

<110> CJ CheilJedang Corporation  
 <120> A recombinant microorganism for producing L-glutamic acid and a method for producing L-glutamic acid using the same  
 <130> OPA21083-PCT  
 <150> KR 10-2020-0115570  
 <151> 2020-09-09  
 <160> 32  
 <170> KoPatentIn 3.0  
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 <212> PRT  
 <213> Unknown  
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 Met Leu Leu Thr Lys Ile Gly Leu Thr Gly Gly Met Ala Ile Arg Asn  
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 Ser Asn Leu Thr Glu Met Leu Leu Pro Val Ala Phe Ser Val Ile Leu  
 65 70 75 80  
 Gly Ile Leu Ile Val Phe Ile Ala Arg Phe Thr Leu Ala Lys Leu Pro  
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 Asn Val Arg Thr Val Asp Ala Leu Ala Thr Gly Gly Leu Phe Gly Ala  
 100 105 110  
 Val Ser Gly Ser Thr Met Ala Ala Ala Leu Thr Thr Leu Glu Glu Ser  
 115 120 125  
 Lys Ile Ser Tyr Glu Ala Trp Ala Gly Ala Leu Tyr Pro Phe Met Asp  
 130 135 140

Ile Pro Ala Leu Val Thr Ala Ile Val Val Ala Asn Ile Tyr Leu Asn  
 145 150 155 160  
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 Lys Gln Pro Val Ala Ala Gly Asp Tyr Gly Asp Gln Thr Asp Tyr Pro  
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 Arg Thr Arg Gln Glu Tyr Leu Ser Gln Gln Glu Pro Glu Asp Asn Arg  
 195 200 205  
 Val Lys Ile Trp Pro Ile Ile Glu Glu Ser Leu Gln Gly Pro Ala Leu  
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 225 230 235 240  
 Ser Val Tyr Glu Gly Phe Tyr Asp Pro Leu Phe Arg Gly Leu Leu Ser  
 245 250 255  
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 Leu Arg Lys Val Ala Gln Trp Tyr Val Val Tyr Ser Leu Ile Ala Pro  
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 Ala Ser Ser Ser Asp Ile Ser Gly Pro Pro Thr Leu Arg Ala Gly Ile  
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 Pro Ser Ala Asn Pro Ser Ala Tyr Ile Gly Ser Ser Thr Ala Ile Gly  
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<223> codon optimized sbtA

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| gccatctcaa cgattatcgt tttcatgttg cttactaaaa ttggacttac cggaggtatg | 180  |
| gcgattcgga atagcaacct gaccgagatg cttttgcccg tggccttctc cgtcattttg | 240  |
| ggaattttga tcgtatttat cgcgcgtttc actttggcta agctcccaa tgtgcgcact  | 300  |
| gtggacgccc ttgctacggg tggctctctc ggtgcggtgt caggaagcac gatggccgcc | 360  |
| gccctgacta cgcttgagga atcaaaaatt tcatatgaag catgggcagg agctttgtac | 420  |
| ccttttatgg atattccggc cttggtcacg gcaattgttg ttgccaacat ctatttgaat | 480  |
| aaacggaaac gtaaaagcgc cgcagcatca atcgaagaga gcttctcgaa gcagcccgt  | 540  |
| gcggctggcg actatggaga tcagactgat tatccacgta cccgtcagga atacctctct | 600  |
| cagcaagagc cggaggacaa tcgctcaaaa atttgccaa tcattgaaga gtcgcttcaa  | 660  |
| ggcccagccc tttcagctat gttgttggga cttgcactgg gtattttcac gaaacctgaa | 720  |
| tcggtgtatg agggattcta cgatcctctt tttcgcgac tcctgtcgat tctgatgctg  | 780  |
| attatgggca tggaagcctg gagccgtatc ggcgagcttc gtaaggtagc tcagtggat  | 840  |
| gtcgtttact ctttgatcgc tccgatcgta cacggattta tcgcttttgg actgggtatg | 900  |
| atcgcccatt acgctacggg attcagcctc ggtggagtgg tcgttctggc cgtaattgcc | 960  |
| gcatcttctt ctgatatctc tggccacact accctgcgtg ccggcattcc gagcgcaaat | 1020 |
| ccgtcggcat atatcggtag ctctactgca atcgaaccc ccatcgcaat cgggtgtgtgt | 1080 |
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| gcgatttcta cgatcatcgt ctttatgttg ctcactaaga ttggcctaac cgggggcatg  | 180  |
| gcaattcgga actccaactt gacggaaatg ctcctaccg tggcattctc tgtgatattg   | 240  |
| ggaattctta ttgtcttcat cgcccgtttt accctggcta aactgcctaa cgtcagaacc  | 300  |
| gtggatgccc tggccaccgg cggcttgttt ggggcagtca gtggctctac aatggctgcc  | 360  |
| gccctcacta cgttggaaga atcaaaaatt tcctacgaag cctgggctgg tgctctgtat  | 420  |
| ccctttatgg atattcctgc cctggtaacg gcgatcgtcg tagctaatat ttatctcaat  | 480  |
| aagagaaaac gtaagtctgc tgctgctagt attgaggaat cgttcagcaa gcaaccggtt  | 540  |
| gccgccgggg attatggcga ccaaacggat tatcctcgta cccgccaaga gtatttaagc  | 600  |
| cagcaagaac cggaagataa tcgggtcaaa atctggccaa ttatcgaaga aagtttacia  | 660  |
| ggccctgccc tatcagccat gttgttaggt cttgccctgg gcatatttac caagccggaa  | 720  |
| agtgtctatg aaggttttta tgatcctctt tttcgaggac tactttccat cttgatgctg  | 780  |
| attatgggca tggaagcttg gtccagaatt ggtgaactac gtaaagtagc tcaatggtat  | 840  |
| gtgggtctata gcctaatagc tcccatagtg cacgggttta ttgcctttgg tcttggtatg | 900  |
| attgcccact atgctacggg tttcagtctg ggtgggtgtg tagtttttagc agttatcgcc | 960  |
| gcttctagct ctgatatctc cgggcctcct accttgcgag caggtatccc atctgccaac  | 1020 |
| ccctctgcct atatcggttc atccaccgcc atcggtactc ccattgccat cggcgtgtgc  | 1080 |
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<213> Unknown

