

SEQUENCE LISTINGS

Note: All plasmids used for *E. coli* and *B. subtilis* are originally found in *E. coli* and modified to obtain the indicated plasmids (mostly commercial). All plasmids used for *S. cerevisiae* are originally obtained from that species and modified to obtain the indicated plasmids. See text and tables for further information.

<110> Applicants: OPX Biotechnologies, Inc.; The Regents of the University of Colorado, a body corporate

<110> Inventors: Michael D. Lynch; Tanya E. Warnecke-Lipscomb; Ryan T. Gill

<120> Methods, Systems and Compositions For Increased Microorganism Tolerance to and Production of 3-Hydroxypropionic acid (3-HP)

<130> 729601

<140> (Filed herewith)

<150>61/135,862

<151>2008/07/23

<150>61/135,861

<151>2008/07/23

<150>61/088,331

<151>2008/08/12

<150>61/096,937

<151>2008/09/15

<160> 189

<170> (tbd)

[SEQ ID NO:001] Plasmid comprising aroH

<210>001

<211>5642

<212> DNA

<213>Artificial Sequence

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<223> Plasmid comprising the aroH gene from *E. coli*

<400> 001

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[SEQ ID NO:002] Plasmid comprising carbonic anhydrase/cyanase (cynTS)

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<211>3082

<212> DNA

<213>Artificial Sequence

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[SEQ ID NO:003] Plasmid comprising malonyl CoA reductase

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<211>8252

<212> DNA

<213>Artificial Sequence

<220>

<223> Plasmid comprising the codon-optimized gene for malonyl CoA reductase

<400> 003

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[SEQ ID NO:009] pACYC177 (kan only) plasmid

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 CATGATCGCGATGCTCATCTTCTCGCCACGACAGATCAGGGCTGCGTTAA
 TGCTATCCGGGCACTGGCCACGAGGCTAATGCCATGCAGAACATGCTTA
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 CCGCATCGCTGATGTTTCGGCAATGCGTCTGACCGCTAATGGTCTTTTCA
 ATCATCGCCACCAGATGGTTAGTAATCTTTGCCGGAGCAGACAGGACGGT
 TGCAACCTGACCCTGACGCGCGTTGCTCTCCAGAATGTCCGCAACGCGCA
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 ATGGAAATACTCCTTGAAAAGTAAAGTGTTAGATGAGTGCGTTAATTCAC
 ACTTCTGAGAAATTTTCGCTAAACGCATCAAAAAAGCATAGCAGACAGGCA
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[SEQ ID NO:016] asd DNA

<210>016
 <211>1386
 <212> DNA
 <213>Artificial sequence
 <220>
 <223> codon-optimized gene for asd, originally from E. coli
 <400> 016

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CTACGGCGTTTCACTTCTGAGTTCGGCATGGGGTCAGGTGGGACCACCGC
GCTACTGCCGCCAGGCAAATGAGAAACGATATCGGATCCGGTACCTTATG
CCAACTGACGCAGCATACGGCGCAGCGTTCCGCCGCACCCACAGCAGC
TGATACCAACCGTAAACGCGCTCAAGAACTCTGGGCCCATGTTTCAGCTT
ACGCAGACGACCGACCGGGGTGGTCAGCGTGCCCGTAACGGCAGCCGGGG
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CTTCAGCTTGATGGTGAATGCTTGGGAGTGGCAACGCAGAGCGCCAACGC
GCACGCACAGACCGTCAACCGGAATAACAGAAGAGGTGTTTCAGGATTTTG
TTAGTTTCTGCTTGACCTTCCACTCTTCACGGCTTTGACCATTGTCCAG
CTGCTTATCGATCCACGGAATCAGGCTACCCGCCAGTGGCACACCGAAGT
TGTCAACCGGCAGTTACCGGAACGCGTCAGGGTGGTAACCTTGCCTTCA
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CTGCTAGCCGCATCGATCCAGTAACCTTGCCAGCCAGATTCACGCAGCTT
CGGGTAGATTTTCGTTTCGTATAGTCACCACCTTGGCAAGTCACAATGATGT
CCAGAGCTTTTCAGGGCCTCCAGGTCAAAGGCGTCCTGCAGGGTACCCGTG
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CACTGGGCGAATTGCATCGAAGTCACGCTCTTCCACCATACGCTGCATCA
GGACGCTGCCGACCATAACCGCGCCAGCCGATAAAGCCGACATTCTTCATG
ATCGTTTTCGCCTGTGGTATGAAATTTACACGCATTATATACAAAAAAG
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[SEQ ID NO:017] cysM DNA

<210>017
<211>1264
<212> DNA
<213>Artificial sequence
<220>
<223> codon-optimized gene for cysM, originally from E. coli
<400> 017

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GCTACTGCCGCCAGGCAAATGAGACTGATATCTTAAATGCCCGCACCCCTG
CGAGAAGTGTTCTTACCAAACACGCCAGTGCTCAAATAGCGATCACCGC
GGTCACAAATGATTGCGACGACCACTGCATCCGGATTGCGCTTGGCGACG
CGCAGAGCACCCGCGACTGCACCACCGCTGCTAACACCACAGAAGATGCC
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TCCGTAGGCCAACGGCGGATGCCCGGAATGCTGCTGCCTTCTTCCGGCTG
CAGACCCACAATGGTAACCGGCTTGGATTGTTTCGCGCATGAAGCGGCTGA
CGCCGGTAATCGTGCCCGTCTGTCGCCATGCTCGAAACGAAATGGGTAATA
CGACCACCGGTCTGTTGCCAAATCTCCGGACCGGTCTGTTGATAGTGCGC
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CATGCTCAGAGCCGCACGATCCTTAACGCTGCCCGCTGGGTTATTGCCCT
CCAGCTTCAGCCACACTTCGCTACCGTTGTCCGGACCCATGCGTTGCAGC
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TGTGCGGATCGTGGTTAAAATCTACAGAGACCAACGGCAATTCCGTATAG
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[SEQ ID NO:018] ilvA DNA

<210>018
<211>1893
<212> DNA
<213>Artificial sequence
<220>
<223> codon-optimized gene for ilvA, originally from E. coli
<400> 018

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GCTACTGCCGCCAGGCAAATGAGCTCTTAACCTGCCAGGAAGAAACGGAA
GGCCGGATTGTTCTGCTCTGTCGTGGCAGTCATAACCCAGCTCATTAGAC
GCGTCTCAAAATCCGGCTCGTGATCACCCAGTTTGAACGCCGCCAGGACA
CGGCCGTAATCGGTGCCATGGCTGCGATAGTGAAACAGGGAAATGTTCCA
GTAGGTACCCAGGGTGTTCAGGAAACGCAGCAGCGCGCCTGGAGACTCCG
GGAAGTCTGAAGCTGTACAGGCGCTCCTGCAGCGGGTGGCTCGGACGGCCA
CCCACCATGTAACGAACGTGCAGCTTTGCCATTTTCGTCATCGCTCAGATC
GACAACAGAATAACCGCCGTCATTCAGCATTTGCAGGATTTCTTTACGTT
CTTCCAGACCACGGCTCAGACGCACGCCACGAAGATGCATGCGTTTTTC
GCGTCTGCGAAGCGGTAAATTGAACTCGGTACGCTACGACCGCCAGCAA
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GTCAAACCTGCCATCATTGCATACGCACCACGCAGTTTGAAGCTGTGGAC
CGGCTGGCGATCCTCGCGCTTACCAGGATCACATTATCCAGACGGCTGC
TCAGCTTTTCCATCTTCTGCAGCGGGTACCTGGGCTGCCTCATAACC
GGCGCACGCAGAACCGCACGCAGGTATTCGCGCCTTCCGGCGCACCGCT
CAGCGGCTGGCTGTCTGCCATGGAAATACTCCTTGAAGTAAGTGTTA
GATGAGTGCGTTAATTCACACTTCTGAGAAATTCGCTAAACGCATCAAA
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TGTTATAGGATTATTACCAAAACATTATATGAATTCCCGCTGA

[SEQ ID NO:019] thrA DNA

<210>019
<211>2463
<212> DNA
<213>E. coli
<220>
<223> natural sequence cloned from E. coli using PCR

<400> 019

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GCGCTGATTTGCCGTGGCGAGAAAATGTCGATCGCCATTATGGCCGGCGTATTAGAAGCG
CGCGGTCACAACGTTACTGTTATCGATCCGGTCGAAAACTGCTGGCAGTGGGGCATTAC
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CCCGATGCGAGGTTGTTGAAGTCGATGTCTACCAGGAAGCGATGGAGCTTTCCTACTTC
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TCTGGTCCGGGGATGAAAGGGATGGTCGGCATGGCGGCGCGCGTCTTTGCAGCGATGTCA
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GAAGTGGATGGTAATGATCCGCTGTTCAAAGTGAAAAATGGCGAAAACGCCCTGGCCTTC
TATAGCCACTATTATCAGCCGCTGCCGTTGGTACTGCGCGGATATGGTGCGGGCAATGAC
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[SEQ ID NO:020] cynTS DNA

<210>020

<211>2123

<212> DNA

<213>E. coli

<220>

<223> obtained from selection using SCALES from an E. coli DNA library

<400> 020

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GGTGGAGTATGCCGTCGCTGCGCTTCGGGTATCTGACATTGTGATTTGTG
GTCATTCCAACGTGGCGCGATGACCGCCATTGCCAGCTGTCAGTGCATG

GACCATATGCCTGCCGTCTCCCACTGGCTGCGTTATGCCGATTCAGCCCCG
 CGTCGTTAATGAGGCGCGCCCGCATTCCGATTTACCGTCAAAAAGCTGCGG
 CGATGGTACGTGAAAACGTCATTGCTCAGTTGGCTAATTTGCAAACATCAT
 CCATCGGTGCGCCTGGCGCTCGAAGAGGGGCGGATCGCCCTGCACGGCTG
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 CATGATTCAGTCACAAATTAACCGCAATATTCGTCTTGATCTTGCCGATG
 CCATTTTGTCTCAGCAAAGCTAAAAAGATCTCTCATTTGCCGAGATTGCC
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 GCAGGCGCTTCCTGCCGACGCCGCCCGCCTGGTCGGGGCGAAGCTGGATC
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 GGTTTCAGCAGCGCACGCCACTGGTGATGGGGCTGTGGTCCGCGGCTCTG
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 TTGCCTGGTTACCCGCTTTCTATATTGAGATTGGTGCCAGCGCGCAGTAC
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 GCTGATGCCTGCTATGGCTCGCCATCAGGATCGGCGCAAACGTTAATGC
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 ATGCAATTGCCGGTATTGTGGGCGATGGTGTGTGGGTTAGGTCTGGGCGG
 CGCGTTTCCGCTCTGTTTGTCTGGCGCTCGATCACTCTGTGCAACCGG
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[SEQ ID NO:021 folA C1 PCR Primer

<210>021
 <211>20
 <212> DNA
 <213>artificial sequence
 <220>
 <223> oligonucleotide
 <400> 021

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[SEQ ID NO:022 folA C1 PCR Primer

<210>022
 <211>20
 <212> DNA
 <213>artificial sequence
 <220>
 <223> oligonucleotide
 <400> 022

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[SEQ ID NO:023 folA C1 PCR Product

