glu Glu Val Glu Glu Thr
595 600 605

Ala Leu Val Ala Gly Pro Gly Gly Pro Gly Ile Leu Asn Lys Glu Gly
610 615 620

Glu Pro Phe Asp Tyr Thr Tyr Thr Tyr Arg Asp Leu Ile Leu Tyr Asn
625 630 635 640

Leu Gly Leu Gly Ala Lys Ala Asn Glu Leu Lys Tyr Val Phe Glu Gly
645 650 655

Asp Asp Asp Phe Gln Thr Val Pro Thr Phe Gly Val Ile Pro Tyr Met
660 665 670

Gly Gly Leu Ile Thr Thr Asn Tyr Gly Asp Phe Val Pro Asn Phe Asn
675 680 685

Pro Met Met Leu Leu His Gly Glu Gln Tyr Leu Glu Ile Arg Gln Trp
690 695 700

Pro Ile Pro Thr Asn Ala Thr Leu Glu Asn Lys Ala Lys Val Ile Asp

705 710 715 720

Val Val Asp Lys Gly Lys Ala Ala Leu Leu Val Thr Ala Thr Thr Thr

725 730 735

Thr Asn Lys Glu Thr Gly Glu Glu Val Phe Tyr Asn Glu Ser Ser Leu

740 745 750

Phe Ile Arg Gly Ser Gly Gly Phe Gly Gly Lys Ser Thr Gly Thr Asp

755 760 765

Arg Gly Ala Ala Thr Ala Ala Asn Lys Pro Pro Ala Arg Ala Pro Asp

770 775 780

Phe Val Lys Glu Ile Lys Ile Gln Glu Asp Gln Ala Ala Ile Tyr Arg

785 790 795 800

Leu Ser Gly Asp Tyr Asn Pro Leu His Ile Asp Pro Ala Phe Ala Ala

805 810 815

Val Gly Asn Phe Asp Arg Pro Ile Leu His Gly Leu Cys Ser Phe Gly

820 825 830

Val Ser Gly Lys Ala Leu Tyr Asp Gln Phe Gly Pro Phe Lys Asn Ala

835 840 845

Lys Val Arg Phe Ala Gly His Val Phe Pro Gly Glu Thr Leu Lys Val

850 855 860

Glu Gly Trp Lys Glu Gly Asn Lys Val Ile Phe Gln Thr Lys Val Val

865 870 875 880

Glu Arg Gly Thr Thr Ala Ile Ser Asn Ala Ala Ile Glu Leu Phe Pro

885 890 895

Lys Asp Ala Lys Leu

900

<210> 25

<211> 1134

<212> DNA

<213> *Yarrowia lipolytica*

<400> 25

atgtggggaa gttcacatgc attcgtggt gaatctgac tgacactaca actacacacc 60

aggtccaaca tgagcgacaa tacgacaatc aaaaagccga tccgacccaa accgatccgg 120

acggaacgcc tgccttacgc tggggccgca gaaatcatcc gagccaacca gaaagaccac 180

tactttgagt ccgtgcttga acagcatctc gtcacgttgc tgcagaaatg gaagggagta 240

cgatttatcc accagtacaa ggaggagctg gagacggcgt ccaagttgc atatctcgg 300

ttgtgtacgc ttgtgggctc caagactctc ggagaagagt acaccaatct catgtacact 360

atcagagacc gaacagctct accgggggtg gtgagacggt ttggtacgt gctttccaac 420

actctgtttc catacctgtt tgtgcgctac atgggcaagt tgcgcgcca actgatgcgc	480
gagtatcccc atctggtgga gtacgacgaa gatgagcctg tgcccagccc ggaaacatgg	540
aaggagcggg tcatcaagac gtttgtgaac aagtttgaca agttcacggc gctggagggg	600
tttaccgcga tccactggc gattttctac gtctacggct cgtactacca gctcagtaag	660
cggatctggg gcatgcgtta tgtatttga caccgactgg acaagaatga gcctcgaatc	720
ggttacgaga tgctcgttct gctgatttc gcccggttg ccacgtcatt tgtcagacg	780
ggaagagagt acctcggagc gctgctggaa aagagcgtgg agaaagaggc aggggagaag	840
gaagatgaaa aggaagcggg tgtgccgaaa aagaagtcgt caattccgtt cattgaggat	900
acagaagggg agacggaaga caagatcgat ctggaggacc ctcgacagct caagttcatt	960
cctgaggcgt ccagagcgtg cactctgtgt ctgtcataca ttagtgccg gccatgtacg	1020
ccatgtggac acttttctg ttgggactgt atttccgaat gggtgagaga gaagcccag	1080
tgtccctgt gtcggcaggg tgtgagagag cagaactgt tgcctatcag ataa	1134

