

## SEQUENCE LISTING PART OF DESCRIPTION

**SEQ ID NO: 1 NMB1870**

MPSEPPFGRHLIFASLTCLIDAVCKKRYHNQNVYILSILRMTRSKPVNRTAFCCLSLTTA  
 LILTACSSGGGGVAADIGAGLADALTAPLDHKDKGLQSLTLDQSVRKNEKLKLAQAQAEK  
 5 TYNGDSLNTGKLKNDKVSFRDFIRQIEVDGQLITLESGEFQVYKQSHSALTAFQTEQIQ  
 DSEHSGKMVAKRQFRIGDIAGEHTSFDKLPEGGRATYRGTAFGSDDAGGKLTYTIDFAAK  
 QGNGKIEHLKSPELNVDLAAADIKPDGKRHAVISGSVLYNQAEGSYSLGIFGGKAQEVA  
 GSAEVKTVNGIRHIGLAAKQ

**10 SEQ ID NO: 2 Nucleic acid sequence encoding SEQ ID NO: 1**

atgccgtctgaaccgccgttcggacgacatttgatTTTTGCTTCTTGACCTGCCTCATT  
 gatgcggtatgcaaaaaaagataaccataaccaaagtgttatattattctattctgcgt  
 atgactaggagtaaaccctgtgaatcgaactgccttctgctgcctttctctgaccactgcc  
 ctgattctgaccgcctgcagcagcggaggggtggtgtcgccgccgacatcgggtgcgggg  
 15 cttgccgatgcactaaccgcaccgctcgaccataaagacaaaggtttgcagtctttgacg  
 ctggatcagtcctgcaggaaaaacgagaaactgaagctggcggcacaaggtgcggaaaaa  
 acttatggaaacggtgacagcctcaatacgggcaaattgaagaacgacaaggtcagccgt  
 ttgcactttatccgccaaatcgaagtggacgggcagctcattaccttgagagtgagag  
 ttccaagtatacaaaacaaagccattccgccttaaccgcctttcagaccgagcaaatacaa  
 20 gattcggagcattccgggaagatggttgcgaaacgccagttcagaatcggcgacatagcg  
 ggcgaaacatacatcttttgacaagcttcccgaaggcggcagggcgacatatcgcgggacg  
 gcgttcggttcagacgatgccggcggaactgacctacaccatagatttcgccgccaag  
 cagggaaacggcaaaatcgaacatttgaaatcgccagaactcaatgtcgacctggccgcc  
 gccgatatacaagccggatggaaaacgccatgccgtcatcagcggttccgtcctttacaac  
 25 caagccgagaaaaggcagttactccctcggtatctttggcgaaaagcccaggaagttgcc  
 ggcagcgcggaagtgaaaaccgtaaacggcatacgccatatcggccttgccgccaagcaa  
 taa

**SEQ ID NO: 3 NMA0586-ortholog of NMB1870 and having identity = 0.957 to NMB1870**

30 MTRSKPVNRTAFCCLSLTAALILTACSSGGGGVAADIGAVLADALTAPLDHKDKSLQSLT  
 LDQSVRKNEKLKLAQAQAEKTYNGDSLNTGKLKNDKVSFRDFIRQIEVDGQLITLESGE  
 FQVYKQSHSALTALQTEQVQDSEHSGKMVAKRQFRIGDIAGEHTSFDKLPEGGRATYRG  
 AFGSDDASGKLTYTIDFAAKQGHGKIEHLKSPELNVDLAASDIKPKKRHAVISGSVLYN  
 QAEKGSYSLGIFGGQAQEVAGSAEVETANGIRHIGLAAKQ

**35 SEQ ID NO: 4 Nucleic acid sequence encoding SEQ ID NO: 3**

atgactaggagcaaaccctgtgaaccgaactgccttctgctgcctttctttgaccgccgcc  
 ctgattctgaccgcctgcagcagcggagggcggtgtcgccgccgacatcggcgcggtg

**NVD008BWO**

cttgccgatgcactaaccgcaccgctcgaccataaagacaaaagtttgagtcctttgacg  
 ctggatcagtcctgtcaggaaaaacgagaaactgaagctggcggcacaaggtgcggaaaaa  
 acttatggaaaacggcgacagcctcaatacgggcaaattgaagaacgacaaggtcagccgc  
 ttcgactttatccgtcaaatacgaagtggacgggcagctcattaccttgagagcggagag  
 5 tccaagtgtacaaaacaaagccattccgccttaaccgcccttcagaccgagcaagtacaa  
 gattcggagcattcaggggaagatggttgcgaaacgccagttcagaatcggcgatatagcg  
 ggtgaacatacatcttttgacaagcttcccgaaggcggcagggcgacatatcgcgggacg  
 gcattcgggttcagacgatgccagtggaaaactgacctacaccatagatttcgccgccaag  
 cagggacacggcaaaaatcgaacatttgaaatcgccagaactcaatggttgacctggccgcc  
 10 tccgatatacaagccggataaaaaacgccatgccgtcatcagcggttccgtcctttacaac  
 caagccgagaaaaggcagttactctctaggcatctttggcgggcaagcccaggaagttgcc  
 ggcagcgcagaagtggaaaaccgcaaacggcatacgccatatcggtcttgccgccaagcag  
 taa

**15 SEQ ID NO: 5 NMCC\_0351-ortholog of NMB1870 and having identity = 0.939 to NMB1870**

MNRTAFCCLFLTALILTACSSGGGGSGSGGVAADIGTGLADALTAPLDHKDKGLRSLTL  
 DQSVRKNEKLKLAQAQGAEKTYGNGDSLNTGKLKNDKVSFRDFIRQIEVDRQLITLESGEF  
 QVYKQSHSALTAFQTEQIQDSEHSGKVMVAKRRFRIGDIAGEHTSFDKLPEGGRATYRGTA  
 20 FSSDDAGGKLYTIDFAAKQGYGKIEHLKSPELNVDLVSADIKPDEKRHAVISGSVLYNQ  
 DEKGSYSLGIFGGKAQEVAGSAEVKTVNGIRHIGLAAKQ

**SEQ ID NO: 6 Nucleic acid sequence encoding SEQ ID NO: 5**

gtgaaccgaactgccttctgtgccttttctgaccaccgccctgattctgaccgcctgc  
 25 agcagcgggagggcggcggaagcgggaagcggcggtgtcgccgcccacatcggcacggggctt  
 gccgatgcgctaaccgcggcgtcgaccataaagacaaaagtttgcggtctttgacgctg  
 gaccagtccgtcagggaaaaacgagaaactgaagctggcggcacaaggtgcggaaaaaact  
 tatggaaacggcgacagcctcaatacgggcaaattgaagaacgacaaggtcagccgtttc  
 gactttatccgtcaaatacgaagtggacaggcagctcattaccttgagagcggagagttc  
 30 caagtgtacaaaacaaagccattccgccttaaccgcccttcagaccgagcaaatacaagat  
 tcggagcattccgggaagatggttgcgaaacgccggttcagaatcggcgacatagcgggc  
 gaacatacatcttttgacaagcttcccgaaggcggcagggcgacatatcgcgggacggcg  
 ttcagttcagacgatgccggcggaaaaactgacctacaccatagatttcgccgccaagcag  
 ggatacggcaaaaatcgaacatttgaaatcgccggaaactcaatgtcgacctggtctctgcc  
 35 gatatacaagccggatgaaaaacgccatgccgtcatcagcggctccgtcctttacaaccaa  
 gacgagaaaaggcagttactccctcggtatctttggcggaaaagcccaggaagttgccggc  
 agcgcggaagtgaaaaccgtaaacggcatacgccatatcggccttgccgccaagcaataa

**SEQ ID NO: 7 NMC0349-ortholog of NMB1870 and having identity = 0.714 to NMB1870**

MTRSKPVNRTAFCCLSLTAALILTACSSGGGGVAADIGAGLADALTAPLDHKDKSLQSLT  
 LDQSVRKNEKLKLAAQGAEKTYGNGDSLNTGKLKNDKVSRLFDFIRQIEVDGQLITLESGE  
 FQIYKQDHS AVVALQIEKINNPDKIDSLINQRSFLVSGLGGEHTAFNQLPSGKAEYHGKA  
 5 FSSDDPNGLRHYSIDFTKKQGYGRIEHLKTPEQNVELASAELKADEKSHAVILGDTRYGG  
 EEKGTYHLALFGDRAQEIAGSATVKIREKVHEIGIAGKQ

**SEQ ID NO: 8 Nucleic acid sequence encoding SEQ ID NO: 7**

atgactaggagcaaacctgtgaaccgaactgccttctgctgcctttctttgaccgccgcc  
 10 ctgattctgaccgcctgcagcagcggaggcggtgtcgccgccgacatcggcgcgggg  
 cttgccgatgcactaaccgcaccgctcgaccataaagacaaaagtttgagtcctttgacg  
 ctggatcagtcctgcaggaaaaacgagaaactgaagctggcggcacaaggtgcggaaaaa  
 acttatggaaacggcgacagcctcaatacgggcaaattgaagaacgacaaggtcagccgc  
 ttcgactttatccgtcaaatacgaagtggacgggcagctcattaccttgagagcggagag  
 15 ttccaaatatacaaacaggaccactccgccgtcgttgccctacagattgaaaaaatcaac  
 aaccccgacaaaatcgacagcctgataaaccaacgctccttccttgtagcggtttgggt  
 ggagaacataccgccttcaaccaactgcccgaggcaaaagccgagtatcacggcaaaagca  
 ttcagctccgacgacccgaacggcaggctgcactactccattgattttacaaaaaacag  
 ggttacggcagaatcgaacacctgaaaacgcccagcagaatgtcgagcttgccctccgcc  
 20 gaactcaaagcagatgaaaaatcacacgccgtcattttgggcgacacgcgctacggcggc  
 gaagaaaaaggcacttaccacctcgcccttttcggcgaccgcgccaagaaatcgccggc  
 tcggcaaccgtgaagataagggaaggttcacgaaatcggcacgcggcgaacagtag