<210>023

<211>1212

<212> DNA

<213>E. coli

<220>

<223> natural sequence for folA gene cloned from E. coli using PCR

<400> 023

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GCTGGATGTTCTGCGCTATGTGAAATCCTTAGGCGACAGCGTACGTCTGG
TGCTGGGCAATCACGATCTGCATCTGCTGGCGGTATTTGCCGGGATCAGC
CGCAATAAACCGAAAGATCGCCTGACACCGCTGCTGGAAGCGCCGGATGC
CGACGAGCTGCTTAACTGGCTGCGGCGCCAGCCTCTGCTGCAAAATCGACG
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TGAATCCTATCCCTTCTTTCTTGATGCCATGTACGGCGATATGCCAAATA
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CGGCTGCTGCTGGGGTGGTACATTAACCTGCCTGCGCTGGGAAGATAAAC
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GAATCTCAAAGCAATAGCTGTGAGAGTTCTGCGCATCAGCATCGTGGAAT
TCGCTGAATACCGATTCCCAGTCATCCGGCTCGTAATCCGGGAAATGGGT
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GTACGTCACCA

[SEQ ID NO:024 folA ORF PCR Primer

<210>024

<211>25

<212> DNA

<213>artificial sequence

<220>

<223> oligonucleotide

<400> 024

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[SEQ ID NO:025 folA ORF PCR Primer

<210>025

<211>21

<212> DNA

<213>artificial sequence

<220>

<223> oligonucleotide

<400> 025

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[SEQ ID NO:026 folA ORF PCR Product

<210>026

<211>672

<212> DNA

<213>E. coli

<220>

<223> natural sequence for folA ORF cloned from E. coli using PCR

<400> 026

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CACCAGTCGACGACGGTTTACGCTTTACGTATAGTGCGGACAATTTTTTT
TATCGGGAAATCTCAATGATCAGTCTGATTGCGGCGTTAGCGGTAGATCG
CGTTATCGGCATGGAAAACGCCATGCCGTGGAACCTGCCTGCCGATCTCG
CCTGGTTTAAACGCAACACCTTAAATAAACCCGTGATTATGGGCCGCCAT
ACCTGGGAATCAATCGGTCGTCCGTTGCCAGGACGCAAAAATATTATCCT
CAGCAGTCAACCGGGTACGGACGATCGCGTAACGTGGGTGAAGTCGGTGG
ATGAAGCCATCGCGGCGTGTGGTGACGTACCAGAAATCATGGTGATTGGC
GGCGGTGCGGTTTATGAACAGTTCTTGCCAAAAGCGCAAAAATGTATCT
GACGCATATCGACGCAGAAAGTGAAGGCGACACCCATTTCCCGGATTACG
AGCCGGATGACTGGGAATCGGTATTCAGCGAATTCCACGATGCTGATGCG
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[SEQ ID NO:027 folD PCR Primer

<210>027

<211>20

<212> DNA

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<220>

<223> oligonucleotide

<400> 027

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[SEQ ID NO:028 folD PCR Primer

<210>028

<211>19

<212> DNA

<213>artificial sequence

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<223> oligonucleotide

<400> 028

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[SEQ ID NO:029 folD PCR Product

<210>029

<211>1630

<212> DNA

<213>E. coli

<220>

<223> natural sequence for folD gene cloned from E. coli using PCR

<400> 029

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AAATATATTCAACACAAATATAGACCTGAAGCGGTAAATTACCAGGCTGA
AAATTCCTTTTTATATTGTCAGGTATTTCTTAATTATCTTAATCCTTAGA
CAAGGAAATAAATCAGTTCCAGATTTACAACGCCATCATGGACGAAAAAT
GAAGCTTTCAGTCTCAGCGACGGTGCGCCTCACCTTCGCAAGAGGTCGCT
TCACGCGATAAATCTGAAACGAAACCTGACAGCGCGCCCCGCTTCTGACA
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TGAAGTTGCTCAAAAAGTTCAGGCGCGTATTGCAGCCGGACTGCGGGCAC
CAGGACTGGCCGTTGTGCTGGTGGGTAGTAACCCTGCATCGCAAATTTAT
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GGTTGCCACGCTGATTGAAAACACGCTACAGGCGTGCGTTGAATATCATG
ATCCACAGGATGAGTAACATGGCGACATTTTCTTTAGGTAAACATCCGCA
CGTTGAGCTGTGCGACTTGCTGAAACTGGAAGGCTGGAGCGAAAGCGGCG
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[SEQ ID NO:030 aroKB C1 PCR Primer

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<223> oligonucleotide
<400> 030

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[SEQ ID NO:031 aroKB C1 PCR Primer

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<212> DNA
<213>artificial sequence
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<223> oligonucleotide
<400> 031

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[SEQ ID NO:032 aroKB C1 PCR Product

<210>032
<211>1132
<212> DNA
<213>E. coli
<220>
<223> natural sequence for aroKB genes cloned from E. coli using PCR
<400> 032

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AGGCGAAGAAGGCTTCCGCGATCGCGAAGAAAAGGTCATCAATGAGTTGA
CCGAGAAACAGGGTATTGTGCTGGCTACTGGCGGCGGCTCTGTGAAATCC
CGTGAAACGCGTAACCGTCTTTCCGCTCGTGCGGCTTGTGCTTTATCTTGA
AACGACCATCGAAAAGCAACTTGCACGCACGCAGCGTGATAAAAAACGCC
CGTTGCTGCACGTTGAAACACCGCCGCGTGAAGTTCTGGAAGCGTTGGCC
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TGATGATCAAAGCGCTAAAGTGTTGCAAACCAGATTATTCACATGCTGG
AAAGCAACTAATTCTGGCTTTATATACACTCGTCTGCGGGTACAGTAATT
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[SEQ ID NO:033 pheA C1 PCR Primer

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<400> 033

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[SEQ ID NO:034 pheA C1 PCR Primer

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<400> 034

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[SEQ ID NO:035 pheA C1 PCR Product

<210>035
<211>2491
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<223> natural sequence for pheA gene cloned from E. coli using PCR
<400> 035

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ATCGCCCCGGTACGTGATATTGATCGTGAACGCGATTTGCTGGAAAGATTA
ATTACGCTCGGTAAAGCGCACCATCTGGACGCCATTACATTACTCGCCT
GTTCCAGCTCATCATTGAAGATTCCGTATTAACCTCAGCAGGCTTTGCTCC
AACAACATCTCAATAAAATTAATCCGCACTCAGCACGCATCGCTTTTCTC
GGCCCCAAAGGTTCTTATTCCCATCTTGCGGCGCGCCAGTATGCTGCCCG
TCACTTTGAGCAATTCATTGAAAGTGGCTGCGCCAAATTTGCCGATATTT
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CAGCTTGTGCGATTGTTGGCGAGATGACGTTAACTATCGACCATTTGTTGT
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AGGTTCCGGCGAAAACCACGTTGTTAATGGCGACCGGGCAACAAGCCGGT
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GTGCAGCCCGTAAGCAAAAAGTAGCAAAGTGGCGCAGTGCCTGAATAAACG
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CGGTAAAGGCGGTAAATTTGCCAATAACTTGCTCAGTAACGTGGATTGGCA
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CAGTCATGTTGCTCCAGAATCCGCACCTGATAACCCGAGAGGGTTCAGCAT
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CGCGCTCCGGAACATAAATAGGCAGTCCAAAGCGGCTTTTACCTCGCCC
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ATCGACTTCATCAATTTGATCGCGTAATGCGGTCAATTCAGCAACCATAA
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[SEQ ID NO:036 pheA C2 PCR Primer

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<211>20
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<400> 036

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[SEQ ID NO:037 pheA C2 PCR Primer

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<212> DNA
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<400> 037

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[SEQ ID NO:038 pheA C2 PCR Product

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<211>1484
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<400> 038

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CTGAATTTATTAGCGAAGCGTCTGGAACGGTTGCTGAAGTGGGCGAGGT
GAAAAGCCGCTTTGGAAGTGCCTATTTATGTTCCGGAGCGCGAGGCATCTA
TGTTGGCCTCGCGTCTGTCAGAGGCGGAAGCTCTGGGTGTACCGCCAGAT
CTGATTGAGGATGTTTTGCGTCTGGGTGATGCGTGAATCTTACTCCAGTGA
AAACGACAAAGGATTTAAACACTTTGTCCGTCAGTCCGTCGGGTGGTTA
TCGTCGGCGGTGGCGGTGATGAGGACGCTGTTTCGAGAAGATGCTGACC
CTCTCGGGTTATCAGGTGCGGATTCTGGAGCAACATGACTGGGATCGAGC
GGCTGATATTGTTGCCGATGCCGGAATGGTGATTGTTAGTGTTGCCAATCC
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GGTGGCGCATGATGGTCCGGTCTGGGGCTACACCCGATGTTCCGGTCCGG
ACAGCGGTAGCCTGGCAAAGCAAGTTGTGGTCTGGTGTGATGGACGTAAA
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GCTGCATCGTATTAGCGCCGTCGAGCACGATCAGAATATGGCGTTTATTC
AGGCACTGCGCCACTTTGCTACTTTTGTCTTACGGGCTGCACCTGGCAGAA
GAAAATGTTTCAGCTTGAGCAACTTCTGGCGCTCTCTTCGCCGATTTACCG
CCTTGAGCTGGCGATGGTCGGGCGACTGTTTGCTCAGGATCCGCAGCTTT
ATGCCGACATCATTATGTCGTCAGAGCGTAATCTGGCGTTAATCAAACGT
TACTATAAGCGTTTCGGCGAGGCGATTGAGTTGCTGGAGCAGGGCGATAA
GCAGGCGTTTATTGACAGTTTCCGCAAGGTGGAGCACTGGTTCGGCGATT
ACGCACAGCGTTTTCAGAGTGAAAGCCGCGTGTATTGCGTCAGGCGAAT
GACAATCGCCAGTAATAATCCAGTGCCGGATGATTCACATCATCCGGCAC
CTTTTCATCAGGTTGGATCAACAGGCACTACGTTCTCACTTGGGTAACAG

CCCAATACCTTCATTGAACGGGTGATTTCCCCTAACTCTTCAATGCTTT
TTGCATTTCCGCTGATTCAAGATTGGCCTGAATATCCAGATAGAACATCT
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AGATTGTGTTGCGCAGTACCAGCAACGCTTCAA

[SEQ ID NO:039 menA C1 PCR Primer

<210>039
<211>20
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<223> oligonucleotide
<400> 039

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[SEQ ID NO:040 menA C1 PCR Primer

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<211>20
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 040

TATTCCTAAGCCAGTGGGCA

[SEQ ID NO:041 menA C1 PCR Product

<210>041
<211>1749
<212> DNA
<213>E. coli
<220>
<223> natural sequence for men A gene cloned from E. coli using PCR
<400> 041

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AATCGACAAAATCTGTAAGCGCGGCGAGTCTCCGGTCCGGATGTTTCTC
GTGAAGGCGTTTCAGCGTGACCTGCTGCCGCTGGTAGAAGGTTGCACCGTT
TCCACCAAACACGGGATGGTCAAACTGACCACATTCTGTTTATCGCTTC
TGGCGCGTTCCAGATTGCGAAACCGTCTGACCTGATCCCGGAACTGCAAG
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GAGCGTATTCTGACCGAGCCGAATGCCTCTATCACCGTGCAGTACAAAGC
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ATGTGAGCAAACATCTGGATGCGTTGGTGGCAGATGAAGATCTGAGCCGT
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GAACTCAGGCGTGCGTGGAAGTTTACGACCTAAAACCCTCCCCCTCGCC
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CGATCCGCTGGTCGCCCTGCTGGCACTAATTACCGCCGGGCTATTACAGA
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CCAGCAAGAGATGAAACGGGCGCTCATTATTACCGTCGTGCTCATCTGTC
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GTCGGTTTCCTGATTCTTGGCGGGTTGTCGATCATTGCCGCTATCACCTA
CACCGTGGGCAATCGTCCTTATGGTTATATCGGTCTGGGTGATATTTCCG
TACTGGTTTTCTTTGGCTGGTTGAGTGTGCATGGGGAGCTGGTATTTACAG
GCTCATACATTGATTCCGGCACTGATCCTTCCGGCGACCGCATGCGGCCT
GCTGGCAACGGCAGTACTGAATATTAATAACCTGCGTGATATCAATAGCG
ACCGCGAAAATGGCAAAAACACGCTGGTGGTGCCTTAGGTGAAGTGAAC
GCGCGTCGTTATCATGCCTGCCTGCTGATGGGCTCGCTGGTGTGTCTGGC
GCTGTTTAATCTCTTTTCGCTGCATAGCCTGTGGGGCTGGCTGTTCTGC
TGGCGGCACCATTACTGGTGAAGCAAGCCCGTTATGTGATGCGGGAAATG
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[SEQ ID NO:042 menA ORF PCR Primer