<210> 26
 <211> 377
 <212> PRT

<213> Yarrowia lipolytica

<400> 26

Met Trp Gly Ser Ser His Ala Phe Ala Gly Glu Ser Asp Leu Thr Leu

1 5 10 15

Gln Leu His Thr Arg Ser Asn Met Ser Asp Asn Thr Thr Ile Lys Lys

20 25 30

Pro Ile Arg Pro Lys Pro Ile Arg Thr Glu Arg Leu Pro Tyr Ala Gly

35 40 45

Ala Ala Glu Ile Ile Arg Ala Asn Gln Lys Asp His Tyr Phe Glu Ser

50 55 60

Val Leu Glu Gln His Leu Val Thr Phe Leu Gln Lys Trp Lys Gly Val

65 70 75 80

Arg Phe Ile His Gln Tyr Lys Glu Glu Leu Glu Thr Ala Ser Lys Phe

85 90 95

Ala Tyr Leu Gly Leu Cys Thr Leu Val Gly Ser Lys Thr Leu Gly Glu

100 105 110

Glu Tyr Thr Asn Leu Met Tyr Thr Ile Arg Asp Arg Thr Ala Leu Pro

115 120 125

Gly Val Val Arg Arg Phe Gly Tyr Val Leu Ser Asn Thr Leu Phe Pro

130 135 140

Tyr Leu Phe Val Arg Tyr Met Gly Lys Leu Arg Ala Lys Leu Met Arg
145 150 155 160

Glu Tyr Pro His Leu Val Glu Tyr Asp Glu Asp Glu Pro Val Pro Ser
165 170 175

Pro Glu Thr Trp Lys Glu Arg Val Ile Lys Thr Phe Val Asn Lys Phe
180 185 190

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

Phe Tyr Val Tyr Gly Ser Tyr Tyr Gln Leu Ser Lys Arg Ile Trp Gly
210 215 220

Met Arg Tyr Val Phe Gly His Arg Leu Asp Lys Asn Glu Pro Arg Ile
225 230 235 240

Gly Tyr Glu Met Leu Gly Leu Leu Ile Phe Ala Arg Phe Ala Thr Ser
245 250 255

Phe Val Gln Thr Gly Arg Glu Tyr Leu Gly Ala Leu Leu Glu Lys Ser
260 265 270

Val Glu Lys Glu Ala Gly Glu Lys Glu Asp Glu Lys Glu Ala Val Val
275 280 285

Pro Lys Lys Lys Ser Ser Ile Pro Phe Ile Glu Asp Thr Glu Gly Glu

290	295	300	
Thr Glu Asp Lys Ile Asp Leu Glu Asp Pro Arg Gln Leu Lys Phe Ile			
305	310	315	320
Pro Glu Ala Ser Arg Ala Cys Thr Leu Cys Leu Ser Tyr Ile Ser Ala			
	325	330	335
Pro Ala Cys Thr Pro Cys Gly His Phe Phe Cys Trp Asp Cys Ile Ser			
	340	345	350
Glu Trp Val Arg Glu Lys Pro Glu Cys Pro Leu Cys Arg Gln Gly Val			
	355	360	365
Arg Glu Gln Asn Leu Leu Pro Ile Arg			
370	375		