**SEQ ID NO: 9 NGO0033-ortholog of NMB1870 and having identity = 0.622 to NMB1870**

MTRSKPVNRTTFCCLSLTAGPDSRLQRRGGGGVAADIGTGLADALTAPLDHKDKGLK  
 25 SLTLEASIPQNGTLTLTAQGAEKTFKAGGKDNSLNTGKLKNDKISRFDVQKIEVDGQTI  
 TLASGEFQIYKQDHS AVVALRIEKINNPDKIDSLINQRSFLVSDLGGEHTAFNQLPDGKA  
 EYHGKAFSSDDADGKLTYTIDFAAKQGHGKIEHLKTPEQNVELASAELKADEKSHAVILG  
 DTRYGGEEKGTYRLALFGDRAQEIAGSATVKIGEKVHEIGIADKQ

**SEQ ID NO: 10 Nucleic acid sequence encoding SEQ ID NO: 9**

atgactaggagtaaacctgtgaaccgaactaccttctgctgcctttctttgaccgccggc  
 cctgattctgaccgcctgcagcagcggaggggcgaggcggtggtgtcgccgccgacatc  
 ggcacggggccttgccgatgcattaaccgcgcgctcgaccataaagacaaaaggtttgaaa  
 35 tccctaacattggaagcctccattccccaaaacggaacactgaccctgtcggcacaaggt  
 gcggaaaaaactttcaaagccggcggaagacaacagcctcaacacgggcaaaactgaag  
 aacgacaaaatcagccgcttcgacttcgtgcaaaaaatcgaagtggacggacaaaccatc  
 aactggcaagcggcgaatttcaaataatacaaacaggatcactccgccgtcgttgcccta  
 cggattgaaaaaatcaacaaccccgacaaaatcgacagcctgataaaccaacgctccttc

**NVD008BWO**

cttgtcagcgatttgggcggaacataccgccttcaaccaactgcctgacggcaaagcc  
gagtatcacggcaaagcattcagctccgacgatgccgacggaaaactgacctataccata  
gatttcgccgccaaaacagggacacggcaaaatcgaacacctgaaaacacccgagcagaat  
gttgagcttgcctccgccgaactcaaagcagatgaaaaatcacacgccgtcattttgggc  
5 gacacgcgctacggcggcgaagagaaaggcacttaccgcctcgcccttttcggcgaccgc  
gccaagaaatcgctggctcggcaaccgtgaagataggggaaaagggttcacgaaatcggc  
atcgccgacaaacagtag

### SEQ ID NO: 11 NMB1030

10 MKKII FAALAAAAISTASAATYKVDEYHANARFAIDHFNTSTNVGGFYGLTGSVEFDQAK  
RDGKIDITIPIANLQSGSQHFTDHLKSADIFDAAQYPDIRFVSTKFNFNKKLVSDGNL  
TMHGKTAPVKLKAKEKFNCYQSPMEKTEVCGGDFSTTIDRTKWGMDYLVNVGMTKSVRIDI  
QIEAAKQ

### 15 SEQ ID NO: 12 Nucleic acid sequence encoding SEQ ID NO: 11

atgaaaaaatcatcttcgccgcactcgcagccgcccatcagtactgcctccgccgcc  
acctacaaagtggacgaatatcacgccaacgcccgtttcgccatcgaccatttcaacacc  
agcaccaacgtcggcggtttttacgggtctgaccggttcgctcgagttcgaccaagcaaaa  
cgcgacggtaaaatcgacatcaccatccccattgccaacctgcaaagcggttcgcaacac  
20 tttaccgaccacctgaaatcagccgacatcttcgatgccgccaatatccggacatccgc  
tttgtttccaccaaattcaacttcaacggcaaaaaactggtttcggttgacggcaacctg  
accatgcacggcaaaaccgccccgtcaaaactcaaagccgaaaaattcaactgctacaa  
agccccgatggagaaaaccgaagtgttggtggcgacttcagcaccaccatcgaccgcacc  
aaatggggcatggactacctcggttaacgttggtatgacaaaagcgtccgcatcgacatc  
25 caaatcgaggcagccaaacaataa

### SEQ ID NO: 13 NMC1183- Ortholog of NMB1030 and having identity = 0.973 to NMB1030

30 MKKII FAALAAAVGTASAATYKVDEYHANARFAIDHFNTSTNVGGFYGLTGSVEFDQAK  
RDGKIDITIPVANLQSGSQHFTDHLKSADIFDAAQYPDIRFVSTKFNFNKKLVSDGNL  
TMHGKTAPVKLKAKEKFNCYQRPMEKTEVCGGDFSTTIDRTKWGVDYLVNVGMTKSVRIDI  
QIEAAKQ

### SEQ ID NO: 14 Nucleic acid sequence encoding SEQ ID NO: 13

35 atgaaaaaatcatcttcgccgcactcgcagcggcagccgttggcactgcctccgccgcc  
acctacaaagtggacgaatatcacgccaacgcccgtttcgccatcgaccatttcaacacc  
agcaccaacgtcggcggtttttacgggtctgaccggttcgctcgagttcgaccaagcaaaa  
cgcgacggtaaaatcgacatcaccatccccgttgccaacctgcaaagcggttcgcaacac  
tttaccgaccacctgaaatcagccgacatcttcgatgccgccaatatccggacatccgc

NVD008BWO

tttgtttccaccaaattcaacttcaacggcaaaaaactggtttccgttgacggcaacctg  
 accatgcacggcaaaaccgccccgtcaaactcaaagccgaaaaattcaactgctaccaa  
 cgcccgatggagaaaaaccgaagtttgcgggcgacttcagcaccaccatcgaccgcacc  
 aaatggggcggtgactacctcgtaacgttggtatgacaaaagcgctccgcatcgacatc  
 5 caaatcgaggcagccaaacaataa

**SEQ ID NO: 15 NMA1457- Ortholog of NMB1030 and having identity = 0.973 to NMB1030**

MKKIIIAALAAAAIGTASAATYKVDEYHANARFSIDHFNTSTNVGGFYGLTGSVEFDQAK  
 10 RDGKIDITIPVANLQSGSQHFTDHLKSADIFDAAQYPDIRFVSTKFNFNKGKLVSDGNL  
 TMHGKTAPVKLKAKEKFNCYQSPMLKTEVCGGDFSTTIDRTKWGMDYLVNVGMTKSVRIDI  
 QIEAAKQ

**SEQ ID NO: 16 Nucleic acid sequence encoding SEQ ID NO: 15**

15 atgaaaaaatcatcatcgccgcgtcgcagcagcccatcggcactgcctccgccgcc  
 acctacaaagtggacgaatatcacgccaacgcccgtttctctatcgaccatttcaacacc  
 agcaccaacgtcggcggtttttacggtctgaccggttccgttgagttcgaccaagcaaaa  
 cgcgacggtaaaatcgacatcaccatccccgttgccaacctgcaaagcggttcgcaacac  
 tttaccgaccacctgaaatcagccgacatcttcgatgccgccaatatccggacatccgc  
 20 tttgtttccaccaaattcaacttcaacggcaaaaaactggtttccgttgacggcaacctg  
 accatgcacggcaaaaccgccccgtcaaactcaaagccgaaaaattcaactgctaccaa  
 agcccgatggtgaaaaccgaagtttgcgggcgacttcagcaccaccatcgaccgcacc  
 aaatggggcatggactacctcgtaacgttggtatgacaaaagcgctccgcatcgacatc  
 caaatcgaggcagccaaacaataa

25 **SEQ ID NO: 17 NMCC\_1165- Ortholog of NMB1030 and having identity = 0.963 to NMB1030**

MKKIIIAALAAAAVGTASAATYKVDEYHANARFAIDHFNTSTNVGGFYGLTGSVEFDQAK  
 RDGKIDITIPVANLQSGSQHFTDHLKSADIFDAAQYPDIRFVSTKFNFNKGKLVSDGNL  
 30 TMHGKTAPVKLKAKEKFNCYQSPMAKTEVCGGDFSTSIDRTKWGVDYLVNVGMTKSVRIDI  
 QIEAAKQ

**SEQ ID NO: 18 Nucleic acid sequence encoding SEQ ID NO: 17**

35 atgaaaaaatcatcatcgccgcactcgcagcggcagccgtcggcactgcctccgccgcc  
 acctacaaagtggacgaatatcacgccaacgcccgtttcgccatcgaccatttcaacacc  
 agcaccaacgtcggcggtttttacggtctgaccggttccgttgagttcgaccaagcaaaa  
 cgcgacggtaaaatcgacatcaccatccccgttgccaacctgcaaagcggttcgcaacac  
 tttaccgaccacctgaaatcagccgacatcttcgatgccgccaatatccggacatccgc  
 tttgtttccaccaaattcaacttcaacggcaaaaaactggtttccgttgacggcaacctg

**NVD008BWO**

accatgcacggcaaaaaccgccccgtcaaactcaaagccgaaaaattcaactgctaccaa  
agccccgatggcgaaaaaccgaagtttgcggcggcgacttcagcaccagcatcgaccgcacc  
aaatggggcggtggactacctcgtaacgttggtatgacaaaaagcgccgcatcgacatc  
caaatcgaggcagccâaacaataa

5  
**SEQ ID NO: 19 NGO0558- Ortholog of NMB1030 and having identity = 0.930 to NMB1030**

MKKII FAALAAA AVGTASATYKVDEYHANVRFAIDHFNTSTNVGGFYGLTGSVEFDQAKR  
DGKIDITIPVANLQSGSQPFTGHLKSADIFDAAQYPDIRFVSTKFNFNKGKLVSV DGNLT  
MRGKTAPVKLKA EKFN CYQSPMAETEVC GGDFSTTIDRTKWGV DYL VNAGMTKNVRIDIQ  
10 IEAAKQ