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<211>20
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<223> oligonucleotide
<400> 042

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[SEQ ID NO:043 menA ORF PCR Primer

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<211>20
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 043

TTCTCGCAGCAACTGAATGT

[SEQ ID NO:044 menA ORF PCR Product

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<211>1132
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<213>E. coli
<220>
<223> natural sequence for menA ORF cloned from E. coli using PCR
<400> 044

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GCGTGGCTGGAAAGTTTACGACCTAAACCCCTCCCCCTCGCCTTTGCTGC
AATTATCGTCGGGACAGCGCTGGCATGGTGGCAAGGTCACCTTCGATCCGC
TGGTCGCCCTGCTGGCACTAATTACCGCCGGGCTATTACAGATCCTTTCT
AACCTCGCCAATGATTACGGCGATGCGGTAAAAGGCAGCGATAAACCTGA

CCGCATTGGGCGCTACGCGGCATGCAAAAAGGGGTCATTACCCAGCAAG
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 CTGGCACTGGTTGCAGTGGCATGCCATACGCTGGCCGATTTTGTGGTTT
 CCTGATTCTTGGCGGGTTGTCGATCATTGCCGCTATCACCTACACCGTGG
 GCAATCGTCCTTATGGTTATATCGGTCTGGGTGATATTTCCGTAAGTT
 TTCTTTGGCTGGTTGAGTGTGTCATGGGGAGCTGGTATTTACAGGCTCATAC
 ATTGATTCCGGCACTGATCCTTCCGGCGACCGCATGCGGCCTGCTGGCAA
 CGGCAGTACTGAATATTAATAACCTGCGTGATATCAATAGCGACCGCGAA
 AATGGCAAAAACACGCTGGTGGTGCGCTTAGGTGAAAGTGAACGCGCGTCG
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 ATCTCTTTTCGCTGCATAGCCTGTGGGGCTGGCTGTTCTGCTGGCGGCA
 CCATTACTGGTGAAGCAAGCCCGTTATGTGATGCGGGAAATGGACCCGGT
 GGCGATGCGACCAATGCTGGAACGTACTGTCAAGGGAGCGTTACTGACTA
 ACCTGCTGTTTGTGTTTAGGGATATTCTAAGCCAGTGGGCAGCATAACTG
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 ATATACTGAAAATTCTCGCAGCAACTGAATGT

[SEQ ID NO:045 serA PCR Primer

<210>045
 <211>20
 <212> DNA
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 <400> 045

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[SEQ ID NO:046 serA PCR Primer

<210>046
 <211>20
 <212> DNA
 <213>artificial sequence
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 <223> oligonucleotide
 <400> 046

TTTATCCCTTCTCCACACCG

[SEQ ID NO:047 serA PCR Product

<210>047
 <211>1907
 <212> DNA
 <213>E. coli
 <220>
 <223> natural sequence for serA gene cloned from E. coli using PCR
 <400> 047

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 CGATGGCACGTAGTGCAGTGGCGCGTCAGCTGGTGAAGTGGGCGGTTCG
 CCGGAATACCGTCAGGGCGTGGTGACCGATAATGGCAACGTGATCCTCGA
 CGTCCACGGCATGGAAATCCTTGACCCGATAGCGATGGAAAACGCCATAA
 ATGCGATTCTGGCGTGGTGACTGTTGGCTTGTGCTAACCGTGGCGCG
 GACGTTGCGCTGATTGGCACACCTGACGGTGTCAAAACCATTGTGAAATG

ATCTGACGGGGGAACCTCCCCCGTTAAAAAATTCTCTTCATTAAATTTG
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TCCTCTAAACCAGCATATTCATCCAAGAATTACCTTTGCGTGATATTTCC
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GGTAGAAGGCGTGACCAAAAAGGCGCTGGAAAGCCTTCGTGCAGCTGGTT
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CGCCGCGCAATATCTGCAAACCTCCGCCCAGATGGGTTATGTGGTTATTG
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[SEQ ID NO:048 glyA C1 PCR Primer

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<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 048

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[SEQ ID NO:049 glyA C1 PCR Primer

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<211>20
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 049

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[SEQ ID NO:050 glyA C1 PCR Product

<210>050
<211>2379
<212> DNA
<213>E. coli
<220>
<223> natural sequence for glyA gene cloned from E. coli using PCR
<400> 050

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TTGTCGGATCGCTGAACGCACCTTCCAGTTTGCTCAAATCCATCAGACCT
TCGCTATCAAACCTGACCTTTAGCGCGATCGGCTTCGCTCGGCTGACGATA
CCAGGTGTGCGCGGTAAAGCGCGGCAGTGACTGCCCCAGTTCCTTAACTT
CATCGGCAAAGGCGTGAACATCGCCATTTTCTGCCGCATGGAACCAGTTC
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CCAACATTGGCGTGATTGTGCAACCAGTTGGATACCTGCCCCACCCTCTTC
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AGTACTGACGAATTTCTGATGTGGGAAACCTTCCGGCTTCAGCCAGACG
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CATGCTCACGTTGTTACTACCACCACTCACAAAACCCTGGCGGGTCCGCG
CGGCGGCCTGATCCTGGCGAAAGGTGGTAGCGAAGAGCTGTACAAAAAAC
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[SEQ ID NO:051 glyA ORF PCR Primer

<210>051

<211>20
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 051

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[SEQ ID NO:052 glyA ORF PCR Primer

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<223> oligonucleotide
<400> 052

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[SEQ ID NO:053 glyA ORF PCR Product

<210>053
<211>1839
<212> DNA
<213>E. coli
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<223> natural sequence for glyA ORF cloned from E. coli using PCR
<400> 053

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CGTTGATATGGCGCACGTTGCGGGCCTGGTTGCTGCTGGCGTCTACCCGA
ACCCGGTTCCTCATGCTCACGTTGTTACTACCACCACTCACAAAACCCTG
GCGGGTCCGCGCGGCGGCCTGATCCTGGCGAAAGGTGGTAGCGAAGAGCT
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GAAGCAGACGCCGCTCTGGGCCGTGCTAACATCACCGTCAACAAAAACAG
CGTACCGAACGATCCGAAGAGCCCGTTTGTGACCTCCGGTATTCGTGTAG
GTACTCCGGCGATTACCCGTCGCGGCTTTAAAGAAGCCGAAGCGAAAGAA
CTGGCTGGCTGGATGTGTGACGTGCTGGACAGCATCAATGATGAAGCCGT
TATCGAGCGCATCAAAGGTAAAGTTCTCGACATCTGCGCACGTTACCCGG
TTTACGCATAAGCGAAACGGTGATTTGCTGTCAATGTGCTCGTTGTTTAT
GCCGGATGCGGCGTGAACGCCTTATCCGGCCTACAAAAC

[SEQ ID NO:054 metC C1 PCR Primer

<210>054
<211>20
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<223> oligonucleotide
<400> 054

GTTTAAGGAACGCGCTTCAG

[SEQ ID NO:055 metC C1 PCR Primer

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<223> oligonucleotide
<400> 055

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[SEQ ID NO:056 metC C1 PCR Product

<210>056
<211>1251
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<213>E. coli
<220>
<223> natural sequence for metC gene cloned from E. coli using PCR
<400> 056

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ACTACGGAGGCCAAAATAAGCCCAATCATCACGCACTTAACGACAATATC
GGCGTGCTGATACATACCCAGACGGAAGGTCCGTCTGCATTAAATTAT
TACCCACTGTGTATCTCCAGGACGCAAGTCACAAAATCTGCGCATAATAA
TATCAAAACGACGTCGAATTGATAGTCGTTCTCATTACTATTTGCATACT
GCCGTACCTTTGCTTTCTTTTCCTTGCGTTTACGCAGTAAAAAAGTCACC
AGCACGCCATTTGCGAAAATTTCTGCTTTATGCCAATTCTTCAGGATGC
GCCCCGGAATATTCATGCTAGTTTAGACATCCAGACGTATAAAAACAGGA
ATCCCAGCATGGCGGACAAAAGCTTGATACTCAACTGGTGAATGCAGGA
CGCAGCAAAAAATACACTCTCGGCGCGGTAAATAGCGTGATTTCAGCGCGC
TTCTTCGCTGGTCTTTGACAGTGTAGAAGCCAAAAACACGCGACACGTA
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TTCTCCTTACAACAAGCGATGTGTGAACTGGAAGGTGGCGCAGGCTGCGT
GCTATTTCCCTGCGGGGCGGCAGCGGTTGCTAATTCCATTCTTGCTTTTA
TCGAACAGGGCGATCATGTGTTGATGACCAACACCGCCTATGAACCGAGT
CAGGATTTCTGTAGCAAAATCCTCAGCAAACCTGGGCGTAACGACATCATG
GTTTGATCCGCTGATTGGTGCCGATATCGTTAAGCATCTGCAGCCAAACA
CTAAAATCGTGTTTCTGGAATCGCCAGGCTCCATCACCATGGAAGTCCAC
GACGTTCCGGCGATTGTTGCCGCGGTACGCAGTGTGGTGCCGGATGCCAT
CATTATGATCGACAACACCTGGGCAGCCGGTGTGCTGTTTAAGGCGCTGG
ATTTTGGCATCGATGTTTCTATTCAAGCCGCCACCAAATATCTGGTTGGG
CATTGATGCGATGATTGGCACTGCCGTGTGCAATGCCCGTTGCTGGGA
GCAGCTACGGGAAAATGCCTATCTGATGGGCCAGATGGTCGATGCCGATA
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[SEQ ID NO:057 tyrA PCR Primer

<210>057
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[SEQ ID NO:058 tyrA PCR Primer

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<400> 058

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[SEQ ID NO:059 tyrA PCR Product

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<211>1131
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<213>E. coli
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<400> 059

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TGCGTCCGGTGTTATCGTCGGCGGTGGCGGTCAGATGGGACGCCTGTT
GAGAAGATGCTGACCCTCTCGGGTTATCAGGTGCGGATTCTGGAGCAACA
TGACTGGGATCGAGCGGCTGATATTGTTGCCGATGCCGGAATGGTGATTG
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TTACCGAAAGATTGTATTCTGGTCGATCTGGCATCAGTGAAAAATGGGCC
ATTACAGGCCATGCTGGTGCGCATGATGGTCCGGTGCTGGGGCTACACC
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CTGCACCTGGCAGAAGAAAATGTTTCAGCTTGAGCAACTTCTGGCGCTCTC
TTCGCCGATTTACCGCCTTGAGCTGGCGATGGTTCGGGCGACTGTTTGCTC
AGGATCCGCAGCTTTATGCCGACATCATTATGTCGTCAGAGCGTAATCTG
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GGAGCAGGGCGATAAGCAGGCGTTTATTGACAGTTTCCGCAAGGTGGAGC
ACTGGTTCGGCGATTACGCACAGCGTTTTCAGAGTGAAAGCCGCGTGTTA
TTGCGTCAGGCGAATGACAATCGCCAGTAATAATCCAGTGCCGGATGATT
CACATCATCCGGCACCTTTTCATCAGGTTGGATCAACAGGCACTACGTTT
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CTCTTCAATGCTTTTTGCATTTCCGCTGAT