<210> 27

<211> 1245

<212> DNA

<213> Yarrowia lipolytica

<400> 27

atggaccgac ttaacaacct cgccacccag ctcgagcaga accccgcaa gggcctcgac 60

gctatcacct ccaagaaccc cgatgacgtt gtcacaccg ccgcctaccg aactgccac 120

accaagggag gcaagggctt gttcaaggac acctcttctt ccgagctgct cgctctctg 180

ctggagggcc tcgtcaagga gtccaagatc gacccaagc tcatcgggtga tgcgtctgc	240
gggaacgttc tcgtgccgg tgccgggtgcc actgagcacc gagctgcctg cttgttgcc	300
ggcatccccg agaccgttc cttcgtcgt ctcaaccgac agtgctctc tggctgatg	360
gccgtcaacg acgttgccaa caagatccga gccggccaga ttgacattgg tatcggctgt	420
ggtgtcagat ccatgtcaa ccagtacggt cccaactccg tcaccccctt ctccaacaag	480
ttcagaaca acgaggaggc taagaagtgc ctgatccca tgggtatcac ttccgagaac	540
gttgcccca agtacaacgt gtccgaaag gcccaggacg ctttgctgc caagtcctac	600
gagaaggccg ccgtgccca ggccgccggc aagttcgacc aggagatcct ccccatcaag	660
accactgttc tcgatgatga tgacaacgag aaggagggtta ccgtcaaca ggacgacggt	720
atccgacctg gtgtcaccgc cgagaagctc ggcaagctca agcctgctt ctccgccgag	780
ggaaccaccc acgctggtaa cgcctctcag atctccgacg gtgccggagc cgttctctc	840
atgcgacgat ctgttgccga gaagcttggc cagcccatcc ttgccaagtt tgtccactgc	900
aagaccgtcg gtgtccccc cgagctcatg ggaattggcc ccgcttacgc cattctgct	960
gtccttgagg accttggtct gaccgtcaac gacgttgacg tttcgagat caacgaggct	1020

ttcgcttccc aggctctgtt ctccatccag cattgtggaa tcgacgagtc caaggtcaac	1080
ccccgagggtg gtgccattgc tattggccac cctctgggag ccaccggtgc tcgacagttt	1140
gccactctgc tctccgagct taaggagtct ggcaagaagg tcggtgtcac ctccatgtgc	1200
attggtaccg gtatgggtgc cgcttctctg gttgtgccg agtaa	1245

<210> 28
 <211> 414
 <212> PRT
 <213> Yarrowia lipolytica

<400> 28
 Met Asp Arg Leu Asn Asn Leu Ala Thr Gln Leu Glu Gln Asn Pro Ala
 1 5 10 15