**SEQ ID NO: 20 Nucleic acid sequence encoding SEQ ID NO: 19**

atgaaaaaatcatcttcgcccgcgtcgcagcggcagccgtcggcactgcctccgccacc  
tacaaagtggacgaatatcacgccaacgtccgtttcgccatcgaccacttcaacaccagc  
15 accaacgtcggcgggtttttacggtctgaccggttcgctcgagttcgatcaagcaaaacgc  
gacggcaaaatcgacatcaccattcccgtcgccaacctgcaaagcggttcgcaacccttc  
accggccacctgaaatccgccgacatcttcgatgccgctcaatatccggacatccgcttc  
gtttccacaaaattcaacttcaacggcaaaaaacttgtttcggttgacggcaacctgacc  
atgcgcggcaaaaaccgccccgtcaaactcaaagccgaaaaattcaactgctaccaaagc  
20 ccgatggcggaaaccgaagtttgcggcggcgacttcagcaccaccatcgaccgcacaaa  
tggggcggtggactacctcgtaacgccggtatgacaaaaaacgtccgcatcgacatcaa  
atcgaagctgcaaaacaataa

25  
**SEQ ID NO: 21 Oant\_3992- Ortholog of NMB1030 and having identity = 0.553 to NMB1030**

MRKFVLP LLASLLSVSAAQAADYKLDPTH TKAVFYIDHFNTSTNSGGFY EINGDISFDPE  
TMDGKMDISIPVKTLNTGMAAFDKHVTGADMLDA EKFTIEFKSTKWNFDEDKLVSV DGD  
LTMKGKTLPIQLTATKFGCYQSPIFKAEVC GGDFEATIDRTQWGVDFLVKEGMAKMKVLE  
IQAEAIKQ

30  
**SEQ ID NO: 22 Nucleic acid sequence encoding SEQ ID NO: 21**

atgagaaagttcgctactgcccctcttagcctcgttgctgtcagtcctcggtgcccaggct  
gcggattacaaactggacccaacacatacaaaagctgttttctatattgatcacttcaat  
acatcgacaaacagcggcggtttctatgaaatcaacggcgatatctcggtcgatcctgaa  
35 accatggatgggaagatggatatttcaattcccgtcaagacgctgaatacaggcatggcc  
gcatttgataagcacgtgacaggtgctgacatgctggacgcggaaaagttcccgaccatt  
gagttcaagtcgaccaagtggaaatttgacgaagacaagctggatcagtggtatggcgat  
ctgacatgaagggaagacactgccaatccagctcacggccaccaagttcggttgttac  
cagagcccgatcttcaaggcagaagctctgtggtggcgattttgaagcaactatcgatcgc

**NVD008BWO**

accagtggtggcggtgacttccttgtaaaagaaggcatggccaagatggtcaagcttgaa  
attcaggctgaggctatcaagcagtaa

**SEQ ID NO: 23 SPAB\_01659- Ortholog of NMB1030 and having identity = 0.527 to NMB1030**

MNIMKKNFLGAVLSLGLLSAAHADVYKFDNTHNAVFNIDHFQTSTNHGGFYAISGELKY  
QPEKQDAEMRV TIPVSALNTGGDAFDNHIRSSDILDAEKYPEIVFKSTKWHFEDNKPVSI  
DGLLTMKGVTKPVTLT TTKFGCYMSPIFKAQVCGGDFVTQIDRTQWGV DYLVDMGMTKV  
DIKIQAEAVKQ

**SEQ ID NO: 24 Nucleic acid sequence encoding SEQ ID NO: 23**

gtgaatataatgaaaaagaattttcttggtgctgtcctgtctctgggtttattaagtgct  
gctcatgcagatgtatataaaatttgataatacgcatacaaatgcggtatttaatatcgat  
catttccagacctcaaccaatcatggcggttttatgctattagcggcgaactgaaatat  
cagccggaaaagcaagatgcagagatgcgcgtgacgattcccgtgagcgccttaaatacc  
gggggggatgcgtttgataaccatattcgagtagcgatattctggatgcggaaaaatat  
ccagaaatagtatttaaatcgacaaaatggcattttgaagataataaaccagtttctatt  
gacggtttgttaacaatgaagggagtaactaagcccgtcaccttaaccaccaccaagttt  
ggctgttatatgagcccgatattcaaggcacaggtttgcggcggtgattttgtcacgcaa  
atagatcgacccagtggggtgtagattatctggtcgatatggggatgacgaaagttgtc  
gatataaaaatccaggcagaagcggttaagcaataa

**SEQ ID NO: 25 SPA1248- Ortholog of NMB1030 and having identity = 0.527 to NMB1030**

MKKSFLGAALSLGLLSAAHADVYKFDNTHNAVFNIDHFQTSTNHGGFYAISGELKYQPE  
KQVAEMRV TIPVSALNTGVDAFDNHIRSSDILDAEKYPEIVFKSTKWHFEDNKPVSIDGL  
LTMKGVTKPVTLT TTKFGCYMSPIFKAQVCGGDFVTQIDRTQWGV DYLVDMGMTKVVDIK  
IQAEAVKQ

**SEQ ID NO: 26 Nucleic acid sequence encoding SEQ ID NO: 25**

atgaaaaagagttttcttggtgctgccctgtctctgggtttattaagtgctgctcatgca  
gatgtatataaaatttgataatacgcataccaatgcggtatttaatatcgatcatttccag  
acctcaaccaatcatggcggttttatgctattagcggcgaactgaaatatcagccggaa  
aagcaagtcgcagagatgcgcgtgacgattcccgtgaagcgccttaaataaccggggtggat  
gcgtttgataaccatattccgcagtagcgatattctggatgcggaaaaatatccagaaata  
gtatttaaatcgacaaaatggcattttgaagataataaaccggtttctattgacggtttg  
ttaacaatgaagggggtaactaagcccgtcaccttaaccaccaccaagtttggctgttat  
atgagcccgatattcaaggcgcaggtttgcggcggtgattttgtcacgcaaatagatcgc  
accagtggtggggtgtagattatctggtcgatatggggatgacgaaagttgtcgatataaaa  
atccaggcagaagcggttaagcaataa

**NVD008BWO**

**SEQ ID NO: 27 Aave\_3505- Ortholog of NMB1030 and having identity = 0.534 to NMB1030**

MRKSLFALAAAAALVAGAAQAETATYTVEPHTTFATFEISHFGASVNRGRFDKKEGTIAL  
 5 DKAARTGKVDITFQINSINTGTPPFDKHLQSPDIFDAAKYPTARFVGDKFTFDGDKLVS  
 AGNLTIKGQTHPATFKANQFACYQSPMLKREVCGGDFETTIDRTLFLGLDYGQYGFKNV  
 RIVAQVEAVKQ

**SEQ ID NO: 28 Nucleic acid sequence encoding SEQ ID NO: 27**

10 atgcgcaaatccctgttcgcctggccgcccgcggccgcctcgttgccggtgccgctcag  
 gcggagaccgccacgtacacggtggagccgacgcacaccttcgccacgttcgagatcagc  
 cacttcggcgccagcgtgaaccgcgccgcttcgacaagaaggaaggcacgatcgcgctg  
 gacaaggccgcccaggaccggcaaggtggacatcaccttcagatcaactccatcaacacc  
 ggcacgcccgccttcgacaagcacctgcagagccccgacatcttcgacgcgccaagtac  
 15 cccaccgcgcgcttcgtggcgacaagttcaccttcgacggcgacaagctggtgtccgtg  
 gccggcaacctgacgatcaagggccagaccatcccgcgaccttcaaggccaaccagttc  
 gcctgctaccagagcccgatgctcaagcgcaagtgtgcggcgcgatttcgagaccacg  
 atcgaccgcacctgttcggcctggactacggcgtgcagtacggcttccccagaacgtg  
 cgcacgtggcgagggtcgaggccgtcaagcagtaa

20 **SEQ ID NO: 29 STM1621- Ortholog of NMB1030 and having identity = 0.516 to NMB1030**

MNIMKKSFLGALLSLGLLSAAHADVYKFDNHTNAVFNI DHFQTSTNHGGFYAISGELKY  
 QPEKQVAEMRVTI PVSA LNTGVDAFDNHIRSSDILDAEKYPEMVFKSTKWHFEDNKPVSI  
 DGLLTMKGVT KPVTLTTTKFGCYMSPI FKAQVCGGDFVTQIDRTQWGIDYLVDMGMTKV  
 25 DIKIQA EAVKQ

**SEQ ID NO: 30 Nucleic acid sequence encoding SEQ ID NO: 29**

gtgaatataatgaaaaagagttttcttggtgctctcctgtctctgggtttattaagtgt  
 gctcatgcagatgtatataaatttgataatacgcataccaatgcggtatttaatatcgat  
 30 catttccagacctcaaccaatcatggcggttttatgctatttagcgcggaactgaaat  
 cagccggaaaagcaagtcgcagagatgcgtgtgacgattcccgtgaagcgccttaaatacc  
 ggggtggatgcgtttgataaccatataccgcagtagcgatattctggatgcggaaaaatat  
 ccagaaatgggtattttaaatcaacaaaatggcattttgaagataataaacgggtttctatt  
 gacggtttgctaacaatgaagggagtaacgaagcccgtcaccttaaccaccaccaagttt  
 35 ggctgttatatgagcccgatattcaaggcgaggtttgcggtggtgattttgtcacgcaa  
 atagatcgcacccagtgggggatagattatctggtcgatatggggatgacgaaagttgtc  
 gatataaaaatccaggcagaagcggttaagcaataa



**SEQ ID NO: 31 SC1617- Ortholog of NMB1030 and having identity = 0.516 to NMB1030**

MNIMKKSFLGAVLSLGLLSAAHADVYKFDNHTNAVFNIDHFQTSTNHGGFYAISGELKY  
 QPEKQVAEMRVITIPVSALNTGVDAFDNHIRSSDILDAEKYPEMVKSTKWHFEDNKPVSI  
 DGLLTMKGVTKPVTLTSTTKFGCYMSPIFKAQVCGGDFVTQIDRTQWGVLDYLVDMGMTKVV  
 5 DIKIQAQAEAVKQ