[SEQ ID NO:060 tyrA -aroF PCR Primer

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[SEQ ID NO:061 tyrA -aroF PCR Primer

<210>061
<211>20
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 061

GCCTGTTGATCCAACCTGAT

[SEQ ID NO:062 tyrA -aroF PCR Product

<210>062
<211>2382
<212> DNA
<213>E. coli
<220>
<223> natural sequence for tyrA-aroF genes cloned from E. coli using PCR
<400> 062

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TACCGACGAACAGGTTTTAATGACTCCGGAACAACCTGAAGGCCGCTTTTC
CATTGAGCCTGCAACAAGAAGCCCAGATTGCTGACTCGCGTAAAAGCATT
TCAGATATTATCGCCGGGCGCGATCCTCGTCTGCTGGTAGTATGTGGTCC
TTGTTCCATTATGATCCGGAAACTGCTCTGGAATATGCTCGTCGATTTA
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AGCAATTGGTGCTCGTACAACGGAATCGCAAACCTCACCGTGAAATGGCCT
CCGGGCTTTCCATGCCGGTTGGTTTTAAAAACGGCACCGACGGCAGTCTG
GCAACAGCAATTAACGCTATGCGCGCCGCCGCCAGCCGCACCGTTTTGT
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GCGGATGTTGCGCAATGTGAAAAAGAGATGGAACAGGCGGGACTGCGCCC
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GTCAGCCTGCGGTGGCAGAATCCGTGGTTGCTCAAATCAAAGATGGCAAT
CGCTCAATTATTGGTCTGATGATCGAAAGTAATATCCACGAGGGCAATCA
GTCTTCCGAGCAACCGCGCAGTGAAATGAAATACGGTGTATCCGTAACCG
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GCGCTGCTGAATTTATTAGCGAAGCGTCTGGAAGTGGTTGCTGAAGTGGG
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CCAGATCTGATTGAGGATGTTTTGCGTCGGGTGATGCGTGAATCTTACTC
CAGTGAACAAACGACAAAGGATTTAAACACTTTGTCCGTCACTGCGTCCGG
TGGTTATCGTCGGCGGTGGCGGTCAGATGGGACGCCTGTTGAGAAGATG
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GCGATTACGCACAGCGTTTTAGAGTGAAAGCCGCGTGTTATTGCGTCAG
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[SEQ ID NO:063 aroE PCR Primer

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<211>21
<212> DNA
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<220>
<223> oligonucleotide
<400> 063

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[SEQ ID NO:064 aroE PCR Primer

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<211>20
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 064

ATCGAGTTTTGGTTGGGATG

[SEQ ID NO:065 aroE PCR Product

<210>065
<211>1867
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<223> natural sequence for aroE gene cloned from E. coli using PCR
<400> 065

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GTTGATAAGGGGCTGATTTTAATCGCAGCAAATTACGAGCAGCTTAAACC
CTATATTGATGACACCATGTTGACTGACGTGCGAGCGTGAAACCATTTTTT
CCCGCTGGCCAGGTCTGTACCTTTGTCTTTCCCGCGCCTGCGACAACA
CCGCGCTGGTTGACGGGCGCTTTGATTGCTTGCTGTACGAGTCACCGA
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AGTTATAAAGCAATTGCAGGAGGAATTGTCCGCGTGAATCAGGCCATCCA
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CCGCTCTCGTGAATGGTATGCAACTGACATGCGCGATCTCTGGCGAGAGT
CTGGCGTATCGCTTTACTGGAGATACGCCAGAACAGTGGTTAGCGAGTTT
TCGTACAGCATCGCTGGGACCTGGAAGAAGAAGCGGAAAACTTAATTCAGG
AACAAAGTGAAGATGATCAAGGCTGGGTCTGGTTACCCTGATCCAGATAT
TCGTCCCTTCCATTTACGTAATTATTCGCGGAATAGCGTAACCCAGCCTT
CTCTTCATCACTTAACGGGCGGATCTGTTTGACGGGGCTACCGAGATACA
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[SEQ ID NO:066 ilvA PCR Primer

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<211>20
<212> DNA
<213>artificial sequence
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<223> oligonucleotide
<400> 066

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[SEQ ID NO:067 ilvA PCR Primer

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<211>20
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 067

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[SEQ ID NO:068 ilvA PCR Product

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<211>1066
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<213>E. coli
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<223> natural sequence for ilvA cloned from E. coli using PCR
<400> 068

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AAGGCAGCTTCCTCAAATTCTGCCAACTGCTTGGCGGGCGTTCGGTCACC
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TGTGCGCCTGAGCCGCGGCCCTCGAAGAGCGCAAAGAAATTTTGCAGATGC
TCAACGACGGCGGCTACAGCGTGTTGATCTCTCCGACGACGAAATGGCG
AAGCTACACGTGCGCTATATGGTTCGGCGGACGTCCATCGCATCCGTTGCA
GGAACGCCTCTACAGCTTCGAATTCCCGGAATCACCGGGCGCGCTGCTGC
GCTTCCTCAACACGCTGGGTACGTACTGGAACATTTCTTTGTTCCACTAT
CGCAGCCATGGCACCGACTACGGGCGCGTACTGGCGGCGTTTCGAACTTGG
CGACCATGAACCGGATTTTCGAAACCCGGCTGAATGAGCTGGGCTACGATT
GCCACGACGAAACCAATAACCCGGCGTTTCAGGTTCTTTTTGGCGGGTTAG
GGAAAAATGCCTGATAGCGCTTCGCTTATCAGGCCTACCCGCGCGACAAC
GTCATTTGTGGTTTCGGCAAAATCTTCAGAATGCCTCAATTAGCGGCTCA
TGTAGCCGCTTTTTCTGCGCACACACGCCAGCTCAAACGGCGTTTTCTC
ATCGCTGCGCTCTAAAATCATCACGCGGTTACGCACCGGTTTCGGGGCTGT
TTTCCAGCACCACTTCCGGCAACAATGCCACGCCACAGCCGAGTGCCACC
ATCGATACCATCGCTTCATGCCCCGCCAACCGTGGCGTAAATCATCGGGTT
ACTGATTTTATTGCGTCGAAACCACAGTTCAATGCGGCGGCGTACCGGCC
CCTGATCGGCCATAATAAACGGCACCGTTGACCAGTCCGGCTTCTCTACC
GACACCTGATTACGCA

[SEQ ID NO:069 ilvA PCR Primer

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<212> DNA
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<220>
<223> oligonucleotide

<400> 069

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[SEQ ID NO:070 ilvA PCR Primer

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<211>20
<212> DNA
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<220>
<223> oligonucleotide
<400> 070

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[SEQ ID NO:071 ilvA PCR Product

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<211>2139
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<400> 071

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GCGATAAATCGAACTGGGGGGTTAATAATGGCTGACTCGCAACCCCTGT
CCGGTGCTCCGGAAGGTGCCGAATATTTAAGAGCAGTGCTGCGCGCGCCG
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TCAGGTTCTTTTTGGCGGGTTAGGGAAAAATGCCTGATAGCGCTTCGCTT
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CCACGCCACAGCCGAGTGCCACCATCGATACCATCGCTTCATGCCCCGCA
ACCGTGGCGTAAATCATCGGGTTACTGATTTTATTGCGTCGAAACCACAG
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[SEQ ID NO:072 cysM PCR Primer

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<211>20
<212> DNA
<213>artificial sequence
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<223> oligonucleotide
<400> 072

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[SEQ ID NO:073 cysM PCR Primer

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<211>20
<212> DNA
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<220>
<223> oligonucleotide
<400> 073

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[SEQ ID NO:074 cysM PCR Product

<210>074
<211>1348
<212> DNA
<213>E. coli
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<223> natural sequence for cysM gene cloned from E. coli using PCR
<400> 074

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TTCGATAATGAAGAACAGTGTCTGAAAGAAGCCAGTAAATTGATTGCCGC
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GCTACTATTTTGATGATGAAGAAATTGGGTACATGTTAAAACGTCACAC
CCAAACTTCCAGTGCCATTTTACTGATCCACTTTATATGTGTTGCTGGGA
TGAAGAATCTCTTTTGGCAGCGATGAAGGTGCTGATGCTCTAAACGTTT
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CATCGCGCTGATGAATATCCAGCACCTCATCCACCAGAGAAGCGTTGAAA
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[SEQ ID NO:075 cynTS PCR Primer

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<211>26
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 075

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[SEQ ID NO:076 cynTS PCR Primer

<210>076
<211>21
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 076

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[SEQ ID NO:077 cynTS PCR Product xx

<210>077
<211>2123
<212> DNA
<213>E. coli
<220>
<223> natural sequence for cynTS genes cloned from E. coli using PCR
<400> 077

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GGTGGAGTATGCCGTGCTGCGCTTCGGGTATCTGACATTGTGATTTGTG
GTCATTCCAACGTGTGGCGCGATGACCGCCATTGCCAGCTGTCAGTGCATG
GACCATATGCCTGCCGTCTCCCACTGGCTGCGTTATGCCGATTCAGCCCG
CGTCGTTAATGAGGCGCGCCCGCATTCCGATTTACCGTCAAAAGCTGCGG
CGATGGTACGTGAAAACGTCATTGCTCAGTTGGCTAATTTGAAACTCAT

CCATCGGTGCGCCTGGCGCTCGAAGAGGGGCGGATCGCCCTGCACGGCTG
GGTCTACGACATTGAAAGCGGCAGCATCGCAGCTTTTGACGGCGCAACCC
GCCAGTTTGTGCCACTGGCCGCTAATCCTCGCGTTTGTGCCATACCGCTA
CGCCAACCGACCGCAGCGTAACCTTATTTTTAAACCATCAGGAGTTCCAC
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CACAAGACAACAACCACTCCGGTTCGCGTGGTATTCACTCCCCGCGCGTG
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GCTGATGCCTGCTATGGCTCGCCATCAGGATCGGCGCAAACTGTTAATGC
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CGCGTTTCCGCTCTGTTTGCTGCTGGCGCTCGATCACTCTGTGCAACCGG
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[SEQ ID NO:078 metC PCR Primer

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<400> 078

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[SEQ ID NO:079 metC PCR Primer

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<212> DNA
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<400> 079

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[SEQ ID NO:080 metC PCR Product

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<211>1251
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<400> 080

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GGCGTGCTGATACATACCCAGACGGAAAGGTCCGTCTGCATTAAATTAT
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TATCAAAACGACGTCGAATTGATAGTCGTTCTCATTACTATTTGCATACT
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[SEQ ID NO:081 dapA PCR Primer

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[SEQ ID NO:082 dapA PCR Primer

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[SEQ ID NO:083 dapA PCR Product

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<212> DNA
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<400> 083

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[SEQ ID NO:084 cadA PCR Primer

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[SEQ ID NO:085 cadA PCR Primer

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<212> DNA
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<400> 085

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[SEQ ID NO:086 cadA PCR Product

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<400> 086

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[SEQ ID NO:087 prs PCR Primer