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| Met | Gln | Ile | Thr | Asn | Lys | Ile | His | Phe | Arg | Asn | Leu | Gln | Gly | Asp | Leu |
| 1   |     |     |     | 5   |     |     |     |     | 10  |     |     |     |     | 15  |     |
| Phe | Gly | Gly | Val | Thr | Ala | Ala | Val | Ile | Ala | Leu | Pro | Met | Ala | Leu | Ala |
|     |     |     | 20  |     |     |     |     | 25  |     |     |     |     | 30  |     |     |
| Phe | Gly | Ile | Ala | Ser | Gly | Ala | Gly | Ala | Thr | Ala | Gly | Leu | Trp | Gly | Ala |
|     |     | 35  |     |     |     |     | 40  |     |     |     |     | 45  |     |     |     |
| Val | Ile | Val | Gly | Phe | Phe | Ala | Ala | Leu | Phe | Gly | Gly | Thr | Pro | Thr | Leu |
|     | 50  |     |     |     |     | 55  |     |     |     |     | 60  |     |     |     |     |
| Ile | Ser | Glu | Pro | Thr | Gly | Pro | Met | Thr | Val | Val | Gln | Thr | Ala | Val | Ile |
| 65  |     |     |     |     | 70  |     |     |     |     | 75  |     |     |     |     | 80  |
| Ala | Ser | Leu | Val | Ala | Ala | Asp | Pro | Asp | Asn | Gly | Leu | Ala | Met | Ala | Phe |
|     |     |     |     | 85  |     |     |     |     | 90  |     |     |     |     | 95  |     |
| Thr | Val | Val | Met | Met | Ala | Gly | Leu | Phe | Gln | Ile | Ala | Phe | Gly | Leu | Leu |
|     |     |     | 100 |     |     |     |     | 105 |     |     |     |     | 110 |     |     |
| Lys | Leu | Gly | Lys | Tyr | Val | Thr | Met | Met | Pro | Tyr | Thr | Val | Ile | Ser | Gly |
|     |     | 115 |     |     |     |     | 120 |     |     |     |     | 125 |     |     |     |
| Phe | Met | Ser | Gly | Ile | Gly | Ile | Ile | Leu | Val | Ile | Leu | Gln | Leu | Ala | Pro |
|     | 130 |     |     |     |     | 135 |     |     |     |     | 140 |     |     |     |     |
| Phe | Leu | Gly | Gln | Ala | Ser | Pro | Lys | Gly | Gly | Val | Ile | Gly | Thr | Leu | Gln |
| 145 |     |     |     |     | 150 |     |     |     |     | 155 |     |     |     |     | 160 |
| Ala | Leu | Pro | Asn | Leu | Val | Ser | Asn | Val | Arg | Pro | Val | Glu | Thr | Leu | Leu |
|     |     |     |     | 165 |     |     |     |     | 170 |     |     |     |     | 175 |     |
| Ala | Leu | Met | Thr | Val | Gly | Ile | Ile | Trp | Phe | Met | Pro | Ser | Arg | Trp | Lys |
|     |     |     | 180 |     |     |     |     | 185 |     |     |     |     | 190 |     |     |
| Lys | Phe | Ala | Pro | Pro | Gln | Leu | Val | Ala | Leu | Val | Leu | Gly | Thr | Ile | Ile |
|     |     | 195 |     |     |     |     | 200 |     |     |     |     | 205 |     |     |     |
| Ser | Ile | Thr | Leu | Phe | Gly | Asp | Leu | Asp | Ile | Arg | Arg | Ile | Gly | Glu | Ile |
|     | 210 |     |     |     |     | 215 |     |     |     |     | 220 |     |     |     |     |
| Gln | Ala | Gly | Leu | Pro | Ala | Leu | Gln | Leu | Pro | Val | Phe | Gln | Ala | Asp | Gln |
| 225 |     |     |     |     | 230 |     |     |     |     | 235 |     |     |     |     | 240 |

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 Ile Asp Ala Leu Leu Thr Ser Val Val Ala Asp Ser Leu Thr Arg Thr  
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 Glu His Asn Ser Asn Lys Glu Leu Val Gly Gln Gly Ile Gly Asn Val  
 275 280 285  
 Met Ser Gly Leu Phe Gly Gly Leu Gly Gly Ala Gly Ala Thr Met Gly  
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 Thr Val Val Asn Ile Gln Ser Gly Gly Arg Thr Ala Leu Ser Gly Leu  
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 Ile Arg Ala Met Val Leu Leu Val Val Ile Leu Gly Ala Ala Lys Leu  
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 Ala Ala Thr Ile Pro Leu Ala Val Leu Ala Gly Ile Ala Phe Lys Val  
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 Gly Val Asp Ile Ile Asp Trp Gly Phe Leu Lys Arg Ala His His Val  
 355 360 365  
 Ser Ile Lys Gly Ala Leu Ile Met Tyr Ala Val Ile Val Leu Thr Val  
 370 375 380  
 Leu Val Asp Leu Ile Ala Ala Val Gly Ile Gly Val Phe Ile Ala Asn  
 385 390 395 400  
 Ile Leu Thr Ile Asp Arg Met Ser Ala Leu Gln Ser Lys Ala Val Lys  
 405 410 415  
 Ser Ile Ser Asp Ala Asp Asp Glu Ile Leu Leu Ser Ala Asn Glu Lys  
 420 425 430  
 Arg Trp Leu Asp Glu Gly Asn Gly Arg Val Leu Leu Phe Gln Leu Ser  
 435 440 445  
 Gly Pro Met Ile Phe Gly Val Ala Lys Ala Ile Ala Arg Glu His Asn  
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 Ala Ile Gln Glu Cys Ala Ala Ile Val Phe Asp Leu Ser Asp Val Pro  
 465 470 475 480  
 His Leu Gly Val Thr Ala Ser Leu Ala Leu Glu Asn Ala Ile Glu Glu  
 485 490 495  
 Ala Ala Glu Lys Gly Arg Ala Val Tyr Ile Val Gly Ala Thr Gly Gln  
 500 505 510

Thr Lys Arg Arg Leu Glu Lys Leu Gln Val Phe Arg Phe Val Pro Glu  
515 520 525

Ser Asn Cys Tyr Asp Asp Arg Ser Glu Ala Leu Lys Asp Ala Val Leu  
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Ala Leu Gly Pro His Glu Ser Glu Asp Ser Pro Ser Ser Ser Ser Val  
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Gln Thr Thr Tyr

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gccacggccg gactctgggg agccgtaatt gtgggcttct tcgccgcact gttcggagga 180  
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caacttgccg ctttccttgg acaagcttct ccgaaaggag gcgtgatcgg aacgctgcaa 480  
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|                                                                    |      |
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| gttggccaag gtatcggaaa cgtaatgtca ggcttgttcg gtggtctggg cggcgccggc  | 900  |
| gcaacgatgg gcactgtggt gaacatccaa tccggaggcc gcacggccct gtctggtttg  | 960  |
| attcgcgcta tggttctgct ggtggtcac ttgggagctg caaagctggc agccaccatt   | 1020 |
| ccgcttgctg tgcttgctgg aattgcgttt aaggtaggtg tagacattat cgactggggc  | 1080 |
| tttctgaagc gcgcacacca tgtgtcaatt aagggcgcac ttatcatgta tgctgttata  | 1140 |
| gtcctcactg tcctggtaga tctcatcgcc gcggttggtg ttggagtctt tatcgcgaa   | 1200 |
| attcttacca tcgaccggat gtcggccttg caatcaaaag cggtgaaatc aatttctgat  | 1260 |
| gcagatgacg aaattctttt gtctgccaat gaaaaacgtt gggtggacga aggcaatggt  | 1320 |
| cgcgtcttgc tctttcagtt gagcggacct atgatctttg gaggggcaaa agcgatcgca  | 1380 |
| cgggaacaca atgcgatcca ggaatgtgct gccatcgat ttgacttgag cgacgttccc   | 1440 |
| catctcgggtg tcaccgcatc attggctctt gagaacgcaa ttgaagaggc agcagagaag | 1500 |
| ggacgtgccg tttatatcgt gggcgccacc ggacagacca agcgccgttt ggagaaactt  | 1560 |
| caagtctttc gcttcgtccc agaaagcaac tgttacgacg accgctctga ggcgcttaaa  | 1620 |
| gacgccgtgc tcgcgttggg accccatgag tcggaagatt cgccgagcag ctcttccgtg  | 1680 |
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| acagcggcgg ttattgccct gcccatggcc ttagccttcg ggattgcttc cggagcaggg   | 120 |
| gctacggccg gactctgggg ggcggtgatc gtagggtttt tcgcggcctt atttggcggc   | 180 |
| acccccacct taatttccga accgactggg cccatgacgg tgggtgcaaac ggcggttatt  | 240 |