**SEQ ID NO: 32 Nucleic acid sequence encoding SEQ ID NO: 31**

gtgaatataatgaaaaagagttttcttggtgctgtcctgtctctggggttattaagtgct  
 gctcatgcagatgtatataaatttgataatacgcataccaatgcggtatttaatatcgat  
 10 catttccagacctcaaccaatcatggcgggttttatgctattagcggcgaactgaaatat  
 cagccggaaaagcaagtcgcagagatgctgtgacgattcccgtgagcgccttaaatacc  
 ggggtggatgcgtttgataaccatatccgcagtagcgatattctagatgcggaaaaatat  
 ccagaaatgggtatttaaatcaacaaaatggcattttgaagataataaacgggtttctatt  
 gacgggttgctaacaatgaagggagtaacgaagcccgtcaccttaaccaccaccaagttt  
 15 ggctgttatatgagcccgatattcaaggcgcaggtttgcggtggtgattttgtcacgcaa  
 atagatcgcaaccagtgggggtagattatctggtcgatatggggatgacgaaagttgtc  
 gatataaaaatccaggcagaagcgggttaagcaataa

**SEQ ID NO: 33 Pnap\_3578- Ortholog of NMB1030 and having identity = 0.518 to NMB1030**

MRKSILTLAAAAALLAGAAHAETATYAMDPTHTFATFEIGHFGTSTNRGRFDKKEGSGVQL  
 DRAAKTGKVEVSIDATSVNTGAAAFDKHLQSPDLFDAKYPTIKFVSDKFSFNGDKVSEI  
 AGNLTLLGKTLPVTLKANQFNCYTSPMLKREVC GGDFETTIDRTAFGMNYGIDWGF PKNV  
 25 RLVVQVEAVKQQ

**SEQ ID NO: 34 Nucleic acid sequence encoding SEQ ID NO: 33**

atgcgtaaatcaattttgaccctggccgcccgcggccgcccctgctggccggcgcgcccat  
 gccgaaaccgccacctacgcgatggaccgcgcatacctttgcgacgtttgaaatcggc  
 cacttcggcaccagcaccaaccggggccgcttcgacaagaaggaaggctcggtgcaactg  
 30 gaccgcgcccgaagaccggcaaggtggaggtcagcatcgacgccacctccgtcaatacc  
 ggccgcccgcggtttgacaagcacctgcaaagccccgacctgttcgacgcccgaatac  
 ccgaccatcaagtttgtctccgacaagttcagcttcaacggcgacaaggtgtccgaaatc  
 gccggcaacctgaccctgcttgcaaaaacctgcccgtcacgctcaaagccaaccagttc  
 aactgctacaccagcccgatgctcaagcggaagtgtgcggcggcgacttcgaaaccag  
 35 attgaccgcaccgccttcggcatgaactacggcatcgactggggcttcccgaaaaacgtc  
 cgccctggtggtccagggtcgaagccgtcaagcagcaataa

**SEQ ID NO: 35 t1530- Ortholog of NMB1030 and having identity = .516 to NMB1030**

MNIMKKSFLGALLSLGLLSAAHADVYKFDNTHTNVFNIDRFQTSTNHGGFYAISGELKY  
 QPEKQVAEMRVTI PVSALNTGVDAFDNHIRSSDILDAEKYPEIVFKSTKWHFEDNKPVSI  
 DGLLTMKGVTKPVTLLTTTKFGCYMSPI FKAQVCGGDFVTQIDRTQWGVLDYLVDMGMTKVV  
 5 DIKIQAQAEAVKQ

**SEQ ID NO: 36 Nucleic acid sequence encoding SEQ ID NO: 35**

gtgaatataatgaaaaagagttttcttggtgctctcctgtctctgggtttattaagtgct  
 gctcatgcagatgtatataaatttgataatacgcataccaatgcggtatttaatatcgat  
 10 cgtttccagacctcaaccaatcatggcgggttttatgctattagcggcgaactgaaatat  
 cagccggaaaagcaagtcgcagagatgctgtgacgattcccgtagcgccttaaatacc  
 ggggtggatgcgtttgataaccatattcgtagtagcgatattttggatgcggaaaaatat  
 ccagaaatagtagtttaaatcgacaaaatggcattttgaagataataaaccagtttctatt  
 gacggtttgtaacaatgaagggagtaactaagcccgtcaccttaaccaccaccaagttt  
 15 ggctgttatatgagcccgatattcaaggcgcaggtttgcgggtggtgattttgtcacgcaa  
 atagatcgcacccagtggggtgtagattatctggtcgatatggggatgacgaaagttgtc  
 gatataaaaatccaggcagaagcgggttaagcaataa

**SEQ ID NO: 37 STY1443- Ortholog of NMB1030 and having identity = .516 to NMB1030**

20 MNIMKKSFLGALLSLGLLSAAHADVYKFDNTHTNVFNIDRFQTSTNHGGFYAISGELKY  
 QPEKQVAEMRVTI PVSALNTGVDAFDNHIRSSDILDAEKYPEIVFKSTKWHFEDNKPVSI  
 DGLLTMKGVTKPVTLLTTTKFGCYMSPI FKAQVCGGDFVTQIDRTQWGVLDYLVDMGMTKVV  
 DIKIQAQAEAVKQ

**25 SEQ ID NO: 38 Nucleic acid sequence encoding SEQ ID NO: 37**

gtgaatataatgaaaaagagttttcttggtgctctcctgtctctgggtttattaagtgct  
 gctcatgcagatgtatataaatttgataatacgcataccaatgcggtatttaatatcgat  
 cgtttccagacctcaaccaatcatggcgggttttatgctattagcggcgaactgaaatat  
 cagccggaaaagcaagtcgcagagatgctgtgacgattcccgtagcgccttaaatacc  
 30 ggggtggatgcgtttgataaccatattcgtagtagcgatattttggatgcggaaaaatat  
 ccagaaatagtagtttaaatcgacaaaatggcattttgaagataataaaccagtttctatt  
 gacggtttgtaacaatgaagggagtaactaagcccgtcaccttaaccaccaccaagttt  
 ggctgttatatgagcccgatattcaaggcgcaggtttgcgggtggtgattttgtcacgcaa  
 atagatcgcacccagtggggtgtagattatctggtcgatatggggatgacgaaagttgtc  
 35 gatataaaaatccaggcagaagcgggttaagcaataa

**SEQ ID NO: 39 PsycPRwf\_2217- Ortholog of NMB1030 and having identity = 0.542 to NMB1030****NVD008BWO**

MNLIQKTLTIATVVGLGSLVAANAALYEIDPAHANARFSVDHFGTTTNAGGFYGLTGTV  
 DYSPEKKQGFVGITIPMNNLSTNFKPFDKHLKSADFFNVEKYPTAYFKSTKWEFDGDKVK  
 SVKGELTMLDQTHPVTLTATKFNCDNPILKTKCGGDFETTIDRTQWGINITYTDGMMK  
 DVKLKIQIEAGLKDDNKKS

5

**SEQ ID NO: 40 Nucleic acid sequence encoding SEQ ID NO: 39**

gtgaatctaattcaaaaaacgcttactattgccactgtagttggcctaggttctttaagc  
 gttgctgccaatgctgcgctttatgaaattgatcctgcccatgccaatgctcgcttttct  
 gtagaccattttggtaccaccacgaacgctggcggcttctacggtctaacaggtgtggtg  
 10 gattattctcctgagaaaaacaaggctttgtgggtattaccattcctatgaacaactta  
 agcaccaactttaagccttttgataagcacttaaaatctgctgacttcttcaacgtagaa  
 aaataccctactgcttacttcaaactctaccaaattgggaatttgatggcgataaagtaaaa  
 tcagtcaaaggcgagctaaccatgcttgaccaaacacacccagttactttaacagccact  
 aagtttaactgctacgataaccaatcttagaaacaaaaacttggtggtgactttgaa  
 15 accactatcgacagaactcagtggggtattaacacttacactgacggcggtatgatgaaa  
 gacgttaaaactaaaaatccagatcgaagcgggtctaaaagacgataacaaaaagtcttaa

**SEQ ID NO: 41 NMB2091**

MKPKPHTVRTLIAAIFSLALSGCVSAVIGSAAVGAksAVDRRTTGAQTDDNVMALRIETT  
 20 ARSYLRQNNQTKGYTPQISVVGYNRHLALLGQVATEGEKQFVGQIARSEQAAEGVNYIT  
 VASLPRTAGDIAGDTWNTSKVRATLLGISPATQARVKIVTYGNVTYVMGILTPEEQAQIT  
 QKVSTTVGVQKVITLYQNYVQR

**SEQ ID NO: 42 Nucleic acid sequence encoding SEQ ID NO: 41**

atgaaacccaaaccgcacaccgtccgcaccctgattgccgccattttcagccttgccctt  
 agcggctgctgcagcgcagtaatcggaagcgccgctcggcgcgaaatccgccgtcgac  
 cgccgaaccaccggcgcgcaaacggacgacaacgttatggcgttgctatcgaaaccacc  
 gcccgcttctatctgcgccaaaacaacaaacaaaggctacacgccccaaatctccgtc  
 gtcggctacaaccgccacctgctgctgctcggaacagtcgccaccgaaggcgaaaaacag  
 30 ttcgctcggtcagattgcacgttccgaacaggccgccaaggcgtgtacaactatattacc  
 gtcgcctccctgccgcgactgccggcgacatcgccggcgacacttgaacacatccaaa  
 gtccgcgccacgctgttgggcatcagccccgccacacaggcgcgctcaaaatcgttacc  
 tacggcaacgtaacctacgttatgggcatcctacccccgaagaacaggcgagattacc  
 caaaaagtcagcaccaccgtcggcgtacaaaaagtcacacctctacaaaactacgtc  
 35 caacgctga

**SEQ ID NO: 43 NMCC\_2056- Ortholog of NMB2091 and having identity = 1.0 to NBM2091**

MKPKPHTVRTLIAAIFSLALSGCVSAVIGSAAVGAksAVDRRTTGAQTDDNVMALRIETT  
 NVD008BWO

ARSYLQRNNQTKGYTPQISVVGYNRHLALLGQVATEGEKQFVGQIARSEQAAEGVYNYIT  
 VASLPRTAGDIAGDTWNTSKVRATLLGISPATQARVKIVTYGNVTYVMGILTPEEQAQIT  
 QKVSTTVGVQKVITLYQNYVQR