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<400> 087

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[SEQ ID NO:088 prs PCR Primer

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<400> 088

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[SEQ ID NO:089 prs PCR Product

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<211>1409
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<400> 089

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AAGCCGGGCAAGCTGAGTTTCGGTGACAACGTCACCTTGTTCCAGACGTT
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[SEQ ID NO:090 nrdAB PCR Primer

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<400> 090

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[SEQ ID NO:091 nrdAB PCR Primer

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[SEQ ID NO:092 nrdAB PCR Product

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<211>3806
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<400> 092

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[SEQ ID NO:093 nrdLEF PCR Primer

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<400> 093

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[SEQ ID NO:094 nrdLEF PCR Primer

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[SEQ ID NO:095 nrdLEF PCR Product

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<211>4076
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<400> 095

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AACGCACCGTTGCAGCGAAAAGCTCAGATTATTCAGCAACATTATCGCGG
TGATGATCCGCTGAAAAAGAAAATCGCCAGTGTGTTTCTTGAATCTTTTT
TGTTCTATTCCGTTTCTGGCTGCCGATGTATTTTCCAGCCGCGGAAAG
CTGACCAATACCGCGGACCTGATCCGTCTGATTATCCGCGATGAAGCAGT
CCACGGTTACTACATAGGCTATAAATATCAGAAAAACATGGAAAAGATAT
CTCTGGGACAACGTGAAGAGTTGAAGAGTTTCGCCTTCGATTTGTTGCTG
GAACTCTACGACAACGAGTTGCAATACACCGATGAGCTGTACGCCGAAAC
CCCGTGGGCTGACGATGTGAAAGCGTTTCTCTGTTACAACGCCAATAAGG
CTTTGATGAATCTGGGCTACGAACCGTTATTTCCCGCAGAAATGGCGGAA
GTGAATCCGGCAATCCTCGCCGCGCTTTCGCCGAATGCCGATGAAAATCA
CGATTTCTTTTCCGTTTCCAGGCTCCTCTTATGTGATGGGGAAAGCGGTTG
AAACAGAAGATGAAGACTGGAATTTCTGAGGGTGTATTTTCAAAAATAT
CACTACCCGCAGCAGGGAAATAATCCCGCCAAATAGCTTTTTATCACGC
AAATAATTTGTGGTGATCTAGATCCC

[SEQ ID NO:096 lysA PCR Primer

<210>096

<211>20
<212> DNA
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<220>
<223> oligonucleotide
<400> 096

CAATATGACGTAAGTTAACG

[SEQ ID NO:097 lysA PCR Primer

<210>097
<211>28
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 097

GGGATCTAGACGCTGGTACGTCGTCATT

[SEQ ID NO:098 lysA PCR Product

<210>098
<211>1496
<212> DNA
<213>E. coli
<220>
<223> natural sequence for lys A gene cloned from E. coli using PCR
<400> 098

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TGCCACATTCACTGTTGAGCACCACGATCTCACCAGCCGAAAATCTG
CTGCGTTTGCCCGCTGAATTTGGCTGCCCGGTGTGGGTCTACGATGCGCA
AATTATTCGTCGGCAGATTGCAGCGCTGAAACAGTTTGATGTGGTGCGCT
TTGCACAGAAAGCCTGTTCCAATATTCATATTTTGCCTTAATGCGTGAG
CAGGGCGTGAAAGTGGATTCCGTCTCGTTAGGCGAAATAGAGCGTGCGTT
GGCGGCGGGTTACAATCCGCAAACGCACCCCGATGATATTGTTTTACGG
CAGATGTTATCGATCAGGCGACGCTTGAACGCGTCAGTGAATTGCAAATT
CCGGTGAATGCGGGTTCTGTTGATATGCTCGACCAACTGGGCCAGGTTTC
GCCAGGGCATCGGGTATGGCTGCGCGTTAATCCGGGGTTTGGTCACGGAC
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GCTGGTCGGCATTACATGCACATTGGTTCTGGCGTTGATTATGCCCATC
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GATTTACAGGCTATTTCTGCGGGCGGTGGGCTTTCTGTTCCCTTATCAACA
GGGTGAAGAGGCGGTTGATACCGAACATTATTATGGTCTGTGGAATGCCG
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GCGGAGCGTCAAACAAATGGGGAGCCGCCACTTTGTGCTGGTTGATGCCG
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AACCGTCGTCGCCGACCGTTATGTGAATCGGGCGATGTCTTTACCCAGC
AGGAAGGGGGAAATGTTGAAACCCGCGCCTTGCCGGAAGTGAAGGCAGGT
GATTATCTGGTACTGCATGATACAGGGGCATATGGCGCATCAATGTCATC
CAACTACAATAGCCGTCCGCTGTTACCAGAAGTTCTGTTTGATAATGGTC

AGGCGCGGTTGATTGCGCGTCGCCAGACCATCGAAGAATTACTGGCGCTG
GAATTGCTTTAACTGCGGTTAGTCGCTGGTTGCATGATGACTTGCCTCCA
GCGACGGAGTTGACACTGAATGACGACGTACCAGCGTCTAGATCCC

[SEQ ID NO:099 cyntTS PCR Primer

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<211>26
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 099

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[SEQ ID NO:100 cyntTS PCR Primer

<210>100
<211>21
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 100

CAGTCCAGTTACGCTGGAGTC

[SEQ ID NO:101 cyntTS PCR Product

<210>101
<211>2123
<212> DNA
<213>artificial sequence
<220>
<223> sequence obtained via PCR from pSMART-LC-kan-cynTS
<400> 101

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GGTGGAGTATGCCGTCGCTGCGCTTCGGGTATCTGACATTGTGATTTGTG
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GACCATATGCCTGCCGTCTCCCACTGGCTGCGTTATGCCGATTCAGCCCG
CGTCGTTAATGAGGCGCGCCCGCATTCCGATTTACCGTCAAAAGCTGCGG
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CATGATTCAGTCACAAATTAACCGCAATATTCGTCTTGATCTTGCCGATG
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CACGATGCTGCTGGTACTGGTGTGATTGGTCTTAATATGCGACCACTGC
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AGCTTTAGCGTGGCTGCCCTGTTGACCGCTCTGCCGGTGGTTACCATGGG
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GAGCTTTACCCGCAAAGTGCGCTGCTGCTTAGCAGCGCACTGCTTGGTGG
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GGTTTCAGCAGCGCACGCCACTGGTGATGGGGCTGTGGTCCGCGGCTCTG
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TGGCGCTGGTGTTACAACCTGGTGGGGTTCTGCGGCTTTATCTGGCTGCCG
ATGCAATTGCCGGTATTGTGGGCGATGGTGTGTGGGTTAGGTCTGGGCGG
CGCGTTTCCGCTCTGTTTGTGCTGGCGCTCGATCACTCTGTGCAACCGG
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[SEQ ID NO:102 aroH G149C PCR Primer

<210>102
<211>24
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 102

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[SEQ ID NO:103 aroH G149C PCR Primer

<210>103
<211>20
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 103

GCCACCC TCCGGGCCGT TGC

[SEQ ID NO:104 aroH G149C PCR Product

<210>104
<211>1903
<212> DNA
<213>artificial sequence
<220>
<223> sequence obtained via PCR from pKK223-aroH*445
<400> 104

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GTATAATGTGTGGAATTGTGAGCGGATAACAATTTACACAGGAAACAGA
ATTCCTGAGACTTGTAATGAACAGAACTGACGAACTCCGTACTGCGCGT
ATTGAGAGCCTGGTAACGCCCCGCGAACTCGCGCTACGGTATCCCGTAAC
GCCTGGCGTCGCCACCCATGTCACCGACTCCCGCCGCGAGAATTGAAAAA
TACTGAATGGTGAAGATAAGCGACTGTTGGTCATTATTGGCCCCCTGCTCG
ATCCACGATCTACCGCTGCAATGGAGTACGCCACCCGTCTGCAGTCGCT
GCGCAACCAGTACCAGTCACGGCTGGAAATCGTAATGCGCACCTATTTTG
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TTAAACGGCAGCTATCGGGTAAATCACGGTCTGGAGCTGGCGCGCAAATT
ACTTTTACAGGTAAATGAGCTGGGCGTCCCAACCGCGACCGAGTTCCTCG
ATATGGTGACCTGTCAGTTTATTGCTGATTTAATCAGTTGGGGCGCGATT
GGCGCACGTACTACCGAAAGTCAGATCCACCGCGAAATGGCTTCGGCACT
CTCCTGTCCGGTAGGTTTTAAAAATGGTACCGATGGCAATACGCGGATTG
CTGTGGATGCTATCCGCGCAGCCCCGCGCCAGCCATATGTTCTCTCGCCA
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AACAGAATTTGCCTGGCGGCAGTAGCGCGGTGGTCCCACCTGACCCCATG
CCGAACCTCAGAAGTGAACGCCGTAGCGCCGATGGTAGTGTGGGGTCTCC
CCATGCGAGAGTAGGGAACTGCCAGGCATCAAATAAAACGAAAGGCTCAG
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TCCTGAGTAGGACAAATCCGCCGGGAGCGGATTTGAACGTTGCGAAGCAA
CGGCCCGGAGGGTGCG

[SEQ ID NO:105 speB PCR Primer

<210>105
<211>25
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 105

GGACCCGGGATCAAGTGAAGAAAAC

[SEQ ID NO:106 speB PCR Primer

<210>106
<211>24
<212> DNA
<213>artificial sequence
<220>

<223> oligonucleotide
<400> 106
GGTAACCCGGGTGGTGTCTGAACGT

[SEQ ID NO:107 speB PCR Product

<210>107
<211>1377
<212> DNA
<213>E. coli
<220>
<223> natural sequence for speB gene cloned from E. coli using PCR
<400> 107

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AGATGAGTAAGTCCTGTGTTACTTGAATCCGCTTAATTTAGCGGTGATAA
TCCGCCACAATTTATTGTGACAAATCCAACCCTTCCTCGTCGGGCCTAAC
GACGCGGAAGGGTTTTTTTATATCGACTTTGTAATAGGAGTCCATCCATG
AGCACCTTAGGTCATCAATACGATAACTCACTGGTTTCCAATGCCTTTGG
TTTTTTACGCCTGCCGATGAACTTCCAGCCGATGACAGCGATGCAGACT
GGGTGATTACTGGCGTGCCGTTTCGATATGGCCACTTCTGGTCGTGCGGGT
GGTCGCCACGGTCCGGCAGCGATCCGTCAGGTTTCGACGAATCTGGCCTG
GGAACACAACCGCTTCCCGTGGAATTTTCGACATGCGTGAGCGTCTGAACG
TCGTGGACTGCGGCGATCTGGTATATGCCTTTGGCGATGCCCGTGAGATG
AGCGAAAAGCTGCAGGCGCACGCCGAGAAGCTGCTGGCTGCCGGTAAGCG
TATGCTCTCTTTTCGGTGGTGACCACTTTGTTACGCTGCCGCTGCTGCGTG
CTCATGCGAAGCATTTTCGGCAAATGGCGCTGGTACACTTTGACGCCCAC
ACCGATACCTATGCGAACGGTTGTGAATTTGACCACGGCACTATGTTCTA
TACCGCGCCGAAAGAAGGTCTGATCGACCCGAATCATTCCGTGCAGATTG
GTATTCGTACCGAGTTTGATAAAGACAACGGCTTTACCGTGCTGGACGCC
TGCCAGGTGAACGATCGCAGCGTGGATGACGTTATCGCCCAAGTGAAACA
GATTGTGGGTGATATGCCGTTTTACCTGACTTTTGATATCGACTGCCTGG
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TCCGATCGCGCTATTAACTGGTACGCGGCCTGAAAGATCTCAACATTGT
TGGGATGGACGTAGTGGAAGTGGCTCCGGCATAACGATCAGTCGGAAATCA
CTGCTCTGGCAGCGGCAACGCTGGCGCTGGAAATGCTGTATATTCAGGCG
GCGAAAAAGGGCGAGTAAGCACCAGATGCGATGCGCACGGGTAAAACGTG
CCATTAATGTCGGATGCGGCGTGAACGCCTTATCCGACCTACGTTTCGGCA
CCCGTAGGCCGGATAAGATGCGCCAGCATCGCATCCGGCAATGCGCACAA
GGTAACAAATGTGCCATTTCATGTCAGATGCGGCGTGAACGCCTTATCTGA
CCTACGTTTCGACACCACCCGGGTACC