|                                                                     |      |
|---------------------------------------------------------------------|------|
| gctagtttag tggcggcaga tcccgacaat ggcttggcca tggccttcac tgtggtaatg   | 300  |
| atggcgggggt tgttccagat tgcctttgggt ctgctcaaat tgggcaaata tgtcaccatg | 360  |
| atgccctaca cagtcatttc cggctttatg tccggcattg ggattatttt ggtgattttg   | 420  |
| caactggctc cttttcttgg ccaagctagt cccaagggag gggtaatcgg caccctccag   | 480  |
| gccctcccta acctagtaag caatgtcagg ccggtggaaa ccctattggc gctcatgacg   | 540  |
| gtgggcatta tttggtttat gccttcccgt tggaaaaagt ttgctccgcc ccaattgggtg  | 600  |
| gcttttagtgt tggggacaat tatttccatc accctatttg gcgatctgga tatccgtcgc  | 660  |
| attggggaaa ttcaggccgg tttgcccgt ctacagctac cagtgtttca ggctgatcaa    | 720  |
| ttacagagaa tgctgattga tgcggctgtt ctgggaatgc tgggctgtat tgatgccctc   | 780  |
| ctgacttcgg tgggtggctga tagcttgacc cgcacagaac ataactcaa caaggaatta   | 840  |
| gtcggccagg gcatcggcaa tgtaatgtcc ggtttatttg gtggcttggg gggagctggg   | 900  |
| gccaccatgg ggacggtgggt aaatatccag tccgggggac gcacagctct gtctggcttg  | 960  |
| atccgggcga tgggtgttgct ggtggtaatt ttaggcgcag ctaaattggc ggctaccatt  | 1020 |
| cccctagccg tattggctgg tattgcgttc aaagttgggg tggacattat tgattggggg   | 1080 |
| ttcctcaagc gggctcacca tgtctccatc aaaggggcct tgattatgta tgccgtcatt   | 1140 |
| gtcctgacgg tgttggtgga ttttaattgcg gcagtaggta ttggtgtatt tattgccaat  | 1200 |
| attctcacca ttgaccgtat gagtgcgttg cagtccaaag ctgtgaaaag tattagcgat   | 1260 |
| gccgacgacg aaattctcct ttccgccaat gagaaacgtt ggctagatga gggcaatggc   | 1320 |
| cgggtcttgc ttttccaact cagtggcca atgatttttg ggggtggcaa ggcgatcgcc    | 1380 |
| agggaaacata atgccattca agaattgtgcc gccattgttt ttgatctgag cgatgtgccc | 1440 |
| catttgggag taaccgcttc cctggccctg gaaaatgcca ttgaagaagc ggcggaaaaa   | 1500 |
| ggtcgggccc tttacattgt gggggcaaca gggcaaacca agcgacgctt ggaaaaattg   | 1560 |
| caagtgttcc gctttgttcc tgaaagtaat tgctatgacg accgttctga agctctcaag   | 1620 |
| gacgctgtcc tagctttggg acctcatgaa agtgaggact ccccttccag ttcttccgtc   | 1680 |
| cagaccacat actga                                                    | 1695 |

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 tgcgcggccg ggtaatgcat cttctttagc aacaagttga ggggtaggtg caaataagaa 180  
 cgacatagaa atcgtctcct ttctgttttt aatcaacata caccaccacc taaaaattcc 240  
 ccgaccagca agttcacagt attcgggcac aatatcgttg ccaaaatatt gtttcggaat 300  
 atcatgggat acgtacccaa cgaaaggaaa cactcatgga ttttctttct aatttcttga 360  
 ccgacttcgt gggtaactg cagtcacca ctctggcgtt tctgatcggc ggtatggtaa 420  
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 ctgattatcc acgtacccgt caggaatacc tctctcagca agagccggag gacaatcgcg 960  
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 tgggacttgc actgggtatt ttacgaaac ctgaatcggg gtatgaggga ttctacgatc 1080

|                                                                     |      |
|---------------------------------------------------------------------|------|
| ctcttttttcg cggactcctg tcgattctga tgctgattat gggcatggaa gcctggagcc  | 1140 |
| gtatcggcga gcttcgtaag gtagctcagt ggtatgtcgt ttactctttg atcgctccga   | 1200 |
| tcgtacacgg atttatcgct tttggactgg gtatgatcgc ccattacgct acgggattca   | 1260 |
| gcctcgggtgg agtggtcgtt ctggccgtaa ttgccgcatac ttcttctgat atctctggcc | 1320 |
| cacctaccct gcgtgccggc attccgagcg caaatccgtc ggcatatatc ggtagctcta   | 1380 |
| ctgcaatcgg aacccccatc gcaatcgggtg tgtgtattcc tctcttcatac ggtctcgccc | 1440 |
| agacgcttgg cgcgggctaa actaaacagg aagagcc                            | 1477 |

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<220>  
 <223> CJ7-sbtA\_F

|                    |    |
|--------------------|----|
| <400> 12           |    |
| ggcccttccg gtttagt | 17 |

<210> 13  
 <211> 17  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> CJ7-sbtA\_R

|                    |    |
|--------------------|----|
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| ggctcttcct gtttagt | 17 |

<210> 14  
 <211> 39  
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<220>  
 <223> CglE0085\_up\_F

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<211> 44  
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<223> CglE0085\_up\_R

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<210> 16  
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<220>  
<223> CglE0085\_down\_F

<400> 16  
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<210> 17  
<211> 39  
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<220>  
<223> CglE0085\_down\_R

<400> 17  
tgcatgcctg caggtcgacg taatcgaatc accggccag 39

<210> 18  
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<220>  
<223> CJ7-bicA