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

Thr Ala Ala Tyr Arg Thr Ala His Thr Lys Gly Gly Lys Gly Leu Phe
 35 40 45

Lys Asp Thr Ser Ser Ser Glu Leu Leu Ala Ser Leu Leu Glu Gly Leu
 50 55 60

Val Lys Glu Ser Lys Ile Asp Pro Lys Leu Ile Gly Asp Val Val Cys
 65 70 75 80

Gly Asn Val Leu Ala Ala Gly Ala Gly Ala Thr Glu His Arg Ala Ala

85

90

95

Cys Leu Val Ala Gly Ile Pro Glu Thr Val Pro Phe Val Ala Leu Asn

100

105

110

Arg Gln Cys Ser Ser Gly Leu Met Ala Val Asn Asp Val Ala Asn Lys

115

120

125

Ile Arg Ala Gly Gln Ile Asp Ile Gly Ile Gly Cys Gly Val Glu Ser

130

135

140

Met Ser Asn Gln Tyr Gly Pro Asn Ser Val Thr Pro Phe Ser Asn Lys

145

150

155

160

Phe Gln Asn Asn Glu Glu Ala Lys Lys Cys Leu Ile Pro Met Gly Ile

165

170

175

Thr Ser Glu Asn Val Ala Ala Lys Tyr Asn Val Ser Arg Lys Ala Gln

180

185

190

Asp Ala Phe Ala Ala Lys Ser Tyr Glu Lys Ala Ala Ala Ala Gln Ala

195

200

205

Ala Gly Lys Phe Asp Gln Glu Ile Leu Pro Ile Lys Thr Thr Val Leu

210

215

220

Asp Asp Asp Asp Asn Glu Lys Glu Val Thr Val Asn Lys Asp Asp Gly

225 230 235 240

Ile Arg Pro Gly Val Thr Ala Glu Lys Leu Gly Lys Leu Lys Pro Ala

245 250 255

Phe Ser Ala Glu Gly Thr Thr His Ala Gly Asn Ala Ser Gln Ile Ser

260 265 270

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

275 280 285

Leu Gly Gln Pro Ile Leu Ala Lys Phe Val His Cys Lys Thr Val Gly

290 295 300

Val Pro Pro Glu Leu Met Gly Ile Gly Pro Ala Tyr Ala Ile Pro Ala

305 310 315 320

Val Leu Glu Asp Leu Gly Leu Thr Val Asn Asp Val Asp Val Phe Glu

325 330 335

Ile Asn Glu Ala Phe Ala Ser Gln Ala Leu Phe Ser Ile Gln His Cys

340 345 350

Gly Ile Asp Glu Ser Lys Val Asn Pro Arg Gly Gly Ala Ile Ala Ile

355 360 365

Gly His Pro Leu Gly Ala Thr Gly Ala Arg Gln Phe Ala Thr Leu Leu

370 375 380

385 390 395 400

405 410

<213> Yarrowia lipolytica

gagtatgcac acgacgagct gcatgacacc tcttcgtgct ccgactcgca gtcgagcttt 480

tcccctcagc agtcccctgc ctccccggcc tccacttact cgcctctcga ggacgagttt	540
ctcaacttgg ctggatccga gttgaagagc gagcccagcg cggacgacga gaaggatgat	600
gtggacacgg agcttcccca gcagcccag atcatcatcc ctgtgtcgtg ccgaggccga	660
aagccgtcca tcgacgactc caaaaagact ttgtctgca cccactgcca gcgtcggttc	720
cggcgccagg agcatctcaa gcgacatttc cgatccctac aactcgaga gaagccttc	780
aactgcgaca cgtgcggcaa gaagtttct cggtcggaca atctcgcca gcatatgcgt	840
acgcacctc gggactag	858

<210> 30

<211> 285

<212> PRT

<213> Yarrowia lipolytica

<400> 30

Met Asp Leu Glu Leu Glu Ile Pro Val Leu His Ser Met Asp Ser His

1	5	10	15
---	---	----	----

His Gln Val Val Asp Ser His Arg Leu Ala Gln Gln Gln Phe Gln Tyr

20	25	30
----	----	----

Gln Gln Ile His Met Leu Gln Gln Thr Leu Ser Gln Gln Tyr Pro His

35	40	45
----	----	----

Thr Pro Ser Thr Thr Pro Pro Ile Tyr Met Leu Ser Pro Ala Asp Tyr

50

55

60

Glu Lys Asp Ala Val Ser Ile Ser Pro Val Met Leu Trp Pro Pro Ser

65

70

75

80

Ala His Ser Gln Ala Ser Tyr His Tyr Glu Met Pro Ser Val Ile Ser

85

90

95

Pro Ser Pro Ser Pro Thr Arg Ser Phe Cys Asn Pro Arg Glu Leu Glu

100

105

110

Val Gln Asp Glu Leu Glu Gln Leu Glu Gln Gln Pro Ala Ala Leu Ser

115

120

125

Val Glu His Leu Phe Asp Ile Glu Asn Ser Ser Ile Glu Tyr Ala His

130

135

140

Asp Glu Leu His Asp Thr Ser Ser Cys Ser Asp Ser Gln Ser Ser Phe

145

150

155

160

Ser Pro Gln Gln Ser Pro Ala Ser Pro Ala Ser Thr Tyr Ser Pro Leu

165

170

175

Glu Asp Glu Phe Leu Asn Leu Ala Gly Ser Glu Leu Lys Ser Glu Pro

180

185

190

Ser Ala Asp Asp Glu Lys Asp Asp Val Asp Thr Glu Leu Pro Gln Gln

195	200	205	
Pro Glu Ile Ile Ile Pro Val Ser Cys Arg Gly Arg Lys Pro Ser Ile			
210	215	220	
Asp Asp Ser Lys Lys Thr Phe Val Cys Thr His Cys Gln Arg Arg Phe			
225	230	235	240
Arg Arg Gln Glu His Leu Lys Arg His Phe Arg Ser Leu His Thr Arg			
	245	250	255
Glu Lys Pro Phe Asn Cys Asp Thr Cys Gly Lys Lys Phe Ser Arg Ser			
	260	265	270
Asp Asn Leu Ala Gln His Met Arg Thr His Pro Arg Asp			
275	280	285	