**5 SEQ ID NO: 44 Nucleic acid sequence encoding SEQ ID NO: 43**

atgaaacccaaaccgcacaccgtccgcaccctgattgccgccattttcagccttgccctt  
 agcggctgcgtcagcgcagtaatcggaagcgcccgctcggcgcgaaatccgccgtcgac  
 cgccgcaccaccggcgcgcaaacggacgacaacgtaatggcggtgcgtattgaaaccacc  
 gcccgctcctacctacgcaaaaacaacaaaccaagggtacacgccccaaatctccgtc  
 10 gtcggctacaaccgccacctgctgctgctcggacaagtcgccaccgaaggcgaaaaacag  
 ttcgctcggtcagattgcacgttccgaacaggccgccgaaggcggtgtacaactacattacc  
 gtgcctccctgccgcgcaactgccggcgacatcgccggcgacacttggaacacatccaaa  
 gtccgcgccacgctgttgggcatcagccccgccacacaggcgcgcggtcaaaatcgttacc  
 tacggcaacgtaacctacgttatgggcatcctcaccgccgaagaacaggcgcgagattacc  
 15 caaaaagtcagcaccaccgtcggcggtacaaaaagtcacaccctctacaaaactacgtc  
 caacgctga

**SEQ ID NO: 45 NMC2071- Ortholog of NMB2091 and having identity = 1.0 to NBM2091**

MKPKPHTVRTLIAAIFSLALSGCVSAVIGSAAVGAKSAVDRRTTGAQTDDNVMALRIETT  
 20 ARSYLQRNNQTKGYTPQISVVGYNRHLALLGQVATEGEKQFVGQIARSEQAAEGVYNYIT  
 VASLPRTAGDIAGDTWNTSKVRATLLGISPATQARVKIVTYGNVTYVMGILTPEEQAQIT  
 QKVSTTVGVQKVITLYQNYVQR

**SEQ ID NO: 46 Nucleic acid sequence encoding SEQ ID NO: 45**

atgaaacccaaaccgcacaccgtccgcaccctgattgccgccattttcagccttgccctt  
 agcggctgcgtcagcgcagtaatcggaagcgcccgctcggcgcgaaatccgccgtcgac  
 cgccgaaccaccggcgcgcaaacggacgacaacgttatggcggtgcgtatcgaaaccacc  
 gcccgctcctatctgcgcgaaaaacaacaaaccaagggtacacgccccaaatctccggtt  
 gtcggctacaaccgccacctgctgctgctcggacaagtcgccaccgaaggcgagaaacag  
 30 ttcgctcggtcagattgcacgttccgaacaggccgccgaaggcggtatataactacattacc  
 gtgcctccctgccgcgcaactgccggcgacatcgccggcgacacttggaacacatccaaa  
 gtccgcgccacgctgttgggcatcagccccgccacacaggcgcgcggtcaaaatcgttacc  
 tacggcaacgtaacctacgttatgggcatcctcaccgccgaagaacaggcgcgagattacc  
 caaaaagtcagcaccaccgtcggcggtacaaaaagtcacaccctctacaaaactacgtc  
 35 caacgctga

**SEQ ID NO: 47 NMA03391- Ortholog of NMB2091 and having identity = 0.970 to NBM2091**

MKPKPHTVRTLTAAVLALGGCVSAVVGGAAGAKSAVDRRTTGAQTDDNVMALRIETT  
**NVD008BWO**

ARSYLRQNNQTKGYTPQISVVGYNRHLHLLLGQVATEGEKQFVGQIARSEQAAEGVYNYIT  
 VASLPRTAGDIAGDTWNTSKVRATLLGISPATQARVKIVTYGNVTYVMGILTPEEQAQIT  
 QKVSTTVGVQKVITLYQNYVQR

**5 SEQ ID NO: 48 Nucleic acid sequence encoding SEQ ID NO: 47**

atgaaacccaaaccgcacaccgtccgcaccctgactgccgccgtcctcagccttgccctc  
 ggcggtgctgcagcgcagtcgtcgccggcgccggcggtcgccgcgaaatccgccgtcgac  
 cgccgaaccaccggcgcgcaaacgcgacaacgtaatggcgctgcgtatcgaaaccacc  
 gcccgctcctatctgcgcaaaaacaaccaaaggctacacgccccaaatctccgtt  
 10 gtcggctacaaccgccacctgctgctgctcggaagaagtcgccaccgaaggcgagaaacag  
 ttgctcggtcagattgcacgttccgaacaggccgccgaaggcggtgtacaactacattacc  
 gtcgcctccctgccgcgcaactgccggcgacatcgccggcgacacttggaacacatccaaa  
 gtccgcgccacgctggtgggcatcagccccgccacacaggcgcgctcaaaatcgttacc  
 tacggcaacgtaacctacgttatgggcatcctcaccgccgaagaacaggcgcgattacc  
 15 caaaaagtcagcaccaccgtcgccgtacaaaagtcattaccctctacaaaactacgtc  
 caacgctga

**SEQ ID NO: 49 NGO1985- Ortholog of NMB2091 and having identity = 0.955 to NBM2091**

20 MKPKPHTVRTLIAAVLSLALGGCFSAVVGGAAGAKSVIDRRRTGAQTDDNVMALRIETT  
 ARSYLRQNNQTKGYTPQISVVGYNRHLHLLLGQVATEGEKQFVGQIARSEQAAEGVYNYIT  
 VASLPRTAGDIAGDTWNTSKVRATLLGISPATQARVKIITYGNVTYVMGILTPEEQAQIT  
 QKVSTTVGVQKVITLYQNYVQR

**25 SEQ ID NO: 50 Nucleic acid sequence encoding SEQ ID NO: 49**

atgaaacccaaaccacacaccgtccgcaccctgattgccgccgtcctcagccttgccctc  
 ggcggtgcttcagcgcagtcgtcgccggggccgccgtcgccgcgaaatccgtcatcgac  
 cgccgaaccaccggcgcgcaaacgatgacaacgttatggcggtgcgtatcgaaaccacc  
 gcccgctcctacctgcgcaaaaacaaccaaaggctacacgccccaaatctccgtc  
 30 gtcggctacaaccgccacctgctgctgctcggaagaagtcgccaccgaaggcgaaaaacag  
 ttgctcggtcagattgcacgttccgaacaggccgccgaaggcggtatataactacattacc  
 gtcgcctccctgccgcgcaactgccggcgacatcgccggcgacacttggaacacgtccaaa  
 gtccgcgccacgctgctgggcatcagccccgtacacaggcgcgctcaaaatcattacc  
 tacggcaatgtaacctacgttatgggcatcctcaccgccgaagaacaggcgcgattacc  
 35 caaaaagtcagcaccaccgtcgccgtacaaaagtcattaccctctacaaaactacgtc  
 caacgctga

**SEQ ID NO: 51 NMB0667**

MIYIVLFLAVVLAVVAYNMYQENQYRKVRDQFGHSDKDALLNSKTSHVVDGKPSGGSSVM  
**NVD008BWO**

MPKPQPAVKKTAKPQDPAMRNLQEQDAVYIAKQKQAKASPFKTEIETALESIGIIGNSAH  
 TVSEPQTGHSAPKPADAPAKPAPVPQTPAKPLITLKELSKVELPWFDVRFDFISYIALTE  
 AKELHALPRLSNRCRYQIVGCTMDDHFQIAEPIPGIRYQAFIVGIQAVSRNGLASQEELS  
 AFNRQVDAFAQSMGGQTLHTDLAAFI EVASALDAFCARVDQTIAIHLVSPTSISGVELRS  
 5 AVTGVGVFLEDDGAFHYTDTSGSTMFSICSLNNEPFTNALLDNQSYKGFSMLLDIPHSPA  
 GEKTFDDL FMDLAVRLSGQLNLNLVNDKMEEVSTQWLKDVRTYVLARQSEMLKVGIEPGG  
 KTALRLFS

**SEQ ID NO: 52 Nucleic acid sequence encoding SEQ ID NO: 51**

10 atgatttacatcgctactgtttctagctgtcgtcctcgccgttgctgcctacaacatgtat  
 caggaaaaccaataaccgcaaaaaagtgcgcgaccagttcggacactccgacaaagatgcc  
 ctgctcaacagcaaaaccagccatgtccgcgacggcaaacctcggcggtcagtcagt  
 atgccgaaccccaaccggcggtcaaaaaaacggcaaaaccccaagaccccgccatgctc  
 aacctgcaagaacaggatgccgtctacatcgccaagcagaaacaggcaaaagcctccccg  
 15 ttcaaaaccgaaatcgaaaccgccttggaagaaagcggcattatcggcaactccgcccac  
 accgtttccgaaccccaaacggacattccgcaccgaaacctgccgacgcgcgggcaaaa  
 cctgcacccggttccgcaaacacctgcaaaacggctgattacgctcaaagaactgtcaaaa  
 gtcgaattaccctgggttgacgtgcgcttcgacttcatctcctatatcgcgctgaccgaa  
 gccaaagaactgcacgcactgccgcgcctttccaaccgctgccgtaccagattgtcggc  
 20 tgcaccatggacgaccattttccagattgccgaacccatcccgggcatccgctatcaggca  
 tttatcgtgggtattcaggcagtcagccgcaacggacttgcctcgaggaagaactctcc  
 gcattcaaccgccaggtggacgcattcgacaaaagcatggcggtcagacgctgcacacc  
 gaccttgccgcctttatcgaaagtggcttccgcactggacgcattctgcgcgcgctcgac  
 cagaccatcgccatccattttgggtttccccgaccagcatcagcggcgtagaactgcgttcc  
 25 gccgtaacggcggtgggtttcggttttgggaagacgacggcgcggttccactataccgacacg  
 tcgggctcgaccatgttctccatctgctcgtcacaacgagccgtttaccaacgcccctt  
 ttggacaaccagtcctacaaaggcttcagtatgctgctcgacatcccgcactctccggca  
 ggcgaaaaaaccttcgacgatttggttatggatttgcggtacgcctgtccggccagttg  
 aacctgaatctggtcaacgacaaaatggaagaagtttcgacccaatggctcaaagacgtg  
 30 cgcacttatgtattggcgcgctcagtcagagatgctcaaagtcgggtatcgaaccggcgcg  
 aaaaccgcattgcgcctgttctcctaa