<400> 18

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| ccacggaccg gtaatcggag tgcctaaaac cgcatgcggc ttaggctcca agataggttc  | 120  |
| tgcgcggccg ggtaatgcat cttcttttagc aacaagttga ggggtaggtg caaataagaa | 180  |
| cgacatagaa atcgtctcct ttctgttttt aatcaacata caccaccacc taaaaattcc  | 240  |
| ccgaccagca agttcacagt attcgggcac aatatcgttg ccaaaatatt gtttcggaat  | 300  |
| atcatgggat acgtacccaa cgaaaggaaa cactcatgca gattacgaac aagattcact  | 360  |
| ttcgtaattt gcagggtgat ctttttggcg gcgttacggc cgctgttatt gcattgccta  | 420  |
| tggctttggc ttttgggaatt gcatcgggtg cgggtgccac ggccggactc tggggagccg | 480  |
| taattgtggg cttcttcgcc gcactgttcg gaggaacccc tacgcttatt tcagagccaa  | 540  |
| ccggacccat gaccgttgtg cagaccgccg tgatcgcttc tctttagct gcggatcccg   | 600  |
| ataacggcct tgctatggca ttcacggtgg tgatgatggc cggtttgttt cagattgcct  | 660  |
| tcggtctgct caaacttggg aaatatgtga ccatgatgcc atatacggtg atctctggct  | 720  |
| ttatgtccgg cattggtatt attttggtaa ttctgcaact tgcgcccttc cttggacaag  | 780  |
| cttctccgaa aggaggcgtg atcggaacgc tgcaagcact tcccaacctc gtgtcgaatg  | 840  |
| tacggcccgt agaaacgttg ctggcattga tgaccgtcgg tattatctgg ttcatgcctt  | 900  |
| ctcgttggaa gaaattcgcg cctccgcaac tcgtagccct ggtactcggc acgattattt  | 960  |
| ctatcacctt tttcggagat cttgacattc gccggatcgg agaaatccaa gcgggcttgc  | 1020 |
| cagcccttca actcccgtt ttccaagccg atcagttgca gcggatgctg atcgatgcag   | 1080 |
| cagtcctcgg aatgcttggg tgtattgacg ccctccttac gtcggtagtt gccgattctc  | 1140 |
| tgaccgcac cgagcataac tcgaataaag aactcgttgg ccaaggtatc ggaaacgtaa   | 1200 |
| tgtcaggctt gttcgggtgt ctgggcggcg ccggcgcaac gatgggcact gtggtgaaca  | 1260 |
| tccaatccgg aggccgcac gccctgtctg gtttgattcg cgctatggtt ctgctggtgg   | 1320 |
| tcattcttggg agctgcaaag ctggcagcca ccattccgct tgctgtgctt gctggaattg | 1380 |
| cgtttaaggt aggtgtagac attatcgact ggggctttct gaagcgcgca cccatgtgt   | 1440 |

|                                                                    |      |
|--------------------------------------------------------------------|------|
| caattaaggg cgcaattatc atgtatgctg ttatcgtcct cactgtcctg gtagatctca  | 1500 |
| tcgccgcggt tggatttgga gtctttatcg cgaacattct taccatcgac cggatgtcgg  | 1560 |
| ccttgcaatc aaaagcgggtg aaatcaattt ctgatgcaga tgacgaaatt cttttgtctg | 1620 |
| ccaatgaaaa acgttggttg gacgaaggca atggtcgcgt cttgctcttt cagttgagcg  | 1680 |
| gacctatgat ctttggagtg gcaaaagcga tcgcacggga acacaatgcg atccaggaat  | 1740 |
| gtgctgccat cgtatttgac ttgagcgacg ttcccatctt cgggtgtcacc gcatcattgg | 1800 |
| ctcttgagaa cgcaattgaa gaggcagcag agaagggacg tgccgtttat atcgtgggcg  | 1860 |
| ccaccggaca gaccaagcgc cgtttggaga aacttcaagt ctttcgcttc gtcccagaaa  | 1920 |
| gcaactgtta cgacgaccgc tctgaggcgc ttaaagacgc cgtgctcgcg ttgggacccc  | 1980 |
| atgagtcgga agattcgccg agcagctctt ccgtgcagac cacttattga actaaacagg  | 2040 |
| aagagcc                                                            | 2047 |

<210> 19  
 <211> 38  
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<220>  
 <223> odhA\_up\_F

|                                           |    |
|-------------------------------------------|----|
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| tgaattcgag ctcggtaccc ttgaacggaa ttgggtgg | 38 |

<210> 20  
 <211> 38  
 <212> DNA  
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<220>  
 <223> odhA\_up\_R

|                                            |    |
|--------------------------------------------|----|
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| cccaggtggc atcgggtacct tcacccagcg ccacgcag | 38 |

<210> 21  
<211> 39  
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<220>  
<223> odhA\_down\_F

<400> 21  
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<210> 22  
<211> 38  
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<220>  
<223> odhA\_down\_R

<400> 22  
gtcgactcta gaggatcccc ggacaaggaa tggagaga 38

<210> 23  
<211> 18  
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<220>  
<223> odhA\_del\_F

<400> 23  
cttaccgttg ttgccctt 18

<210> 24  
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<212> DNA  
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<220>  
<223> odhA\_del\_R

<400> 24  
ctccttcacc cacatcatt 19

<210> 25  
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<400> 25  
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<210> 26  
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<400> 26  
ccaactgctc cgacgaag 18

<210> 27  
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<220>  
<223> CJ7-bicA\_confirm\_F

<400> 27  
attcccaaag gtgccagc 18

<210> 28  
<211> 18  
<212> DNA  
<213> Artificial Sequence

<220>  
<223> CJ7-bicA\_confirm\_R

<400> 28  
cagtgcgcaa aaggcctc

18

<210> 29  
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<213> Unknown

<220>  
<223> OdhA

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Arg Glu Leu Phe Glu Ala Gln Gly Gly Pro Asn Ala Thr Pro Ala Thr  
35 40 45  
Thr Glu Ala Gln Pro Ser Ala Pro Lys Glu Ser Ala Lys Pro Ala Pro  
50 55 60  
Lys Ala Ala Pro Ala Ala Lys Ala Ala Pro Arg Val Glu Thr Lys Pro  
65 70 75 80  
Ala Ala Lys Thr Ala Pro Lys Ala Lys Glu Ser Ser Val Pro Gln Gln  
85 90 95  
Pro Lys Leu Pro Glu Pro Gly Gln Thr Pro Ile Arg Gly Ile Phe Lys  
100 105 110  
Ser Ile Ala Lys Asn Met Asp Ile Ser Leu Glu Ile Pro Thr Ala Thr  
115 120 125  
Ser Val Arg Asp Met Pro Ala Arg Leu Met Phe Glu Asn Arg Ala Met  
130 135 140  
Val Asn Asp Gln Leu Lys Arg Thr Arg Gly Gly Lys Ile Ser Phe Thr  
145 150 155 160  
His Ile Ile Gly Tyr Ala Met Val Lys Ala Val Met Ala His Pro Asp  
165 170 175  
Met Asn Asn Ser Tyr Asp Val Ile Asp Gly Lys Pro Thr Leu Ile Val  
180 185 190