<210> 31

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> POX2_5_For

<400> 31

gtacccgggg atcctctaga gattccgcca agtgagactg 40

<210> 32
<211> 40
<212> DNA
<213> Artificial Sequence

<220>
<223> POX2_5_Rev

<400> 32
gcaatgacga gtcagacagg cgttgcttgt gtgatttttg 40

<210> 33
<211> 40
<212> DNA
<213> Artificial Sequence

<220>
<223> POX2_URA_For

<400> 33
caaaaatcac acaagcaacg cctgtctgac tcgtcattgc 40

<210> 34

<211> 40
<212> DNA
<213> Artificial Sequence

<220>
<223> POX2_URA_Rev

<400> 34
cgcttgcca gtatgaatag ctggtggtat tggactggg 40

<210> 35
<211> 40
<212> DNA
<213> Artificial Sequence

<220>
<223> POX2_5RP_For

<400> 35
cccgatcaca ataccaccag ctattcatatc tggacaagcg 40

<210> 36
<211> 39
<212> DNA
<213> Artificial Sequence

<220>

<223> POX2_5RP_Rev

<400> 36

caataaatac ccgcttgccc gttgcttggt tgatttttg

39

<210> 37

<211> 39

<212> DNA

<213> Artificial Sequence

<220>

<223> POX2_3_For

<400> 37

caaaaatacac acaagcaacg gacaagcggg tattttattg

39

<210> 38

<211> 36

<212> DNA

<213> Artificial Sequence

<220>

<223> POX2_3_Rev

<400> 38

gcaggctcgac tctagaccaa acaaagctga tgacac

36

<210> 39

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> MFE1_5_For

<400> 39

gtacccgggg atcctctaga caagccaaag agatgttgac

40

<210> 40

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> MFE1_5_Rev

<400> 40

gcaatgacga gtcagacagg gttaataacg tatcttctac

40

<210> 41

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> MFE1_URA_For

<400> 41

gtagaagata cgttattaac cctgtctgac tcgtcattgc

40

<210> 42

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> MFE1_URA_Rev

<400> 42

caaatcagcc gttggcctgc ctggtggtat tgtgactggg

40

<210> 43
<211> 40
<212> DNA
<213> Artificial Sequence

<220>
<223> MFE1_5RP_For

<400> 43
cccgatcaca ataccaccag gcaggccaac ggctgatttg 40

<210> 44
<211> 39
<212> DNA
<213> Artificial Sequence

<220>
<223> MFE1_5RP_Rev

<400> 44
cacttggtca gataatagcg ttaataacgt atcttctac 39

<210> 45
<211> 39
<212> DNA

<213> Artificial Sequence

<220>

<223> MFE1_3_For

<400> 45

gtagaagata cggtattaac gctattatct gaccaagtg

39

<210> 46

<211> 38

<212> DNA

<213> Artificial Sequence

<220>

<223> MFE1_3_Rev

<400> 46

gcaggtcgac tctagatgct tgaaggcata tgtgactg

38

<210> 47

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> PEX10_5_For

<400> 47

gtacccgggg atcctctaga gtttcgtct tagcgatg

40

<210> 48

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> PEX10_5_Rev

<400> 48

gcaatgacga gtcagacagg gccgaggcag attgggttg

40

<210> 49

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> PEX10_URA_For

<400> 49

caacccaaat ctgcctcggc cctgtctgac tcgtcattgc

40

<210> 50

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> PEX10_URA_Rev

<400> 50

gagtcagta attcttccg ctggtggtat tgtgactggg

40

<210> 51

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> PEX10_5RP_For

<400> 51

cccagtcaca ataccaccag cggaaagaat tactggactc

40

<210> 52
<211> 40
<212> DNA
<213> Artificial Sequence

<220>
<223> PEX10_5RP_Rev

<400> 52
ccttccatcc agacctcgtc gccgaggcag attggggtg 40

<210> 53
<211> 40
<212> DNA
<213> Artificial Sequence

<220>
<223> PEX10_3_For

<400> 53
caacccaaat ctgcctcggc gacgaggtct ggatggaagg 40

<210> 54
<211> 40

<212> DNA
<213> Artificial Sequence

<220>

<223> PEX10_3_Rev

<400> 54

gcaggtcgac tctagagctg acctatacca gatcagacgc

40

<210> 55

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> POT1_5_For

<400> 55

gtacccgggg atcctctaga cacaataccc cacagtgtgc

40

<210> 56

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> POT1_5_Rev

<400> 56

gcaatgacga gtcagacagg gtgtgtcttg gttggatgag

40

<210> 57

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> POT1_URA_For

<400> 57