**SEQ ID NO: 53 NMC0615- Ortholog of NMB0667 and having identity = 1.0 to NMB0667**

MIYIVLFLAVVLAVVAYNMYQENQYRKKVRDQFGHSDKDALLNSKTSHV RDGKPSGGSVM  
 35 MPKPQPAVKKTAKPQDPAMRNLQEQDAVYIAKQKQAKASPFKTEIETALESIGIIGNSAH  
 TVSEPQTGHSAPKPADAPAKPAPVPQTPAKPLITLKELSKVELPWFDVRFDFISYIALTE  
 AKELHALPRLSNRCRYQIVGCTMDDHFQIAEPIPGIRYQAFIVGIQAVSRNGLASQEELS  
 AFNRQVDAFAQSMGGQTLHTDLAAFI EVASALDAFCARVDQTIAIHLVSPTSISGVELRS  
 AVTGVGVFLEDDGAFHYTDTSGSTMFSICSLNNEPFTNALLDNQSYKGFSMLLDIPHSPA  
 40 GEKTFDDL FMDLAVRLSGQLNLNLVNDKMEEVSTQWLKDVRTYVLARQSEMLKVGIEPGG

**NVD008BWO**

KTALRLFS

**SEQ ID NO: 54 Nucleic acid sequence encoding SEQ ID NO: 53**

atgatttacatcgactgtttctagctgtcgctcctcgccgttgctgcctacaacatgtat  
 5 caggaaaaccaataccgcacaaaagtgcgcgaccagttcggacactccgacaaagatgcc  
 ctgctcaacagcaaaaccagccatgtccgcgacggcaaacctccggcgggtcagtcagt  
 atgccgaaaccccaaccggcggtcaaaaaaacggcaaaaccccaagaccccgccatgctc  
 aacctgcaagaacaggatgccgtctacatcgccaagcagaaacaggcaaaagcctccccg  
 ttcaaaaccgaaatcgaaaccgccttggaagaaagcggcattatcggcaactccgcccac  
 10 accgtttccgaaccccaaacggacattccgcaccgaaacctgccgacgcgcgggcaaaa  
 cctgcacccgttccgcaaacacctgcaaaaccgtgattacgctcaaagaactgtcaaaa  
 gtcgaattaccctggtttgacgtgcgcttcgacttcattctcctatatcgcgctgaccgaa  
 gccaaagaactgcacgcactgccgcgctttccaaccgtgccgctaccagattgtcggc  
 tgcacatggacgaccatttccagattgccgaacccatcccgggcatccgctatcaggca  
 15 tttatcgtaggtattcaggcagtcagccgcaacggacttgctcgcaggaagaactctcc  
 gcattcaaccgccaggtggacgcattcgcaaaagcatggcggtcagacgctgcacacc  
 gaccttgccgcctttatcgaaagtggcttccgcactggacgcattctgcgcgcgctcgac  
 cagaccatcgccatccatttggtttccccgaccagcatcagcggcgtagaactgcgttcc  
 gccgtaacggcggtgggtttcggtttggaagacgacggcggttccactataccgacacg  
 20 tcgggctcgaccatgttctccatctgctcgctcaacaacgagccgtttaccaatgccctt  
 ttggacaaccagtcctacaaaggcttcagtatgctgctcgacatcccgcactctccggca  
 ggcgaaaaaaccttcgacgatttggttatggatttgcggtacgcctgtccggccagttg  
 aacctgaatctggtcaacgacaaaatggaagaagtttcgaccaatggctcaaagacgtg  
 cgacttatgtattggctcgtcagtcagatgctcaaagtcggtatcgaaccggggcggc  
 25 aaaaccgcattgcgcctgttctcctaa

**SEQ ID NO: 55 NMCC\_0620- Ortholog of NMB0667 and having identity = 0.993 to NMB0667**

MIAMIYIVLFLAAVLAVVAYNMYQENQYRKKVRDQFGHSDKDALLNSKTSHVDRDGKPSGG  
 30 PVMMPKPQPAVKKTAKPQDPAMRNLEQDAVYIAKQKQAKASPFKTEIETALESIGIIGN  
 SAHTVSEPQTGHSAPKPADAPAKPVPVPQTPAKPLITLKELSKVELPWFDVRFDFISYIA  
 LTEAKELHALPRLSNRCRYQIVGCTMDDHFQIAEPIPGIRYQAFIVGIQAVSRNGLASQE  
 ELSAFNRQVDAFAQSMGGQTLHTDLAAFIEVASALDAFCARVDQTIAIHLVSPTSISGVE  
 LRSVTVGVGFVLEDDGAFHYTDTSGSTMFSICSLNNEPFTNALLDNQSYKGFSMLLDIPH  
 35 SPAGEKTFDLFDLAVRLSGQLNLNLVNDKMEEVSTQWLKDVRTYVLARQSEMLKVGIE  
 PGGKTALRLFS

**SEQ ID NO: 56 Nucleic acid sequence encoding SEQ ID NO: 55**

gtgattgccatgatttacatcgactgttctcctcgccgccgtcctcgccgttgctgcctac

**NVD008BWO**

aatatgtatcaggaaaaccaataaccgcaaaaaagtgcgcgaccagttcgggcactccgac  
 aaagatgccctgctcaacagcaaaaccagccatgtccgcgacggcaaacctccggcggg  
 ccagtcgatgatgccgaaaccccaaccggcggtcaaaaaacggcaaaaccccaagacccc  
 gccatgcgcaacctgcaagaacaggatgccgtctacatcgccaagcagaaacaggcaaaa  
 5 gctccccgttcaaaaccgaaatcgaaaccgccttggaagaaagcggcattatcggcaac  
 tccgcccacaccgtttccgaaccccaaccggacattccgcaccgaaacctgccgacgcg  
 ccggcaaaaccgttcccggttccgcaaacgcgggcaaaaccgctgattacgctcaaagag  
 ctgtcgaaggtcgagctgccctgggttgacgtgcgcttcgacttcatctcttatatcgcg  
 ctgaccgaagccaaagaacttcacgcactgccgcgctttccaaccgctgccgctaccag  
 10 attgtcggctgcaccatggacgaccatttccagattgccgaacccatcccgggcatccgc  
 tatcaggcatttatcgtgggtattcaggcagtcagccgcaacggacttgctcgcaggaa  
 gaactctccgcattcaaccgccaggtggacgcattcgacaaaagcatgggcgggtcagacg  
 ctgcacaccgaccttgccgcctttatcgaagtggcttccgcactggacgcattctgcgcg  
 cgctcgaccagaccatcgccatccatttggtttccccgaccagcatcagcggcgtagaa  
 15 ctgcgttccgccgtaacgggcgtgggtttcggtttggaagacgacggcgcggttccactat  
 accgacacgtcgggctcgaccatgttctccatctgctcgtcaacaacgagccgtttacc  
 aatgcccttttgacaaccagtcctacaaaggcttcagtatgctgctcgacatcccgcac  
 tctccggcaggcgaaaaaaccttcgacgatttggttatggatttggcggtacgcctgtcc  
 ggccagttgaacctgaatctggtcaacgacaaaatggaagaagtttcgacccaatggctc  
 20 aaagacgtgcgcacttatgtattggctcgtcagtcagatgctcaaagtcggtatcgaa  
 ccgggcggcaaaaccgcattgcgcctgttctcctaa

**SEQ ID NO: 57 NMA0866- Ortholog of NMB0667 and having identity = 0.986 to NMB0667**

25 MIYIVLFLAAVLAVVAYNMYQENQYRKKVRDQFGHSDKDALLNSKTSHVDRDGKPSGGPVM  
 MPKPQPAVKKTAKSQDPAMRNLQEQDAVYIAKQKQAKASPFKTEIETALEESGIIGNSAH  
 TVPEPQTGHSAPKPADAPAKVPVPQTPAKPLITLKELSKVELPWFDVRFDFISYIALTE  
 AKELHALPRLSNRCRYQIVGCTMDDHFQIAEPIPGIRYQAFIVGIQAVSRNGLASQEELS  
 AFNRQVDAFAHSMGGQTLHTDLAAFI EVASALDAFCARVDQTI A IHLVSPTSISGVELRS  
 30 AVTGVGVFLEDDGAFHYTDTSGSTMFSICSLNNEPFTNALLDNQS YKGFSMLLDI PHSPA  
 GEKTFDDL FMDLAVRLSGQLNLNLVNDKMEEVSTQWLKDVRTYV LARQSEMLKVGIEPGG  
 KTALRLFS

**SEQ ID NO: 58 Nucleic acid sequence encoding SEQ ID NO: 57**

35 atgatttacatcgctactgttcctcgccgccgtcctcgccgttgctgcctacaatatgtat  
 caggaaaaccaataaccgcaaaaaagtgcgcgaccagttcgggcactccgacaaagatgcc  
 ctgctcaacagcaaaaccagccatgtccgcgacggcaaacctccggcgggcccagtcgatg  
 atgccgaaaccccaaccggcggtcaaaaaacggcaaaatcccaagaccccgccatgcgc  
 aacctgcaagagcaggatgccgtctacatcgccaagcagaaacaggcaaaagcctccccg  
 40 tcaaaaccgaaatcgaaaccgccttggaagaaagcggcattatcggcaactccgcccac  
**NVD008BWO**



accgttcccgaaccccaaacggacattccgcacaaaacctgccgacgcgccggcaaaa  
 cctgttcccgttccgcaaacgccggcaaaaccgctgattacgctcaaagagctgtcgaag  
 gtcgagctgccctggtttgacgtgcgcttcgacttcattcttataatcgcgctgaccgaa  
 gccaaagaactgcacgcactgccgcgcctttccaaccgctgccgctaccagattgtcggc  
 5 tgcaccatggacgaccatttccagattgccgaacccatcccgggcatccgctatcaggca  
 tttatcgtgggtattcaggcagtcagccgcaacggacttgccctcgaggaagaactctcc  
 gcattcaaccgccaggtggatgcattcgacacagcatgggcggtcagacgctgcacacc  
 gaccttgccgcctttatcgaagtggcttcgcactggacgcattctgcgcgcgcgtcgac  
 cagactatcgccatccatttgggtttccccgaccagcatcagcggcgtagaactgcgttcc  
 10 gccgtaacgggcggtgggtttcggttttgaagacgacggcggttccactataccgacacg  
 tcgggctcgaccatgttctccatctgctcgctcaacaacgagccgtttaccaatgccctt  
 ttggacaaccagtcctataaaggcttcagtatgctgctcgacatcccgcactctccggca  
 ggcgaaaaaaccttcgacgatttgtttatggatttggcggtacgcctgtccggccagttg  
 aacctgaatctggtcaacgacaaaatggaagaagtttcgacccaatggctcaaagacgtg  
 15 cgcacttatgtattggctcgtcagtcagatgctcaaagtcggtatcgaaccgggcggc  
 aaaaccgcattgcgcctgttctcctaa