Pro Glu His Ile Asn Leu Gly Leu Ala Ile Asp Leu Pro Gln Lys Asp  
 195 200 205  
 Gly Ser Arg Ala Leu Val Val Ala Ala Ile Lys Glu Thr Glu Lys Met  
 210 215 220  
 Asn Phe Ser Glu Phe Leu Ala Ala Tyr Glu Asp Ile Val Thr Arg Ser  
 225 230 235 240  
 Arg Lys Gly Lys Leu Thr Met Asp Asp Tyr Gln Gly Val Thr Val Ser  
 245 250 255  
 Leu Thr Asn Pro Gly Gly Ile Gly Thr Arg His Ser Val Pro Arg Leu  
 260 265 270  
 Thr Lys Gly Gln Gly Thr Ile Ile Gly Val Gly Ser Met Asp Tyr Pro  
 275 280 285  
 Ala Glu Phe Gln Gly Ala Ser Glu Asp Arg Leu Ala Glu Leu Gly Val  
 290 295 300  
 Gly Lys Leu Val Thr Ile Thr Ser Thr Tyr Asp His Arg Val Ile Gln  
 305 310 315 320  
 Gly Ala Val Ser Gly Glu Phe Leu Arg Thr Met Ser Arg Leu Leu Thr  
 325 330 335  
 Asp Asp Ser Phe Trp Asp Glu Ile Phe Asp Ala Met Asn Val Pro Tyr  
 340 345 350  
 Thr Pro Met Arg Trp Ala Gln Asp Val Pro Asn Thr Gly Val Asp Lys  
 355 360 365  
 Asn Thr Arg Val Met Gln Leu Ile Glu Ala Tyr Arg Ser Arg Gly His  
 370 375 380  
 Leu Ile Ala Asp Thr Asn Pro Leu Ser Trp Val Gln Pro Gly Met Pro  
 385 390 395 400  
 Val Pro Asp His Arg Asp Leu Asp Ile Glu Thr His Ser Leu Thr Ile  
 405 410 415  
 Trp Asp Leu Asp Arg Thr Phe Ser Val Gly Gly Phe Gly Gly Lys Glu  
 420 425 430  
 Thr Met Thr Leu Arg Glu Val Leu Ser Arg Leu Arg Ala Ala Tyr Thr  
 435 440 445  
 Leu Lys Val Gly Ser Glu Tyr Thr His Ile Leu Asp Arg Asp Glu Arg  
 450 455 460

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Thr | Trp | Leu | Gln | Asp | Arg | Leu | Glu | Ala | Gly | Met | Pro | Lys | Pro | Thr | Gln |
| 465 |     |     |     |     | 470 |     |     |     |     | 475 |     |     |     |     | 480 |
| Ala | Glu | Gln | Lys | Tyr | Ile | Leu | Gln | Lys | Leu | Asn | Ala | Ala | Glu | Ala | Phe |
|     |     |     |     | 485 |     |     |     |     | 490 |     |     |     |     |     | 495 |
| Glu | Asn | Phe | Leu | Gln | Thr | Lys | Tyr | Val | Gly | Gln | Lys | Arg | Phe | Ser | Leu |
|     |     |     | 500 |     |     |     |     | 505 |     |     |     |     | 510 |     |     |
| Glu | Gly | Ala | Glu | Ala | Leu | Ile | Pro | Leu | Met | Asp | Ser | Ala | Ile | Asp | Thr |
|     |     | 515 |     |     |     |     | 520 |     |     |     |     | 525 |     |     |     |
| Ala | Ala | Gly | Gln | Gly | Leu | Asp | Glu | Val | Val | Ile | Gly | Met | Pro | His | Arg |
|     | 530 |     |     |     |     | 535 |     |     |     |     | 540 |     |     |     |     |
| Gly | Arg | Leu | Asn | Val | Leu | Phe | Asn | Ile | Val | Gly | Lys | Pro | Leu | Ala | Ser |
| 545 |     |     |     |     | 550 |     |     |     |     | 555 |     |     |     |     | 560 |
| Ile | Phe | Asn | Glu | Phe | Glu | Gly | Gln | Met | Glu | Gln | Gly | Gln | Ile | Gly | Gly |
|     |     |     |     | 565 |     |     |     |     | 570 |     |     |     |     | 575 |     |
| Ser | Gly | Asp | Val | Lys | Tyr | His | Leu | Gly | Ser | Glu | Gly | Gln | His | Leu | Gln |
|     |     |     | 580 |     |     |     |     | 585 |     |     |     |     | 590 |     |     |
| Met | Phe | Gly | Asp | Gly | Glu | Ile | Lys | Val | Ser | Leu | Thr | Ala | Asn | Pro | Ser |
|     |     | 595 |     |     |     |     | 600 |     |     |     |     | 605 |     |     |     |
| His | Leu | Glu | Ala | Val | Asn | Pro | Val | Met | Glu | Gly | Ile | Val | Arg | Ala | Lys |
|     | 610 |     |     |     |     | 615 |     |     |     |     | 620 |     |     |     |     |
| Gln | Asp | Tyr | Leu | Asp | Lys | Gly | Val | Asp | Gly | Lys | Thr | Val | Val | Pro | Leu |
| 625 |     |     |     |     | 630 |     |     |     |     | 635 |     |     |     |     | 640 |
| Leu | Leu | His | Gly | Asp | Ala | Ala | Phe | Ala | Gly | Leu | Gly | Ile | Val | Pro | Glu |
|     |     |     |     | 645 |     |     |     |     | 650 |     |     |     |     | 655 |     |
| Thr | Ile | Asn | Leu | Ala | Lys | Leu | Arg | Gly | Tyr | Asp | Val | Gly | Gly | Thr | Ile |
|     |     |     | 660 |     |     |     |     | 665 |     |     |     |     | 670 |     |     |
| His | Ile | Val | Val | Asn | Asn | Gln | Ile | Gly | Phe | Thr | Thr | Thr | Pro | Asp | Ser |
|     |     | 675 |     |     |     |     | 680 |     |     |     |     | 685 |     |     |     |
| Ser | Arg | Ser | Met | His | Tyr | Ala | Thr | Asp | Tyr | Ala | Lys | Ala | Phe | Gly | Cys |
|     | 690 |     |     |     |     | 695 |     |     |     |     | 700 |     |     |     |     |
| Pro | Val | Phe | His | Val | Asn | Gly | Asp | Asp | Pro | Glu | Ala | Val | Val | Trp | Val |
| 705 |     |     |     |     | 710 |     |     |     |     | 715 |     |     |     |     | 720 |
| Gly | Gln | Leu | Ala | Thr | Glu | Tyr | Arg | Arg | Arg | Phe | Gly | Lys | Asp | Val | Phe |