ctcatccaac caagacacac cctgtctgac tcgtcattgc

40

<210> 58

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> POT1_URA_Rev

<400> 58

caggcgctcc cccattggcg ctggtggtat tgtgactggg

40

<210> 59

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> POT1_5RP_For

<400> 59

cccagtcaca ataccaccag cgccaatggg ggagcgctg

40

<210> 60

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> POT1_5RP_Rev

<400> 60

gttcgatcgc gattcatttc gtgtgtcttg gttggatgag

40

<210> 61
<211> 40
<212> DNA
<213> Artificial Sequence

<220>
<223> POT1_3_For

<400> 61
ctcatccaac caagacacac gaaatgaatc gcgatcgaac 40

<210> 62
<211> 40
<212> DNA
<213> Artificial Sequence

<220>
<223> POT1_3_Rev

<400> 62
gcaggtcgac tctagagagg agtgctaaaa ttagccctgc 40

<210> 63

<211> 39
<212> DNA
<213> Artificial Sequence

<220>

<223> MHY1_5_For

<400> 63

gtacccgggg atcctctaga tgcagcgaa agctcaaag

39

<210> 64

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> MHY1_5_Rev

<400> 64

gcaatgacga gtcagacagg caattcgagg tccatttgg

40

<210> 65

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> MHY1_URA_For

<400> 65

ccaaaatgga cctcgaattg cctgtctgac tcgtcattgc

40

<210> 66

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> MHY1_URA_Rev

<400> 66

gtggtgcttt tgtactgtc ctgggtggtat tgtgactggg

40

<210> 67

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> MHY1_5RP_For

<400> 67

cccagtcaca ataccaccag gacaagtaca aaagcaccac

40

<210> 68

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> MHY1_5RP_Rev

<400> 68

gaaggcgctc tacctctagt ccaattcgag gtccattttg

40

<210> 69

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> MHY1_3_For

<400> 69

caaaatggac ctggaattgg actagaggta gagcgccttc 40

<210> 70

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> MHY1_3_Rev

<400> 70

gcaggtcgac tctagactgt gtttgattag ctcttctcag 40

<210> 71

<211> 1545

<212> DNA

<213> Yarrowia lipolytica

<400> 71

atgactatcg actcacaata ctacaagtcg cgagacaaaa acgacacggc acccaaaatc 60

gcgggaatcc gatatgcccc gctatcgaca ccattactca accgatgtga gaccttctct 120

ctggctcggc acattttcag cattcccact ttctcacaa tttcatgct atgctgcgca 180

attccactgc tctggccatt tgtgattgcg tatgtagtgt acgctgttaa agacgactcc 240

ccgtccaacg gaggagtggg caagcgatac tcgcctattt caagaaactt cttcatctgg	300
aagctctttg gccgctactt ccccataact ctgcacaaga cgggtggatct ggagcccacg	360
cacacatact accctctgga cgtccaggag tatcacctga ttgctgagag atactggccg	420
cagaacaagt acctccgagc aatcatctcc accatcgagt actttctgcc cgccttcatg	480
aaacgggtctc ttctatcaa cgagcaggag cagcctgccg agcgagatcc tctcctgtct	540
cccgtttctc ccagctctcc gggttctcaa cctgacaagt ggattaacca cgacagcaga	600
tatagccgtg gagaatcatc tggctccaac ggccacgcct cgggctccga acttaacggc	660
aacggcaaca atggcaccac taaccgacga ctttgtcgt ccgcctctgc tggctccact	720
gcacttgatt ccacgttct taacgggtcc ctcaactct acgccaacca gatcattggc	780
gaaaacgacc cacagctgtc gccacaaaa ctcaagcca ctggcagaaa atacatcttc	840
ggctaccacc cccacggcat tatcggcatg ggagcctttg gtggaattgc caccgagga	900
gctggatggt ccaagctctt tccgggcac cctgtttctc ttatgactct caccaacaac	960
ttccgagtgc ctctctacag agagtacctc atgagtctgg gagtcgcttc tgttccaag	1020
aagtctgca aggccctcct caagcgaaac cagtctatct gcattgtcgt tggaggagca	1080

caggaaagtc ttctggccag acccggtgtc atggacctgg tgctactcaa gcgaaaggg	1140
ttgttcgac ttggtatgga ggtcggaaat gtcgcccttg ttcccatcat ggccttgg	1200
gagaacgacc tctatgacca ggtagcaac gacaagtcgt ccaagctgta ccgattccag	1260
cagtttgtca agaacttct tggattcacc cttccttga tgcattgccg aggcgtcttc	1320
aactacgatg tcggtcttgt cccctacagg cgaccgtca acattgtgg	1380
attgacttgc cttatctccc acacccacc gacgaagaag tgcgaata ccacgaccga	1440
tacatgccg agctgcagcg aatctacaac gagcacaagg atgaatatt catcgattgg	1500
accgaggagg gcaaaggagc cccagagttc cgaatgattg agtaa	1545