**SEQ ID NO: 59 NGO0236- Ortholog of NMB0667 and having identity = 0.984 to NMB0667**

20 MIYIVLFLAAVLAVVAYNMYQENQYRKKVRDQFGHSDKDALLNSKTSHVRDGKPSGGPVM  
 MPKPQPAVKKPAKPQDSAMRNLQEQDAVYIAKQKQAKASPFKTEIETALEEIGIIGNSAH  
 TVSEPQTGHSAPKPADAPAKVPVPQTPAKPLITLKELSKVELPWFDVRFDFISYIALTE  
 AKELHALPRLSNRCRYQIVGCTMDDHFQIAEPIPGIRYQAFIVGIQAVSRNGLASQEELS  
 AFNRQADAFQSMGGQTLHTDLAAFIEVASALDAFCARVDQTIHILVSPTSISGVELRS  
 25 AVTGVGVFLEDDGAFHYTDTSGSTMFSICSLNNEPFTNALLDNQSYKGFSMLLDIPHSPA  
 GEKTFDDLFMDLAVRLSGQLNLNLVNDKMEEVSTQWLKDVRTYVLARQSEMLKVGIEPGG  
 KTALRLFS

**SEQ ID NO: 60 Nucleic acid sequence encoding SEQ ID NO: 59**

30 atgatttacatcgctactgttcctcgccgccgtcctcgccgttgctgcctacaatatgtat  
 caggaaaaccaataaccgcaaaaaagtgcgcgaccagttcggacactccgacaaagatgcc  
 ctgctcaacagcaaaaaccagccatgtccgcgacggcaaacctccggcgggccagtcattg  
 atgccgaaaccccaaccggcggtcaaaaaaccggccaaaccccaagactccgccatgcgc  
 aacctgcaagaacaggatgccgtctacatcgccaagcagaaacaggcaaaagcctccccg  
 35 ttcaaaaccgaaatcgaaaccgccttgaagaaatcggcattatcggaactccgcccac  
 accgtttccgaaccccaaacggacattccgcaccgaaacctgccgacgcgccggcaaaa  
 cccgttcccgttccgcaaacgccggcaaaaccgctgattacgctcaaagagctgtcgaag  
 gtcgagctgccctggtttgacgtgcgcttcgacttcattcttataatcgcgctgaccgaa  
 gccaaagaactgcacgcactgccgcgcctttccaaccgctgccgctaccagattgtcggc  
 40 tgcaccatggacgaccatttccagattgccgaacccatcccgggcatccgctatcaggca

**NVD008BWO**

tttatcgtgggtatccaggcagtcagccgcaacggacttgccctgcaggaagaactctcc  
 gcattcaaccgccaggcgagcattcgacaaaagcatgggcggtcagacgctgcacacc  
 gaccttgccgcctttatcgaagtggcttccgcactggacgattctgcgcgcgctcgac  
 cagaccatcgccatccatttggtttcgccgaccagcatcagcggcgtagaactgcgttcc  
 5 gccgtaacggcggtgggtttcggttttgaagacgacggcggttccactataccgacacg  
 tcgggctcgaccatgttctccatctgctcgctcaacaacgagccgtttaccaatgccctt  
 ttggacaaccagtcctacaaaaggcttcagtatgctgctcgacatcccgactctccggca  
 ggcgaaaaaaccttcgacgatttgtttatggatttggcggtacgcctgtccggtcagttg  
 aacctgaatctggtcaacgacaaaaatggaagaagtttcgaccaatgggtcaaagacgta  
 10 cgcacttatgtattggcgcgctcagtcagatgctcaaagtcggtatcgaaccggcgccg  
 aaaaccgccctgcgcctgttttcataa

### SEQ ID NO: 61 *Streptococcus agalactiae* strain 98-D60C beta-antigen (bac)

MFKSNYERKMYSIRKFSVGVASVAVASLFMGSVAHASELVKDD  
 15 SVKTTEVAAPYPSPMAQTDQGNSSSSELETTKMEIPTTDIKKAVEPVEKTAGETSAT  
 DTGKREKQLQQWKNLKNVDNTILSHEQKNEFKTKIDETNDSALLELENQFNETNR  
 LLHIKQHEEVEKDKAKQKTLKQSDTKVDLSNIDKELNHQKSQVEKMAEQKGITNED  
 KDSMLKKIEDIRKQAQQADKKEDA EVKVREELGKLFSSTKAGLDQEIQEHVKKETSSE  
 ENTQKVDEHYVNSLQNLAKSLEELDKATTNEQATQVKNQFLENAQKLKEIQPLIKET  
 20 NVKLYKAMESLEQVEKELKHNSEANLEDLVAKSKEIVREYEGKLNQSKNLPELKQLE  
 EEAHSKLKQVVEDFRKKFKTSEQVTPKKRVKRD LAANENNQQKIELTVSPENITVYEG  
 EDVKFTVTAKSDSKTALDFSDLLTKYNPSVSDRISTNYKTNTDNHKIAEITIKNLKLN  
 ESQTVTLKAKDDSGNVVEKFTTITVQKKEEKQVPKTPEQKDSKTEEKVPQEPKSNKDN  
 QLQELIKSAQQELEKLEKAIKELMEQPEIPSNPEYGIQKSIWESQKEPIQEAITSFKK  
 25 IIGDSSSKYYTEHYFNKYKSDFMNYPLHAQMEMLTRKVQYMNKYPDNAEIKKIFESD  
 MKRTKEDNYGSLNDALKG YFEKYFLTPFNKIKQIVDDLKKEVDQAPAPIPENSEMD  
 QAKEKAKIAVSKYMSKVLDGVHQHLQKKNHSKIVDLFKELEAIKQQTIFDIDNAKTEV  
 EIDNLVHDAFSKM NATVAKFQKGLETNTPETPDTPKIPELPQAPDTPQAPDTPHPVES  
 PKAPEAPRPVESP KPTPEAPHVPESPKAPEAPRPVESP KPTPEAPHVPESPKTPEAPKIP  
 30 EPPKTPDVPKLPDVPKLPDAPKLPDGLNKVGQAVFTSTDGNTKVTVVFDPKPTDADKLH  
 LKEVTTKELADKIAHKTGGGTVRVFDLSLSKGGKETHVNGERTVRLALGQTGSDVHVY  
 HVKENGDLERIPSKVENGVVFKTNHFSLF AIKTL SKDQNVTPPKQTKPSTQGSQVEI  
 AESQTGKFQSKAANH KALATGNETVAKGNPTSTTEKKLPYTGVASNLVLEIMGLGLI  
 GTSFIAMKRRKS

35

### SEQ ID NO: 62 Nucleic acid sequence encoding SEQ ID NO: 61

1 tcatgatttt cttcttttca ttgcgatgaa tgaagttcca atcaaacc aa ggagacccat  
 61 aatttcaaga actagattag atgccactcc tgtatatggc aatttctttt ccgttggtga  
 121 tgtaggattt ctttttgcca ctgtttcatt tccagtagcc agtgctttat gattagctgc  
 40 181 ttactctgg aattttccag tttgactctc tgcaatctct acttgactgc cttgggtaga