[SEQ ID NO:108 metE C645A PCR Primer

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<211>24
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 108

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[SEQ ID NO:109 metE C645A PCR Primer

<210>109

<211>20
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 109

GCCACCC TCCGGGCCGT TGC

[SEQ ID NO:110 metE C645A PCR Product

<210>110
<211>2982
<212> DNA
<213>artificial sequence
<220>
<223> sequence obtained via PCR from pKK223-metE C645A
<400> 110

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GAATTGTGAGCGGATAACAATTTACACAGGAAACAGAATCCCGGGGAT
GAATAAACTTGCCGCCTTCCCTAAATTCAAAATCCATAGGATTTACATAT
AATTAGAGGAAGAAAAAATGACAATATTGAATCACACCCTCGGTTTCCCT
CGCGTTGGCCTGCGTCGCGAGCTGAAAAAAGCGCAAGAAAGTTATTGGGC
GGGGAACCTCCACGCGTGAAGAACTGCTGGCGGTAGGGCGTGAATTGCGTG
CTCGTCACTGGGATCAACAAAAGCAAGCGGGTATCGACCTGCTGCCGGTG
GGCGATTTTGCCTGGTACGATCATGTACTGACCACCAGTCTGCTGCTGGG
TAACGTTCCGGCGCGTCATCAGAACAAAGATGGTTCGGTAGATATCGACA
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ACGAAGTGAGCGAGGCGCTGGCGCTGGGCCACAAGGTGAAACCTGTGCTG
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TGACCGCCTGAGCCTGCTGAACGACATTCTGCCGTTTATCAGCAAGTGC
TGGCAGAACTGGCGAAACGCGGCATCGAGTGGGTACAGATTGATGAACCC
GCGCTGGTACTGGAACCTACCACAGGCGTGGCTGGACGCATACAAACCCGC
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GGTTTGCCTTCGCCCTACAAAAATGCCATGAACTGGCACTGCTGCGCGAT
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GTGCGTGCTGAAGCCCAGCGTGCGCGTTTTAACTGCCAGCGTGGCCGAC
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GCGGAACATATCAAGCAGGCCATTGTTGAGCAGGAACGTTTGGGACTGGA
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GCGAGCACCTCGACGGATTTGTCTTTACGCAAAACGGTTGGGTACAGAGC
TACGGTTCCCCTGCGTGGAAGCCACCGATTGTCATTGGTGACATTAGCCG
CCCGGCACCGATTACCGTGGAGTGGGCGAAGTATGCGCAATCGCTGACCG
ACAAACCGGTGAAAGGGATGCTGACGGGGCCGGTGACCATACTCTGCTGG
TCGTTCCCGCGTGAAAGATGTCAGCCGTGAAACCATCGCCAAACAGATTGC

GCTGGCGCTGCGTGATGAAGTGGCCGATCTGGAAGCCGCTGGAATTGGCA
TCATCCAGATTGACGAACCGGCGCTGCGCGAAGGTTTACCGCTGCGTCGT
AGCGACTGGGATGCGTATCTCCAGTGGGGCGTAGAGGCCTTCCGTATCAA
CGCCGCCGTGGCGAAAGATGACACACAAATCCACACTCACATGTGTTATG
CGGAGTTCAACGACATCATGGATTGATTGCGGCGCTGGACGCAGACGTC
ATCACCATCGAAACCTCGCGTTCGACATGGAGTTGCTGGAGTCGTTTGA
AGAGTTTGATTATCCAAATGAAATCGGTCCTGGCGTCTATGACATTCACT
CGCCAAACGTACCGAGCGTGGAATGGATTGAAGCCTTGCTGAAGAAAGCG
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GAAAACGCGCGGCTGGCCAGAAACCCGCGCGGCACTGGCGAACATGGTGC
AGGCGGCGCAGAACTTGCGTCGGGGGTAAAATCCAAACCGGGTGGTAATA
CCACCCGGTCTTTTCTCATTACAGCGACTTCTTCCCACCATACTGCTTAA
ACCATTCAGCATACGCTGCCAGCCATCTTCTGCAGCCAAGCTTGGCTGT
TTTGGCGGATGAGAGAAGATTTTCAGCCTGATACAGATTAAATCAGAACG
CAGAAGCGGTCTGATAAAACAGAATTTGCCTGGCGGCAGTAGCGCGGTGG
TCCCACCTGACCCCATGCCGAAGTGAAGTGAACGCCGTAGCGCCGAT
GGTAGTGTGGGGTCTCCCCATGCGAGAGTAGGGAAGTGGCAGGCATCAAA
TAAAACGAAAGGCTCAGTCGAAAGACTGGGCCTTTCGTTTTATCTGTTGT
TTGTCGGTGAACGCTCTCCTGAGTAGGACAAATCCGCCGGGAGCGGATTT
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[SEQ ID NO:111 metC PCR Primer

<210>111
<211>26
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 111

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[SEQ ID NO:112 metC PCR Primer

<210>112
<211>21
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 112

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[SEQ ID NO:113 metC PCR Product

<210>113
<211>1251
<212> DNA
<213>E. coli
<220>
<223> natural sequence for metC gene cloned from E. coli using PCR
<400> 113

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GGCGTGCTGATACATACCCAGACGGAAAGGTCCGTCTGCATTAAATTAT

TACCCACTGTGTATCTCCAGGACGCAAGTCACAAAATCTGCGCATAATAA
TATCAAAACGACGTCGAATTGATAGTCGTTCTCATTACTATTTGCATACT
GCCGTACCTTTGCTTTCTTTTCCTTGCGTTTACGCAGTAAAAAAGTCACC
AGCACGCCATTTGCGAAAATTTTCTGCTTTATGCCAATTCTTCAGGATGC
GCCCCGGAATATTCATGCTAGTTTAGACATCCAGACGTATAAAAACAGGA
ATCCCCGACATGGCGGACAAAAAGCTTGATACTCAACTGGTGAATGCAGGA
CGCAGCAAAAAATACACTCTCGGCGCGGTAAATAGCGTGATTGAGCGCGC
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TTCTCCTTACAACAAGCGATGTGTGAAGGTGGCGCAGGCTGCGT
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CAGGATTTCTGTAGCAAAATCCTCAGCAAACTGGGCGTAACGACATCATG
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GACGTTCCGGCGATTGTTGCCGCGTACGCAGTGTGGTGCCGGATGCCAT
CATTATGATCGACAACACCTGGGCAGCCGGTGTGCTGTTTAAGGCGCTGG
ATTTTGGCATCGATGTTTCTATTCAAGCCGCCACCAAATATCTGGTTGGG
CATTGAGATGCGATGATTGGCACTGCCGTGTGCAATGCCCCGTTGCTGGGA
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[SEQ ID NO:114 cyntTS PCR Primer

<210>114
<211>26
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 114

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[SEQ ID NO:115 cyntTS PCR Primer

<210>115
<211>21
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 115

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[SEQ ID NO:116 cyntTS PCR Product

<210>116
<211>2123
<212> DNA
<213>artificial sequence
<220>
<223> sequence obtained via PCR from pSMART-LC-kan-cynTS
<400> 116

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GGTGGAGTATGCCGTCGCTGCGCTTCGGGTATCTGACATTGTGATTTGTG
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GACCATATGCCTGCCGTCTCCCACTGGCTGCGTTATGCCGATTCAGCCCG
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GCAGGCGCTTCCTGCCGACGCCGCCGCTGGTGGGGCGAAGCTGGATC
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GGTGGGGATCGGCATCATTACGGCGGTGATGCCTTCGGTGATTAAACGGC
GGTTTCAGCAGCGCACGCCACTGGTGTATGGGGCTGTGGTCCGCGGCTCTG
ATGGGCGGGCGGTGGGCTTGGTGCCGCCATAACGCCCTGGTTAGTTCAACA
TAGCGAAACCTGGTATCAAACACTCGCCTGGTGGGCGCTGCCTGCCGTTG
TTGCGCTCTTTGCCTGGTGGTGGCAAAGCGCCCGCGAGGTGCGCTCTTCC
CACAAGACAACAACCACTCCGGTTCGCGTGGTATTCACTCCCCGCGCGTG
GACGCTGGGTGTTTACTTCGGTCTGATTAACGGCGGTTACGCCAGCCTGA
TTGCCTGGTTACCCGCTTTCTATATTGAGATTGGTGCCAGCGCGCAGTAC
AGCGGTTCCCTTACTGGCATTGATGACGCTTGGGCAAGCCGCAAGGAGCTTT
GCTGATGCCTGCTATGGCTCGCCATCAGGATCGGCGCAAACGTGTTAATGC
TGCGCTGGTGTACAACGTGGTGGGTTTCTGCGGCTTTATCTGGCTGCCG
ATGCAATTGCCGGTATTGTGGGCGATGGTGTGTGGGTTAGGTCTGGGCGG
CGCGTTTCCGCTCTGTTTGCTGCTGGCGCTCGATCACTCTGTGCAACCGG
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CAGACTCCAGCGTAACTGGACTG

[SEQ ID NO:117 aroH G149C PCR Primer

<210>117
<211>24
<212> DNA
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<220>
<223> oligonucleotide
<400> 117

GCTGTGCAGGTCGTAAATCACTGC

[SEQ ID NO:118 aroH G149C PCR Primer

<210>118

<211>20
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 118

GCCACCC TCCGGGCCGT TGC

[SEQ ID NO:119 aroH G149C PCR Product

<210>119
<211>1903
<212> DNA
<213>artificial sequence
<220>
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<400> 119