<210> 72

<211> 514

<212> PRT

<213> Yarrowia lipolytica

<400> 72

Met Thr Ile Asp Ser Gln Tyr Tyr Lys Ser Arg Asp Lys Asn Asp Thr

1 5 10 15

Ala Pro Lys Ile Ala Gly Ile Arg Tyr Ala Pro Leu Ser Thr Pro Leu

20 25 30

Leu Asn Arg Cys Glu Thr Phe Ser Leu Val Trp His Ile Phe Ser Ile

35

40

45

Pro Thr Phe Leu Thr Ile Phe Met Leu Cys Cys Ala Ile Pro Leu Leu

50

55

60

Trp Pro Phe Val Ile Ala Tyr Val Val Tyr Ala Val Lys Asp Asp Ser

65

70

75

80

Pro Ser Asn Gly Gly Val Val Lys Arg Tyr Ser Pro Ile Ser Arg Asn

85

90

95

Phe Phe Ile Trp Lys Leu Phe Gly Arg Tyr Phe Pro Ile Thr Leu His

100

105

110

Lys Thr Val Asp Leu Glu Pro Thr His Thr Tyr Tyr Pro Leu Asp Val

115

120

125

Gln Glu Tyr His Leu Ile Ala Glu Arg Tyr Trp Pro Gln Asn Lys Tyr

130

135

140

Leu Arg Ala Ile Ile Ser Thr Ile Glu Tyr Phe Leu Pro Ala Phe Met

145

150

155

160

Lys Arg Ser Leu Ser Ile Asn Glu Gln Glu Gln Pro Ala Glu Arg Asp

165

170

175

Pro Leu Leu Ser Pro Val Ser Pro Ser Ser Pro Gly Ser Gln Pro Asp

180

185

190

Lys Trp Ile Asn His Asp Ser Arg Tyr Ser Arg Gly Glu Ser Ser Gly

195 200 205

Ser Asn Gly His Ala Ser Gly Ser Glu Leu Asn Gly Asn Gly Asn Asn

210 215 220

Gly Thr Thr Asn Arg Arg Pro Leu Ser Ser Ala Ser Ala Gly Ser Thr

225 230 235 240

Ala Ser Asp Ser Thr Leu Leu Asn Gly Ser Leu Asn Ser Tyr Ala Asn

245 250 255

Gln Ile Ile Gly Glu Asn Asp Pro Gln Leu Ser Pro Thr Lys Leu Lys

260 265 270

Pro Thr Gly Arg Lys Tyr Ile Phe Gly Tyr His Pro His Gly Ile Ile

275 280 285

Gly Met Gly Ala Phe Gly Gly Ile Ala Thr Glu Gly Ala Gly Trp Ser

290 295 300

Lys Leu Phe Pro Gly Ile Pro Val Ser Leu Met Thr Leu Thr Asn Asn

305 310 315 320

Phe Arg Val Pro Leu Tyr Arg Glu Tyr Leu Met Ser Leu Gly Val Ala

325 330 335

Ser Val Ser Lys Lys Ser Cys Lys Ala Leu Leu Lys Arg Asn Gln Ser

340	345	350	
Ile Cys Ile Val Val Gly Gly Ala Gln Glu Ser Leu Leu Ala Arg Pro			
355	360	365	
Gly Val Met Asp Leu Val Leu Leu Lys Arg Lys Gly Phe Val Arg Leu			
370	375	380	
Gly Met Glu Val Gly Asn Val Ala Leu Val Pro Ile Met Ala Phe Gly			