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |  |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|--|
|     |     |     | 725 |     |     |     |     | 730 |     |     |     |     | 735 |     |     |  |  |
| Ile | Asp | Leu | Val | Cys | Tyr | Arg | Leu | Arg | Gly | His | Asn | Glu | Ala | Asp | Asp |  |  |
|     |     |     | 740 |     |     |     |     | 745 |     |     |     |     | 750 |     |     |  |  |
| Pro | Ser | Met | Thr | Gln | Pro | Lys | Met | Tyr | Glu | Leu | Ile | Thr | Gly | Arg | Glu |  |  |
|     |     |     | 755 |     |     |     |     | 760 |     |     |     |     | 765 |     |     |  |  |
| Thr | Val | Arg | Ala | Gln | Tyr | Thr | Glu | Asp | Leu | Leu | Gly | Arg | Gly | Asp | Leu |  |  |
|     |     |     | 770 |     |     |     |     | 775 |     |     |     |     | 780 |     |     |  |  |
| Ser | Asn | Glu | Asp | Ala | Glu | Ala | Val | Val | Arg | Asp | Phe | His | Asp | Gln | Met |  |  |
| 785 |     |     | 790 |     |     |     |     | 795 |     |     |     |     | 800 |     |     |  |  |
| Glu | Ser | Val | Phe | Asn | Glu | Val | Lys | Glu | Gly | Gly | Lys | Lys | Gln | Ala | Glu |  |  |
|     |     |     | 805 |     |     |     |     | 810 |     |     |     |     | 815 |     |     |  |  |
| Ala | Gln | Thr | Gly | Ile | Thr | Gly | Ser | Gln | Lys | Leu | Pro | His | Gly | Leu | Glu |  |  |
|     |     |     | 820 |     |     |     |     | 825 |     |     |     |     | 830 |     |     |  |  |
| Thr | Asn | Ile | Ser | Arg | Glu | Glu | Leu | Leu | Glu | Leu | Gly | Gln | Ala | Phe | Ala |  |  |
|     |     |     | 835 |     |     |     |     | 840 |     |     |     |     | 845 |     |     |  |  |
| Asn | Thr | Pro | Glu | Gly | Phe | Asn | Tyr | His | Pro | Arg | Val | Ala | Pro | Val | Ala |  |  |
| 850 |     |     | 855 |     |     |     |     | 860 |     |     |     |     |     |     |     |  |  |
| Lys | Lys | Arg | Val | Ser | Ser | Val | Thr | Glu | Gly | Gly | Ile | Asp | Trp | Ala | Trp |  |  |
| 865 |     |     | 870 |     |     |     |     | 875 |     |     |     |     | 880 |     |     |  |  |
| Gly | Glu | Leu | Leu | Ala | Phe | Gly | Ser | Leu | Ala | Asn | Ser | Gly | Arg | Leu | Val |  |  |
|     |     |     | 885 |     |     |     |     | 890 |     |     |     |     | 895 |     |     |  |  |
| Arg | Leu | Ala | Gly | Glu | Asp | Ser | Arg | Arg | Gly | Thr | Phe | Thr | Gln | Arg | His |  |  |
|     |     |     | 900 |     |     |     |     | 905 |     |     |     |     | 910 |     |     |  |  |
| Ala | Val | Ala | Ile | Asp | Pro | Ala | Thr | Ala | Glu | Glu | Phe | Asn | Pro | Leu | His |  |  |
| 915 |     |     | 920 |     |     |     |     | 925 |     |     |     |     |     |     |     |  |  |
| Glu | Leu | Ala | Gln | Ser | Lys | Gly | Asn | Asn | Gly | Lys | Phe | Leu | Val | Tyr | Asn |  |  |
| 930 |     |     | 935 |     |     |     |     | 940 |     |     |     |     |     |     |     |  |  |
| Ser | Ala | Leu | Thr | Glu | Tyr | Ala | Gly | Met | Gly | Phe | Glu | Tyr | Gly | Tyr | Ser |  |  |
| 945 |     |     | 950 |     |     |     |     | 955 |     |     |     |     | 960 |     |     |  |  |
| Val | Gly | Asn | Glu | Asp | Ser | Val | Val | Ala | Trp | Glu | Ala | Gln | Phe | Gly | Asp |  |  |
|     |     |     | 965 |     |     |     |     | 970 |     |     |     |     | 975 |     |     |  |  |
| Phe | Ala | Asn | Gly | Ala | Gln | Thr | Ile | Ile | Asp | Glu | Tyr | Val | Ser | Ser | Gly |  |  |
|     |     |     | 980 |     |     |     |     | 985 |     |     |     |     | 990 |     |     |  |  |

Glu Ala Lys Trp Gly Gln Thr Ser Lys Leu Ile Leu Leu Leu Pro His  
 995 1000 1005

Gly Tyr Glu Gly Gln Gly Pro Asp His Ser Ser Ala Arg Ile Glu Arg  
 1010 1015 1020

Phe Leu Gln Leu Cys Ala Glu Gly Ser Met Thr Val Ala Gln Pro Ser  
 1025 1030 1035 1040

Thr Pro Ala Asn His Phe His Leu Leu Arg Arg His Ala Leu Ser Asp  
 1045 1050 1055

Leu Lys Arg Pro Leu Val Ile Phe Thr Pro Lys Ser Met Leu Arg Asn  
 1060 1065 1070

Lys Ala Ala Ala Ser Ala Pro Glu Asp Phe Thr Glu Val Thr Lys Phe  
 1075 1080 1085

Gln Ser Val Ile Asp Asp Pro Asn Val Ala Asp Ala Ala Lys Val Lys  
 1090 1095 1100

Lys Val Met Leu Val Ser Gly Lys Leu Tyr Tyr Glu Leu Ala Lys Arg  
 1105 1110 1115 1120

Lys Glu Lys Asp Gly Arg Asp Asp Ile Ala Ile Val Arg Ile Glu Met  
 1125 1130 1135

Leu His Pro Ile Pro Phe Asn Arg Ile Ser Glu Ala Leu Ala Gly Tyr  
 1140 1145 1150

Pro Asn Ala Glu Glu Val Leu Phe Val Gln Asp Glu Pro Ala Asn Gln  
 1155 1160 1165

Gly Pro Trp Pro Phe Tyr Gln Glu His Leu Pro Glu Leu Ile Pro Asn  
 1170 1175 1180

Met Pro Lys Met Arg Arg Val Ser Arg Arg Ala Gln Ser Ser Thr Ala  
 1185 1190 1195 1200

Thr Gly Val Ala Lys Val His Gln Leu Glu Glu Lys Gln Leu Ile Asp  
 1205 1210 1215

Glu Ala Phe Glu Ala  
 1220

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<220>

<223> SbtA

<400> 30

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Gly Thr Gln Leu Val Ile Pro Glu Ala Ile Ser Thr Ile Ile Val Phe  
35 40 45

Met Leu Leu Thr Lys Ile Gly Leu Thr Gly Gly Met Ala Ile Arg Asn  
50 55 60

Ser Asn Leu Thr Glu Met Leu Leu Pro Met Ile Phe Ser Val Ile Leu  
65 70 75 80

Gly Ile Leu Ile Val Phe Ile Ala Arg Phe Thr Leu Ala Lys Leu Pro  
85 90 95

Asn Val Lys Thr Val Asp Ala Leu Ala Thr Gly Gly Leu Phe Gly Ala  
100 105 110

Val Ser Gly Ser Thr Met Ala Ala Ala Leu Thr Thr Leu Glu Glu Ser  
115 120 125

Lys Ile Ser Tyr Glu Ala Trp Ala Gly Ala Leu Tyr Pro Phe Met Asp  
130 135 140

Ile Pro Ala Leu Val Thr Ala Ile Val Val Ala Asn Ile Tyr Leu Asn  
145 150 155 160