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GTATAATGTGTGGAATTGTGAGCGGATAACAATTTACACAGGAAACAGA
ATTCCCTGAGACTTGTAAATGAACAGAACTGACGAACTCCGTAATGCGCGT
ATTGAGAGCTGGTAACGCCCGCCGAACCTCGCGCTACGGTATCCCGTAAC
GCCTGGCGTCGCCACCCATGTACCCGACTCCCGCCGAGAATTGAAAAAA
TACTGAATGGTGAAGATAAGCGACTGTTGGTCATTATTGGCCCCTGCTCG
ATCCACGATCTACCGCTGCAATGGAGTACGCCACCCGTCTGCAGTCGCT
GCGCAACCAGTACCAGTCACGGCTGGAAATCGTAATGCGCACCTATTTTG
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ACTTTTACAGGTAAATGAGCTGGGCGTCCCAACCGCGACCGAGTTCCTCG
ATATGGTGACCTGTCAGTTTATTGCTGATTTAATCAGTTGGGGCGCGATT
GGCGCACGTACTACCGAAAGTCAGATCCACCGCGAAATGGCTTCGGCACT
CTCCTGTCCGGTAGGTTTTTAAAAATGGTACCGATGGCAATACGCGGATTG
CTGTGGATGCTATCCGCGCAGCCCGCGCCAGCCATATGTTCTCTCGCCA
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GTCGGCAGTCAGCCGCTCACTTACGGTCAATCCATTACCGACCCGTGTCT
GGGCTGGGAGGATACCGAACGCCTGGTCGAAAAACTCGCCTCTGCGGTAG
ATACCCGCTTCTGAATGCGTGCCCATTCCTGACGGAATGGGCATTTCTGC
GCAACTTGTTGTCTTCTCAACAAATTAAGTCTGCTCTGCTCAGCCATAA
TATTGATAATAAGAATCATTGTTATATCAATTATTATTAATTTTTATGCG
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CCGCTTCCCCGCGAGCCTATTCGGCGAATTCTTGAAGACGAAAGGGCCTCG
TGATACGCCTATTTTTATAGGTTAATGTCATGATAATAATGGTTTCTTAG
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GATTTTCAGCCTGATACAGATTAAATCAGAACGCAGAAGCGGTCTGATAA
AACAGAATTTGCCTGGCGGCAGTAGCGCGGTGGTCCCACCTGACCCCATG
CCGAACCTCAGAAGTGAAACGCCGTAGCGCCGATGGTAGTGTGGGGTCTCC
CCATGCGAGAGTAGGGAAGTCCAGGCATCAAATAAAACGAAAGGCTCAG
TCGAAAGAACTGGGCCTTTCTGTTTTATCTGTTGTTTGTGCGGTGAACGCTC
TCCTGAGTAGGACAAATCCGCCGGGAGCGGATTTGAACGTTGCGAAGCAA
CGGCCCGGAGGGTGGC

[SEQ ID NO:120 speB PCR Primer

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<211>25
<212> DNA
<213>artificial sequence
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<223> oligonucleotide
<400> 120

GGACCCGGGATCAAGTGAAGAAAAAC

[SEQ ID NO:121 speB PCR Primer

<210>121
<211>24
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 121

GGTAACCCGGGTGGTGTCTGAACGT

[SEQ ID NO:122 speB PCR Product

<210>122
<211>1277
<212> DNA
<213>E. coli
<220>
<223> natural sequence for speB gene cloned from E. coli using PCR
<400> 122

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AGATGAGTAAGTCTGTGTTACTTGAATCCGCTTAATTTAGCGGTGATAA
TCCGCCACAATTTATTGTGACAAATCCAACCCTTCCTCGTCGGGCCTAAC
GACGCGGAAGGGTTTTTTTATATCGACTTTGTAATAGGAGTCCATCCATG
AGCACCTTAGGTCATCAATACGATAACTCACTGGTTTCCAATGCCTTTGG
TTTTTTACGCCTGCCGATGAACTTCCAGCCGATGACAGCGATGCAGACT
GGGTGATTACTGGCGTGCCGTTTCGATATGGCCACTTCTGGTCGTGCGGGT
GGTCGCCACGGTCCGGCAGCGATCCGTCAGGTTTCGACGAATCTGGCCTG
GGAACACAACCGCTTCCCGTGGAATTTTCGACATGCGTGAGCGTCTGAACG
TCGTGGACTGCGGCGATCTGGTATATGCCTTTGGCGATGCCCGTGAGATG
AGCGAAAAGCTGCAGGCGCACGCCGAGAAGCTGCTGGCTGCCGGTAAGCG
TATGCTCTCTTTCCGGTGGTGACCACTTTGTTACGCTGCCGCTGCTGCGTG
CTCATGCGAAGCATTTTCGGCAAAATGGCGCTGGTACACTTTGACGCCAC
ACCGATACCTATGCGAACGGTTGTGAATTTGACCACGGCACTATGTTCTA
TACGCGCCGAAAGAAGGTCTGATCGACCCGAATCATTCCGTGCAGATTG
GTATTCGTACCGAGTTTGATAAAGACAACGGCTTTACCGTGCTGGACGCC
TGCCAGGTGAACGATCGCAGCGTGGATGACGTTATCGCCCAAGTGAAACA
GATTGTGGGTGATATGCCGTTTACCTGACTTTTGATATCGACTGCCTGG
ATCCTGCTTTTGCACCAGGCACCGGTACGCCAGTGATTGGCGGCCTGACC
TCCGATCGCGCTATTAACTGGTACGCGGCCTGAAAGATCTCAACATTGT
TGGGATGGACGTAGTGGAAGTGGCTCCGGCATAACGATCAGTCGGAAATCA
CTGCTCTGGCAGCGGCAACGCTGGCGCTGGAAATGCTGTATATTCAGGCG
GCGAAAAAGGGCGAGTAAGCACCAAGATGCGATGCGCACGGGTAAACGTG

CCATTAATGTCGGATGCGGCGTGAACGCCTTATCCGACCTACGTTCGGCA
CCCGTAGGCCGGATAAGATGCGCCAGCATCGCATCCGGCAATGCGCACAA
GGTAACAAATGTGCCATTATGTCAGATGCGGCGTGAACGCCTTATCTGA
CCTACGTTTCGACACCACCCGGGTTACC

[SEQ ID NO:123 Primer

<210>123
<211>19
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 123
CGCGGTATCATTGCAGCAC

[SEQ ID NO:124 Primer

<210>124
<211>31
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 124
GCATCGGCTCTTCCGCGTCAAGTCAGCGTAA

[SEQ ID NO:125 Primer

<210>125
<211>21
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 125
AACGAATTCAAGCTTGATATC

[SEQ ID NO:126 Primer

<210>126
<211>23
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 126
GAATTCGTTGACGAATTCTCTAG

[SEQ ID NO:127 IroK PCR Primer

<210>127
<211>87
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 127

AATTCGTGGAAGAAAGGGGAGATGAAGCCGGCATTACGCGATT
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[SEQ ID NO:128 IroK PCR Primer

<210>128
<211>87
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 128
AGCTTTATGCCGTTACGCTTGCCAAACGTTCTGCACAATGGCGATG
AAATCGCGTAATGCCGGCTTCATCTCCCCTTTCTTCCACG

[SEQ ID NO:129 IroK Protein

<210>129
<211>21
<212> amino acid sequence
<213>amino acid sequence from E. coli
<220>
<223>
<400> 129
MKPALRDFIAIVQERLASVTA

[SEQ ID NO:130 purR Deletion Primer

<210>130
<211>19
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 130

AAGGTCGGTG CTCATCAAG

[SEQ ID NO:131 purR Deletion Primer

<210>131
<211>17
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 131

CTGGTTGCTGGATAACC

[SEQ ID NO:132 lysR Deletion Primer

<210>132
<211>20
<212> DNA
<213>artificial sequence

<220>
<223> oligonucleotide
<400> 132
ATATGAATAT TGGAACAGGC

[SEQ ID NO:133 lysR Deletion Primer

<210>133
<211>22
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 133
ACGCGTTACACCATGGAACAGG

[SEQ ID NO:134 tyrR Deletion Primer

<210>134
<211>19
<212> DNA
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<220>
<223> oligonucleotide
<400> 134
CTGACGGCAC GACTCGGGA

[SEQ ID NO:135 tyrR Deletion Primer

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<211>21
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 135
CTGCCGATCTGCCGTTGCCCC

[SEQ ID NO:136 trpR Deletion Primer

<210>136
<211>20
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 136
AGCAGCTTAT AACGCCGGAC

[SEQ ID NO:137 trpR Deletion Primer

<210>137
<211>21
<212> DNA
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<220>
<223> oligonucleotide
<400> 137

TGGTCCCGTGATGTCGCGTTA

[SEQ ID NO:138 metJ Deletion Primer

<210>138
<211>20
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 138
GATGGTGGCC TGTTTACGCG

[SEQ ID NO:139 metJ Deletion Primer

<210>139
<211>20
<212> DNA
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<223> oligonucleotide
<400> 139
GATCGCTTTACTTTGCGATG

[SEQ ID NO:140 nrdR Deletion Primer

<210>140
<211>19
<212> DNA
<213>artificial sequence
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<223> oligonucleotide
<400> 140
GATTTTGACT GTTTCTTGA

[SEQ ID NO:141 nrdR Deletion Primer

<210>141
<211>20
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 141
CGAGGCAACCACGCGCGCTA

[SEQ ID NO:142 speB Primer

<210>142
<211>30
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 142
GGGAAGTAGTCTTTGTAATAGGAGTCCATC

[SEQ ID NO:143 speB Primer

<210>143

<211>27

<212> DNA

<213>artificial sequence

<220>

<223> oligonucleotide

<400> 143

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[SEQ ID NO:144 speB PCP Product

<210>144

<211>979

<212> DNA

<213>E. coli

<220>

<223> natural sequence for speB gene of E. coli, for introduction into B. bacillus using pWH1520

<400> 144

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AATACGATAACTCACTGGTTTCCAATGCCTTTGGTTTTTACGCCTGCCG
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GCCGTTTCGATATGGCCACTTCTGGTCGTGCGGGTGGTCGCCACGGTCCGG
CAGCGATCCGTCAGGTTTCGACGAATCTGGCCTGGGAACACAACCGCTTC
CCGTGGAATTTGACATGCGTGAGCGTCTGAACGTCGTGGACTGCGGCGA
TCTGGTATATGCCTTTGGCGATGCCCGTGAGATGAGCGAAAAGCTGCAGG
CGCACGCCGAGAAGCTGCTGGCTGCCGGTAAGCGTATGCTCTCTTTCGGT
GGTGACCACTTTGTTACGCTGCCGCTGCTGCGTGCTCATGCGAAGCATTT
CGGCAAAATGGCGCTGGTACACTTTGACGCCACACCGATACCTATGCGA
ACGGTTGTGAATTTGACCACGGCACTATGTTCTATACCGCGCCGAAAGAA
GGTCTGATCGACCCGAATCATTCCGTGCAGATTGGTATTCGTACCGAGTT
TGATAAAGACAACGGCTTTACCGTGCTGGACGCCTGCCAGGTGAACGATC
GCAGCGTGGATGACGTTATCGCCCAAGTGAAACAGATTGTGGGTGATATG
CCGTTTTACCTGACTTTTGATATCGACTGCCTGGATCCTGCTTTTGCACC
AGGCACCGGTACGCCAGTGATTGGCGGCCTGACCTCCGATCGCGCTATTA
AACTGGTACGCGGCCTGAAAGATCTCAACATTGTTGGGATGGACGTAGTG
GAAGTGGCTCCGGCATACGATCAGTCGGAAATCACTGCTCTGGCAGCGGC
AACGCTGGCGCTGGAAATGCTGTATATTCAGGCGGCGAAAAAGGGCGAGT
AAGCACCAGATGCGATGCGCATGCTTCCC

[SEQ ID NO:145 metE Primer

<210>145

<211>29

<212> DNA

<213>artificial sequence

<220>

<223> oligonucleotide

<400> 145

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[SEQ ID NO:146 metE Primer

<210>146

<211>29

<212> DNA

<213>artificial sequence

<220>

<223> oligonucleotide
<400> 146
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[SEQ ID NO:147 metE PCP Product

<210>147
<211>2336
<212> DNA
<213>E. coli
<220>
<223> natural sequence for speB gene of E. coli, for introduction into B. bacillus using pWH1520
<400> 147