385	390	395	400
Glu Asn Asp Leu Tyr Asp Gln Val Ser Asn Asp Lys Ser Ser Lys Leu			
405	410	415	
Tyr Arg Phe Gln Gln Phe Val Lys Asn Phe Leu Gly Phe Thr Leu Pro			
420	425	430	
Leu Met His Ala Arg Gly Val Phe Asn Tyr Asp Val Gly Leu Val Pro			
435	440	445	
Tyr Arg Arg Pro Val Asn Ile Val Val Gly Ser Pro Ile Asp Leu Pro			
450	455	460	
Tyr Leu Pro His Pro Thr Asp Glu Glu Val Ser Glu Tyr His Asp Arg			
465	470	475	480
Tyr Ile Ala Glu Leu Gln Arg Ile Tyr Asn Glu His Lys Asp Glu Tyr			
485	490	495	

Phe Ile Asp Trp Thr Glu Glu Gly Lys Gly Ala Pro Glu Phe Arg Met
500 505 510

Ile Glu

<210> 73

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> DGA1_5_For

<400> 73

gtacccgggg atcctctaga gacgagaaac aaatcatgtg

40

<210> 74

<211> 41

<212> DNA

<213> Artificial Sequence

<220>

<223> DGA1_5_Rev

<400> 74

cgccgccaac ccggtctcta gctttgttt tgtgtgactt g

41

<210> 75

<211> 41

<212> DNA

<213> Artificial Sequence

<220>

<223> DGA1_TEF1_For

<400> 75

caagtcacac aaaacaaaag ctagagaccg ggttgccggc g

41

<210> 76

<211> 42

<212> DNA

<213> Artificial Sequence

<220>

<223> DGA1_TEF1_Rev

<400> 76

gacgagtcag acaggaggca ctgcggttag tactgcaaaa ag

42

<210> 77
<211> 42
<212> DNA
<213> Artificial Sequence

<220>
<223> DGA1_URA_For

<400> 77
cttttgcag tactaaccgc agtgcctcct gtctgactcg tc 42

<210> 78
<211> 38
<212> DNA
<213> Artificial Sequence

<220>
<223> DGA1_URA_Rev

<400> 78
cgccgccaac ccggtctctt ggtggtattg tgactggg 38

<210> 79
<211> 38

<212> DNA
<213> Artificial Sequence

<220>

<223> DGA1_TEF2_For

<400> 79

cccagtcaca ataccaccaa gagaccgggt tggcggcg

38

<210> 80

<211> 43

<212> DNA

<213> Artificial Sequence

<220>

<223> DGA1_TEF2_Rev

<400> 80

gtagtattgt gagtcgatag tctgcgggta gtactgcaaa aag

43

<210> 81

<211> 43

<212> DNA

<213> Artificial Sequence

<220>

<223> DGA1_dga1_For

<400> 81

cttttgcag tactaaccgc agactatcga ctcacaatac tac

43

<210> 82

<211> 41

<212> DNA

<213> Artificial Sequence

<220>

<223> DGA1_dga1_Rev

<400> 82

gcctgcaggt cgactctaga ttactcaatc attcggaact c

41