Lys Lys Lys Arg Arg Ala Ala Ala Ala Ile Glu Gly Ser Leu Ser Lys  
165 170 175

Gln Pro Val Ala Ala Gly Asp Tyr Gly Asp Gln Gln Asp Tyr Pro Arg  
180 185 190

Thr Arg Gln Glu Tyr Leu Ser Gln Gln Glu Pro Glu Asp Asn Arg Val  
195 200 205

Lys Ile Trp Pro Ile Ile Glu Glu Ser Leu Gln Gly Pro Ala Leu Ser  
210 215 220

Ala Met Leu Leu Gly Leu Ala Leu Gly Ile Phe Thr Lys Pro Glu Ser  
225 230 235 240



|                                                                   |      |
|-------------------------------------------------------------------|------|
| gccctaacta cgttgaaga atcaaaaatt tcctacgaag cttgggctgg tgccctctat  | 420  |
| ccttttatgg atattcctgc cctagtaacg gcgatcgtag tggccaatat ttatctcaat | 480  |
| aagaagaagc gtcgtgccgc ggccgccatt gagggatctt taagcaagca acccgttgcc | 540  |
| gcaggggatt atggcgatca gcaggattat cctcgtaccc gccaggagta tttgagccag | 600  |
| caggaaccgg aggataatcg ggtcaagatc tggccgatca tcgaagaaag tttacaaggt | 660  |
| cccgccctgt cagccatggt attaggtctt gcccttggca tatttaccaa gccggaaagt | 720  |
| gtctatgaag gtttctatga tcctcttttt cgaggcctac tttctatctt gatgctcatt | 780  |
| atggggatgg aggcttggtc cagaattggc gaactacgta aagtagctca atggtatgtg | 840  |
| gtctatagcc tggtagctcc gatagtgcac gggtttattg ctttgggtct tggtatgatt | 900  |
| gccactaca ctacgggatt cagcctgggc ggtgtcgtag ttttagcagt catcgccgct  | 960  |
| tctagttctg atatctccgg cccccccacc ttgcgagccg gtatcccgtc ggccaatccc | 1020 |
| tctgcttata ttggtgcatc caccgctatc ggtactccca ttgccatcgg cgtgtgcata | 1080 |
| ccgcttttca ttgggcttgc ccagaccctt ggtgcaggt                        | 1119 |

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 <211> 5803  
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 <223> pDCM2

|                                                                   |     |
|-------------------------------------------------------------------|-----|
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| ctacctgctt tctctttgcg cttgcgtttt cccttgtcca gatagcccag tagctgacat | 120 |
| tcatccgggg tcagcaccgt ttctgcggac tggctttcta cgtgttccgc ttcctttagc | 180 |
| agcccttgcg ccctgagtgc ttgcggcagc gtgaagctag cttttatcgc cattcgccat | 240 |
| tcaggctgcg caactgttgg gaagggcgat cgggtcgggc ctcttcgcta ttacgccagc | 300 |
| tggcgaaagg gggatgtgct gcaaggcgat taagttgggt aacgccaggg ttttcccagt | 360 |

|                                                                    |      |
|--------------------------------------------------------------------|------|
| cacgacgttg taaaacgacg gccagtgaat tcgagctcgg taccgggga tcctctagag   | 420  |
| tcgacctgca ggcatgcaag cttggcgtaa tcatgggtcat agctgtttcc tgtgtgaaat | 480  |
| tggtatccgc tcacaattcc acacaacata cgagccggaa gcataaagtg taaagcctgg  | 540  |
| ggtgcctaata gagtgagcta actcacatta attgcgttgc gctcactgcc cgctttccag | 600  |
| tcgggaaacc tgtcgtgcca gctgcattaa tgaatcggcc aacgcgcggg gagaggcggg  | 660  |
| ttgcgtattg ggcgctcttc cgcttcctcg ctactgact cgctgcgctc ggtcgttcgg   | 720  |
| ctgcggcgag cggtatcagc tcactcaaag gcggtaatag gggtatccac agaatacagg  | 780  |
| gataacgcag gaaagaacat gtgagcaaaa ggccagcaaa aggccaggaa ccgtaaaaag  | 840  |
| gccgcgttgc tggcgttttt ccataggctc cgccccctg acgagcatca caaaaatcga   | 900  |
| cgctcaagtc agaggtggcg aaacccgaca ggactataaa gataccaggc gtttccccct  | 960  |
| ggaagctccc tcgtgcgctc tcctgttccg accctgccgc ttaccggata cctgtccgcc  | 1020 |
| tttctccctt cgggaagcgt ggcgctttct caatgctcac gctgtaggta tctcagttcg  | 1080 |
| gtgtaggtcg ttcgctccaa gctgggctgt gtgcacgaac cccccgttca gcccgaccgc  | 1140 |
| tgcgccctat ccggtaaacta tcgtcttgag tccaacccgg taagacacga cttatcgcca | 1200 |
| ctggcagcag ccactggtaa caggattagc agagcgaggt atgtaggcgg tgctacagag  | 1260 |
| ttcttgaagt ggtggcctaa ctacggctac actagaagga cagtatttgg tatctgcgct  | 1320 |
| ctgctgaagc cagttacctt cggaaaaaga gttggtagct cttgatccgg caaacaacc   | 1380 |
| accgctggta gcggtggttt ttttgtttgc aagcagcaga ttacgcgcag aaaaaagga   | 1440 |
| tctcaagaag atcctttgat cttttctacg gggcttgacg ctcaagtggaa cgaaaactca | 1500 |
| cgtaaggga ttttgggtcat gagattatca aaaaggatct tcacctagat cttttgggg   | 1560 |
| tgggcgaaga actccagcat gagatccccg cgctggagga tcatccagcc ctgatagaaa  | 1620 |
| cagaagccac tggagcacct caaaaacacc atcatacact aaatcagtaa gttggcagca  | 1680 |
| tcacccgacg cactttgcgc cgaataaata cctgtgacgg aagatcactt cgcagaataa  | 1740 |
| ataaatcctg gtgtccctgt tgataccggg aagccctggg ccaacttttg gcgaaaatga  | 1800 |
| gacgttgatc ggcacgtaag aggttccaac tttcaccata atgaaataag atcactaccg  | 1860 |