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GGCGGTAGGGCGTGAATTGCGTGCTCGTCACTGGGATCAACAAAAGCAAG
CGGGTATCGACCTGCTGCCGGTGGGCGATTTTGCCTGGTACGATCATGTA
CTGACCACCAGTCTGCTGCTGGGTAACGTTCCGGCGCGTCATCAGAACAA
AGATGGTTCGGTAGATATCGACACCCTGTTCCGTATTGGTCGTGGACGTG
CGCCGACTGGCGAACCTGCGGCGGCAGCGGAAATGACCAAATGGTTTAAC
ACCAACTATCACTACATGGTGCCGGAGTTCGTTAAAGGCCAACAGTTCAA
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GCCACAAGGTGAAACCTGTGCTGCTGGGGCCGGTTACCTGGCTGTGGCTG
GGGAAAGTGAAAGGTGAACAATTTGACCGCCTGAGCCTGCTGAACGACAT
TCTGCCGGTTTATCAGCAAGTGCTGGCAGAACTGGCGAAACGCGGCATCG
AGTGGGTACAGATTGATGAACCCGCGCTGGTACTGGAACCTACCACAGGCG
TGGCTGGACGCATACAAACCCGCTTACGACGCGCTCCAGGGACAGGTGAA
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CCAACAACCTACCGCACGGGCATTGCGGAACATATCAAGCAGGCCATTGTT
GAGCAGGAACGTTTGGGACTGGATGTGCTGGTACATGGCGAGGCCGAGCG
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CGCAAAACGGTTGGGTACAGAGCTACGGTTCCTCGCTGCGTGAAGCCACCG
ATTGTCATTGGTGACATTAGCCGCCCGGCACCGATTACCGTGGAGTGGGC
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GGCCGGTGACCATACTCTGCTGGTTCGTTCCCGCGTGAAGATGTCAGCCGT
GAAACCATCGCCAAACAGATTGCGCTGGCGCTGCGTGATGAAGTGGCCGA
TCTGGAAGCCGCTGGAATTGGCATCATCCAGATTGACGAACCGGCGCTGC
GCGAAGGTTTACCGCTGCGTCGTAGCGACTGGGATGCGTATCTCCAGTGG
GGCGTAGAGGCCCTCCGTATCAACGCCGCCGTGGCGAAAGATGACACACA
AATCCACACTCACATGTGTTATTGCGAGTTCAACGACATCATGGATTCTGA
TTGCGGCGCTGGACGCAGACGTATCACCATCGAAACCTCGCGTTCCGAC
ATGGAGTTGCTGGAGTCGTTTGAAGAGTTTGATTATCCAAATGAAATCGG
TCCTGGCGTCTATGACATTCACCTCGCCAAACGTACCGAGCGTGGAATGGA
TTGAAGCCTTGCTGAAGAAAGCGGCAAAACGCATTCCGGCAGAGCGCCTG
TGGGTCAACCCGGAAGTGTGGCCTGAAAACGCGCGGCTGGCCAGAAACCCG

CGCGGCACTGGCGAACATGGTGCAGGCGGCGCAGAACTTGCGTCGGGGGT
AAAATCCAAACCGGGTGGTAATACCGCATGCTTCCC

[SEQ ID NO:148 mcr Primer

<210>148
<211>27
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 148
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[SEQ ID NO:149 mcr Primer

<210>149
<211>26
<212> DNA
<213>artificial sequence
<220>
<223> oligonucleotide
<400> 149
GGGATTAGACGGTAATCGCACGACCG

[SEQ ID NO:150 Yeast mcr

<210>150
<211>7839
<212> DNA
<213>artificial sequence
<220>
<223>
<400> 150

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51 CCAACTTTGT ATAGAGAGCC ACTGCGGGAT CGTCACCGTA ATCTGCTTGC
101 ACGTAGATCA CATAAGCACC AAGCGCGTTG GCCTCATGCT TGAGGAGATT
151 GATGAGCGCG GTGGCAATGC CCTGCCTCCG GTGCTCGCCG GAGACTGCGA
201 GATCATAGAT ATAGATCTCA CTACGCGGCT GCTCAAACCTT GGGCAGAACG
251 TAAGCCGCGA GAGCGCCAAC AACCGCTTCT TGGTCGAAGG CAGCAAGCGC
301 GATGAATGTC TTAACACGGA GCAAGTTCCC GAGGTAATCG GAGTCCGGCT
351 GATGTTGGGA GTAGGTGGCT ACGTCACCGA ACTCACGACC GAAAAGATCA
401 AGAGCAGCCC GCATGGATTT GACTTGGTCA GGGCCGAGCC TACATGTGCG
451 AATGATGCCC ATACTTGAGC CACCTAACTT TGTTTTAGGG CGACTGCCCT
501 GCTGCGTAAC ATCGTTGCTG CTCCATAACA TCAAACATCG ACCCAGGCG
551 TAACGCGCTT GCTGCTTGA TGCCCGAGGC ATAGACTGTA CAAAAAACA
601 GTCATAACAA GCCATGAAAA CCGCCACTGC GCCGTTACCA CCGCTGCGTT
651 CGGTCAAGGT TCTGGACCAG TTGCGTGAGC GCATTTTTTT TTCCTCCTCG
701 GCGTTTACGC CCCGCCCTGC CACTCATCGC AGTACTGTTG TAATTCATTA
751 AGCATTCTGC CGACATGGAA GCCATCACAG ACGGCATGAT GAACCTGAAT
801 CGCCAGCGGC ATCAGCACCT TGTCGCCTTG CGTATAATAT TTGCCCATAG
851 TGAAAACGGG GGCGAAGAAG TTGTCCATAT TGGCCACGTT TAAATCAAAA
901 CTGGTGAAAC TCACCCAGGG ATTGGCGCTG ACGAAAAACA TATTCTCAAT
951 AAACCCTTTA GGGAAATAGG CCAGGTTTTT ACCGTAACAC GCCACATCTT
1001 GCGAATATAT GTGTAGAAAC TGCCGGAAAT CGTCGTGGTA TCACTCCAG
1051 AGCGATGAAA ACGTTTCAGT TTGCTCATGG AAAACGGTGT AACAAGGGTG
1101 AACACTATCC CATATCACCA GCTACCGTC TTTCATTGCC ATACGGAAC
1151 CCGGATGAGC ATTCATCAGG CGGGCAAGAA TGTGAATAAA GGCCGGATAA

1201 AACTTGTGCT TATTTTTCTT TACGGTCTTT AAAAAGGCCG TAATATCCAG
1251 CTGAACGGTC TGGTTATAGG TACATTGAGC AACTGACTGA AATGCCTCAA
1301 AATGTTCTTT ACGATGCCAT TGGGATATAT CAACGGTGGT ATATCCAGTG
1351 ATTTTTTCTT CCATTTTTTTT TTCCTCCTTT AGAAAAACTC ATCGAGCATC
1401 AAATGAAACT GCAATTTATT CATATCAGGA TTATCAATAC CATATTTTTG
1451 AAAAAGCCGT TTCTGTAATG AAGGAGAAAA CTCACCGAGG CAGTTCCTATA
1501 GGATGGCAAG ATCCTGGTAT CGGTCTGCGA TTCCGACTCG TCCAACATCA
1551 ATACAACCTA TTAATTTCCC CTCGTCAAAA ATAAGGTTAT CAAGTGAGAA
1601 ATCACCATGA GTGACGACTG AATCCGGTGA GAATGGCAAA AGTTTATGCA
1651 TTTCTTTCCA GACTTGTTCA ACAGGCCAGC CATTACGCTC GTCATCAAAA
1701 TCACTCGCAT CAACCAAACC GTTATTCATT CGTGATTGCG CCTGAGCGAG
1751 GCGAAATACG CGATCGCTGT TAAAAGGACA ATTACAAACA GGAATCGAGT
1801 GCAACCGGCG CAGGAACACT GCCAGCGCAT CAACAATATT TTCACCTGAA
1851 TCAGGATATT CTTCTAATAC CTGGAACGCT GTTTTTCCGG GGATCGCAGT
1901 GGTGAGTAAC CATGCATCAT CAGGAGTACG GATAAAATGC TTGATGGTGC
1951 GAAGTGGCAT AAATTCCGTC AGCCAGTTTA GTCTGACCAT CTCATCTGTA
2001 ACATCATTGG CAACGCTACC TTTGCCATGT TTCAGAAACA ACTCTGGCGC
2051 ATCGGGCTTC CCATACAAGC GATAGATTGT CGCACCTGAT TGCCCGACAT
2101 TATCGCGAGC CCATTTATAC CCATATAAAT CAGCATCCAT GTTGGAATTT
2151 AATCGCGGCC TCGACGTTTC CCGTTGAATA TGGCTCATTT TTTTTCTC
2201 CTTTACCAAT GCTTAATCAG TGAGGCACCT ATCTCAGCGA TCTGTCTATT
2251 TCGTTCATCC ATAGTTGCCT GACTCCCCGT CGTGTAGATA ACTACGATAC
2301 GGGAGGGCTT ACCATCTGGC CCCAGCGCTG CGATGATACC GCGAGAACCA
2351 CGCTCACCGG CTCCGGATTT ATCAGCAATA AACCAGCCAG CCGGAAGGGC
2401 CGAGCGCAGA AGTGGTCCTG CAACTTTATC CGCCTCCATC CAGTCTATTA
2451 ATTGTTGCCG GGAAGCTAGA GTAAGTAGTT CGCCAGTTAA TAGTTTGC
2501 AACGTTGTTG CCATCGCTAC AGGCATCGTG GTGTCACGCT CGTCGTTTGG
2551 TATGGCTTCA TTCAGCTCCG GTTCCCAACG ATCAAGGCGA GTTACATGAT
2601 CCCCCATGTT GTGCAAAAAA GCGGTTAGCT CCTTCGGTCC TCCGATCGTT
2651 GTCAGAAGTA AGTTGGCCGC AGTGTTATCA CTCATGGTTA TGGCAGCACT
2701 GCATAATTCT CTTACTGTCA TGCCATCCGT AAGATGCTTT TCTGTGACTG
2751 GTGAGTACTC AACCAAGTCA TTCTGAGAAT AGTGTATGCG GCGACCGAGT
2801 TGCTCTTGCC CGGCGTCAAT ACGGGATAAT ACCGCGCCAC ATAGCAGAAC
2851 TTTAAAAGTG CTCATCATTG GAAAACGTTT TCGGGGCGA AAACCTCTAA
2901 GGATCTTACC GCTGTTGAGA TCCAGTTCGA TGTAACCCAC TCGTGCACCC
2951 AACTGATCTT CAGCATCTTT TACTTTCACC AGCGTTTCTG GGTGAGCAAA
3001 AACAGGAAGG CAAAATGCCG CAAAAAAGGG AATAAGGGCG ACACGGAAAT
3051 GTTGAATACT CATATTCTTC CTTTTCAAT ATTATTGAAG CATTTATCAG
3101 GGTTATTGTC TCATGAGCGG ATACATATTT GAATGTATTT AGAAAAATAA
3151 ACAAATAGGG GTCAGTGTTA CAACCAATTA ACCAATTCTG AACATTATCG
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3251 CGGCAGTAGC GCGGTGGTCC CACCTGACCC CATGCCGAAC TCAGAAGTGA
3301 AACGCCGTAG CGCCGATGGT AGTGTGGGGA CTCCCCATGC GAGAGTAGGG
3351 AACTGCCAGG CATCAAATAA AACGAAAGGC TCAGTCGAAA GACTGGGCCT
3401 TTCGCCCGGG CTAATTGAGG GGTGTCGCCC TTATTCGACT CTATAGTGAA
3451 GTTCCTATTC TCTAGAAAGT ATAGGAACTT CTGAAGTGGG GTTTAAACTC
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3551 GAACAATTTG AACTTGAATT GGAATTCAGA TTCAGAGCAA GAGACAAGAA
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