|                                                                    |      |
|--------------------------------------------------------------------|------|
| ggcgtatttt ttgagttatc gagattttca ggagctgata gaaacagaag ccactggagc  | 1920 |
| acctcaaaaa caccatcata cactaaatca gtaagttggc agcatcaccg gacgcacttt  | 1980 |
| gcgccgaata aataacctgtg acggaagatc acttcgcaga ataaataaat cctggtgtcc | 2040 |
| ctgttgatac cgggaagccc tgggccaact tttggcgaaa atgagacgtt gatcggcacg  | 2100 |
| taagaggttc caactttcac cataatgaaa taagatcact accgggcgta ttttttgagt  | 2160 |
| tatcgagatt ttcaggagct ctttggcatc gtctctcgcc tgtcccctca gttcagtaat  | 2220 |
| ttcctgcatt tgcctgtttc cagtcggtag atattccaca aaacagcagg gaagcagcgc  | 2280 |
| ttttccgctg cataaccctg cttcggggtc attatagcga ttttttcggt atatccatcc  | 2340 |
| tttttcgcac gatatacagg attttgccaa agggttcgtg tagactttcc ttggtgtatc  | 2400 |
| caacggcgtc agccgggcag gataggtgaa gtagggccac ccgcgagcgg gtgttccttc  | 2460 |
| ttcactgtcc cttattcgca cctggcggtg ctcaacggga atcctgctct gcgaggctgg  | 2520 |
| ccggctaccg ccggcgtaac agatgagggc aagcggatgg ctgatgaaac caagccaacc  | 2580 |
| aggaagggca gcccacctat caaggtgtac tgccttcag acgaacgaag agcgattgag   | 2640 |
| gaaaaggcgg cggcgccgg catgagcctg tcggcctacc tgctggccgt cggccagggc   | 2700 |
| tacaaaatca cgggcgtcgt ggactatgag cacgtccgcg agggcgtccc ggaaaacgat  | 2760 |
| tccgaagccc aacctttcat agaaggcggc ggtggaatcg aaatctcgtg atggcaggtt  | 2820 |
| gggcgtcgct tggtcggtca tttcgaaaaa ggtaggaat acggttagcc atttgcctgc   | 2880 |
| ttttatatag ttcantatgg gattcacctt tatgttgata agaaataaaa gaaaatgcca  | 2940 |
| ataggatatc ggcattttct tttgcgtttt tatttgttaa ctgttaattg tccttgttca  | 3000 |
| aggatgctgt ctttgacaac agatgttttc ttgcctttga tgttcagcag gaagctcggc  | 3060 |
| gcaaacgttg attgtttgtc tgcgtagaat cctctgtttg tcatatagct tgtaatcacg  | 3120 |
| acattgtttc ctttcgcttg aggtacagcg aagtgtgagt aagtaaaggt tacatcgtta  | 3180 |
| ggcggatcaa gatccatttt taacacaagg ccagttttgt tcagcggctt gtatgggcca  | 3240 |
| gttaaagaat tagaaacata accaagcatg taaatatcgt tagacgtaat gccgtcaatc  | 3300 |
| gtcatttttg atccgcggga gtcagtgaac aggtaccatt tgccgttcat tttaaagacg  | 3360 |

|                                                                     |      |
|---------------------------------------------------------------------|------|
| ttcgcgcgtt caatttcac tgttactgtg ttagatgcaa tcagcggttt catcactttt    | 3420 |
| ttcagtggtt aatcatcgtt tagctcaatc ataccgagag cgccgtttgc taactcagcc   | 3480 |
| gtgcgttttt tatcgctttg cagaagtttt tgactttctt gacggaagaa tgatgtgctt   | 3540 |
| ttgccatagt atgctttgtt aaataaagat tcttcgcctt ggtagccatc ttcagttcca   | 3600 |
| gtgtttgctt caaataactaa gtattttgtgg cttttatctt ctacgtagtg aggatctctc | 3660 |
| agcgtatggt tgtcgcctga gctgtagttg ctttcacga tgaactgctg tacattttga    | 3720 |
| tacgtttttc cgtcacctgc aaagattgat ttataatcct ctacaccgtt gatgttcaaa   | 3780 |
| gagctgtctg atgctgatac gttaacttgt gcagttgtca gtgtttgttt gccgtaatgt   | 3840 |
| ttaccggaga aatcagtgta gaataaacgg atttttccgt cagatgtaaa tgtggctgaa   | 3900 |
| cctgaccatt cttgtgtttg gtcttttagg atagaatcat ttgcatcgaa tttgtcgctg   | 3960 |
| tctttaaaga cgcgccagc gtttttccag ctgtcaatag aagtttcgcc gactttttga    | 4020 |
| tagaacatgt aaatcgatgt gtcacccgca tttttaggat ctccggctaa tgcaaagacg   | 4080 |
| atgtggtagc cgtgatagtt tgcgacagtg ccgtcagcgt tttgtaatgg ccagctgtcc   | 4140 |
| caaacgtcca ggccttttgc agaagagata tttttaattg tggacgaatc aaattcagaa   | 4200 |
| acttgatatt tttcattttt ttgctgttca gggatttgca gcatacatg gcgtgtaata    | 4260 |
| tgggaaatgc cgtatgtttc cttatatggc ttttggttcg tttctttcgc aaacgcttga   | 4320 |
| gttgcgctc ctgccagcag tgcggtagta aaggtttaata ctgttgcttg ttttgcaaac   | 4380 |
| tttttgatgt tcatcgttca tgtctcctt tttatgtact gtgttagcgg tctgcttctt    | 4440 |
| ccagccctcc tgtttgaaga tggcaagtta gttacgcaca ataaaaaag acctaaaata    | 4500 |
| tgtaaaggggt gacgcaaag tatacacttt gccctttaca cattttaggt cttgcctgct   | 4560 |
| ttatcagtaa caaacccgcg cgatttactt ttcgacctca ttctattaga ctctcgtttg   | 4620 |
| gattgcaact ggtctatttt cctcttttgt ttgatagaaa atcataaaag gatttgcaga   | 4680 |
| ctacgggcct aaagaactaa aaaatctatc tgtttctttt cattctctgt attttttata   | 4740 |
| gtttctgttg catgggcata aagttgcctt tttaatcaca attcagaaaa tatcataata   | 4800 |
| tctcatttca ctaaataata gtgaacggca ggtatatgtg atgggttaaa aaggatcacc   | 4860 |

|                                                                   |      |
|-------------------------------------------------------------------|------|
| ccagagtccc gctcagaaga actcgtcaag aaggcgatag aaggcgatgc gctgcgaatc | 4920 |
| gggagcggcg ataccgtaaa gcacgaggaa gcggtcagcc cattcgccgc caagctcttc | 4980 |
| agcaatatca cgggtagcca acgctatgtc ctgatagcgg tccgccacac ccagccggcc | 5040 |
| acagtcgatg aatccagaaa agcggccatt ttccaccatg atattcggca agcaggcatc | 5100 |
| gccatgggtc acgacgagat cctcgccgtc gggcatccgc gccttgagcc tggcgaacag | 5160 |
| ttcggctggc gcgagcccct gatgctcttc gtccagatca tcctgacga caagaccggc  | 5220 |
| ttccatccga gtacgtgctc gctcgatgcg atgtttcgct tgggtggcga atgggcaggt | 5280 |
| agccggatca agcgtatgca gccgccgat tgcacagcc atgatggata ctttctcggc   | 5340 |
| aggagcaagg tgagatgaca ggagatcctg ccccgccact tcgcccata gcagccagtc  | 5400 |
| ccttcccgtc tcagtgaaa cgtcgagaca gctgcgaag gaacgccgt cgtggccagc    | 5460 |
| cacgatagcc gcgctgcctc gtcttgaggt tcattcaggg caccggacag gtcggtcttg | 5520 |
| acaaaaagaa ccgggcgccc ctgcgctgac agccggaaca cggcggcatc agagcagccg | 5580 |
| attgtctgtt gtgcccagtc atagccgaat agcctctcca cccaagcggc cggagaacct | 5640 |
| gcgtgcaatc catcttgctc aatcatgcga aacgacctc atcctgtctc ttgatcagat  | 5700 |
| cttgatcccc tgcgcatca gatccttggc ggcaagaaag ccatccagtt tactttgcag  | 5760 |
| ggcttcccaa ccttaccaga gggcgcccca gctggcaatt ccg                   | 5803 |