**NVD008BWO**

241 aggttttagtc tgcttcggtg gagtaacatt ttgatcctta gaaagtgtct taatcgcaaa  
 301 caaactgaag tggttcgttt taaaaacaac ttgcccatTT tcaacttttag aaggaatacg  
 361 ctcaaggtcg ccatttttctt ttacgtgata gacgtgaaca tctgagccag tctgcccag  
 421 cgcgagccga acagttcgtt ctccattgac atgtgtttcc ttgcctcctt tagaaagaga  
 5 481 taagtcaaac acacgaactg ttctctctcc tgttttatga gcaattttat cagccaactc  
 541 tttcgtcgtt acttccttga gatgtaactt atcagcatct gtaggtttat caaatacaac  
 601 cgtaacctta gtattttccat cagttgatgt aaatactgct tgtccaactt tatttaaccc  
 661 atctggtaac ttcggtgcat ctggaagctt agggacgtct ggaagcttag ggacgtctgg  
 721 agtcttaggg ggttccggaa tctttggtgc ttctggagtc tttggtgatt ccggaacatg  
 10 781 cggtgcttct ggagtccttg gtgattccgg aacacgcggt gcttctgggg ctttggtga  
 841 ttccggaaca tgcggtgctt ctggagtctt tgggtattcc ggaacacgcg gtgcttctgg  
 901 ggcttttggg gattccggaa catgcggtgt gtctggagcc tgcggtgtat ctggggcttg  
 961 aggtagctct ggaatcttcg gtgtatctgg agtttctggc gtatttgtct ctagacctt  
 1021 ttgaaattta gcaacagtag cattcatttt tgagaatgca tctgtacta agttatcaat  
 15 1081 ctctacttca gtctttgcat tgtcaatata aaaaatagtt tgttgtttaa tgccttcaag  
 1141 ttccttaaaa agatcaacaa ttttactgtg atttttcttc tgcagatgtt gatgaactcc  
 1201 atctaaaacc ttactcatat acttcgatac agcaatctta gccttttctt tagcctgac  
 1261 catttctgaa ttttccggaa ttggtgctgg ctgatcttgt tctacttttt tatccaaatc  
 1321 atctacaatc tgcttaattt tattaatagg tgtaaggaaa tatttctcaa aatagccttt  
 20 1381 caaagcatca ttttctaaac ttccgtaatt atcttctttc gttctcttca tatctgactc  
 1441 aaatatcttt ttaatttctg cattatcagg atatttgttc atatactgaa ccacttttct  
 1501 agtcagcatc tccatttggt catgaagtgg ataattcata aaatcagatt tatatttggt  
 1561 aaaatagtg c tctgtgtagt attttgaaga tgaatcacca ataatcttct taaaacttgt  
 1621 tatggcttcc tggataggct ctttttgta ctcccaaata gatttttgaa taccatactc  
 25 1681 tggattggat ggaatctctg gttgctccat taattctttt attgcttttt ctaacttttc  
 1741 cagttcttgt tgagctgatt taatcaactc ttgtaattga ttcttgatcat ttgattttgg  
 1801 ttcttgagga accttttctt ccgtttttaga atctttctgc tctggtggtt taggaacttg  
 1861 tttctcctct ttcttttgca ctgtaatagt gaatgttttt tcaactacat tgccagaatc  
 1921 atcttttagct tttagagtca ctgtttgact ttcatthagc ttcaaattct tgatagtgat  
 30 1981 ttcggcaatc ttatgattat ccgtgttagt cttataattt gtactaattc tatctgatac  
 2041 agacggatta tattttgtta aaagatcact gaagtccaac gccgtcttcg aatcactttt  
 2101 agctgtgact gtaaatttca cgtcttcacc ttcatataca gtgatattct ctggtgaaac  
 2161 tgtaactca atcttttggt gattattttc attagcagct aaatctcgtt tgacacgttt  
 2221 ttttggtgtc acttgctctg acgtttttaa ttttttcta aaatcctcca caacttggtt  
 35 2281 caacttcgaa tgagcttctt cttctagttg ctttaattct ggaagatttt tagattgatt  
 2341 aagttttctt tctgtattct ttacgatttc tttagatttc gcaaccaaatt cttctaaatt  
 2401 agcttccgaa ttatgtttta attccttctc aacctgctcc aagctctcac tcatagcctt  
 2461 atacaatttc acattcgttt ctttgataag aggttgattt tctttgagct tttgagcgtt  
 2521 ttctaagaat tgatttttaa cttgtgtagc ttgttcattg gtagttgcct tatctagttc  
 40 2581 ttcaagagat ttttgagcaa ggttctgaag gctattaaca tagtggtcat caactttctg

2641 agtattttcc tcactactcg tttctttctt cacatgctct tgaatttctt gatccagacc  
 2701 agcttttagtt gaactaaaga gtttacctag ttcttcacga acctttactt cggcatcttc  
 2761 ttttttatct gcttggtgag cttggttacg aatatcttcg atttttttca gcatagaatc  
 2821 tttatcttca tttgtgattc ccttttgctc tgccattttt tcaacttgac ttttttgatg  
 5 2881 attaagctct ttgtcaatat tgcttagatc tactttcgta tctgactggt tcagagtttt  
 2941 ctggttgctta gctttcttat ctttctcaac ttcttcagt tggttgatgt gtaacagtct  
 3001 attagtttctg ttaaattgat tttctaattc taataatgca tcagaatcat ttgtttcatc  
 3061 aatttttggt ttaaaactcat ttttctgttc atgagataga attgtggtat ccacatcatt  
 3121 ttttagatta tttttccatt gttgtaattg tttctctcgt tttccagtat cagtggcaga  
 10 3181 tgttttcccca gctgttttct cgaccgggtc aacagctttt tttatgtctg ttgttagaat  
 3241 ttccatcttt gttgtctcaa gttccgagga tgatgaatta tttccttgat ctggttgagc  
 3301 catacttgga tagggcttag ctgcaacctc ggtagtcttc acactatcgt cctttacaag  
 3361 ctcaacttgca tgagcaacgc ttcccatgaa caaactagct accgctacac tagctactcc  
 3421 tacactaaat ttacgaatgg aataacgcat ttttctttca taattagatt taaacat

15

### SEQ ID NO: 63 *Borrelia hermsii* cspH CRASP-1 protein, isolate HS1

MQLTKKYLPAILLLLSLASCDLFYKNRNSNANLLKTLDNNQKQA  
 LIYFKDTLQDKKLYSLTTSQKNFLDDLEKNKKAPGLQYKLKKTLSSEYDESQFNKLL  
 NELGNAKAKQFLQQLHIMLQSIKDGTLTFSFSSANFNDLQNLQKKERALQSINGELYV  
 20 EYFYINGISNPDNFFKIMQNLKT

### SEQ ID NO: 64 Nucleic acid sequence encoding SEQ ID NO: 63

1 atgcaattaa caaaaaaata tttaccagca attcttttat tattaagcct tgctagctgt  
 61 gatttattct ataaaaacag aaactcaaat gctaatttac taaaaactct tgataataat  
 25 121 caaaaacaag ctctcattta ctttaaagat acacttcaag ataaaaaata tttaagttat  
 181 ttaacgacaa gccagaaaaa ttttttagac gatttagaga aaaataaaaa agctcctggt  
 241 ttgcaatata aacttaaaaa aacactaagc tctgagtatg atgaaagtca attcaataaa  
 301 ttacttaatg aacttggaat tgctaaggct aaacaattcc ttcaacaatt gcatataatg  
 361 ctacagtcta tcaaagacgg cacgcttaca agcttttcat ctgcaaattt caatgacttg  
 30 421 caaaatttag agcaaaaaaa agaacgagca ttgcaatcta tcaatggtga attatatgtt  
 481 gaatactatt tctatatcaa tggaattagc aatccggaca atttttttga aaaaataatg  
 541 caaaatttaa aaacttaa

### SEQ ID NO: 65 *Borrelia burgdorferi* strain Sh-2-82 CRASP-2 (cspZ) protein, complete

35 MKKSFLSIYMLISISLLSCDVSRLNQRNIDELKIFVEKAKYYSI  
 KLDAIYSEYTGAYNDIMTYIMTYSEGTSSDKSKVNQAISILKKDNKIVNKFKELEKII  
 EEEKPMFLSKLIDDFAIELDQAVDNDVSNARHVADSYEKLKRSVALAYIESFDVISSK  
 FVDSKFVEASKKFVNKAKEFVEENDLIALKCIVKTIGDMVNDREINSRSRYNNFYKKE  
 ADFLGAAVELEGAYKAIKQTLL

**NVD008BWO**

**SEQ ID NO: 66 Nucleic acid sequence encoding SEQ ID NO: 65**

1 ctatgaatct ctaaagattt tagcaggaga gaaaatatga aaaaaagttt tttatcaata  
 61 tacatgttaa tttcaataag tttattatca tgtgatgtta gtagattaa tcagagaaat  
 5 121 attgatgagc ttaaaatttt tggtgaaaag gccaaagtatt attctataaa attagacgct  
 181 atttatagcg aatatacagg agcatataat gatattatga cttatattat gacttattcg  
 241 gaaggtacat cttctgataa aagtaagggt aatcaagcta tatctatact taaaaaagac  
 301 aataaaattg ttaataagtt taaggagctt gaaaagatta tagaagaata caaacccatg  
 361 tttttaagta aattaattga tgattttgct atagaattag accaagctgt agataatgat  
 10 421 gtgtctaatt ccagacatgt tgctgattct tatgaaaaac ttagaaaatc tggtgcatta  
 481 gcctacattg agagttttga tggtatatct tctaagtttg ttgatagtaa gtttggtgaa  
 541 gcttctaaaa aatttgtaa taaagctaaa gagttttag aggaaaatga tcttatagct  
 601 cttaagtgtt ttgtgaaaac tattggagat atggttaatg atagggaaat aaattcaaga  
 661 agcagggtata ataattttta taaaaaagaa gcagattttt taggtgctgc tgtagaactt  
 15 721 gagggggcct ataaagctat taagcaaact ttattataga tcaaggtata aattttagg

**SEQ ID NO: 67 Streptococcus spp. emm5 protein**

MARENTNKHYSRLKLLKGTASVAVALSVLGAGLVVNTNEVSAAVTRGTINDPQRAKEALDKYELENHDLK  
 TKNEGLKTENEGLKTENEGLKTENEGLKTEKKEHEAENDKLKQQRDTLSTQKETLEREVQNTQYNNETLK  
 20 IKNGDLTKELNKRQELANKQQESKENEKALNELLEKTVKD KIAKEQENKETIGTLKKILDETVKD KIAK  
 EQENKETIGTLKKILDETVKDKLAKEQKSKQNI GALKQELAKKDEANKISDASRKGLRRDL DASREAKKQ  
 LEAEHQKLEEQNKI SEASRKGLRRDL DASREAKKQLEAEHQKLEEQNKI SEASRKGLRRDL DASREAKKQ  
 VEKALEEANSKLALEKLNKELEESKKLTEKEKAELQAKLEAEAKALKEQLAKQAEELAKLRAGKASDSQ  
 TPDTPGNKAVPGKGQAPQAGTKPNQNKAPMKETKRQLPSTGETANPFFTAAAL TVMATAGVAAVVKRKE  
 25 EN

**SEQ ID NO: 68 Nucleic acid sequence encoding SEQ ID NO: 67**

ATGGCTAGAGAAAATACCAATAAGCATTATTCGCTTAGAAAATTAAAAAAGGCACTGCATCAGTAGCAG  
 TAGCTTTGAGTGTCTTAGGAGCAGGATTAGTTGTCAATACTAATGAAGTTAGTGCAGCCGTGACTAGGGG  
 30 TACAATAAATGACCCGCAAAGAGCAAAAGAAGCTCTTGACAAGTATGAGCTAGAAAACCATGACTTAAAA  
 ACTAAGAATGAAGGGTTAAAACTGAGAATGAAGGGTTAAAACTGAGAATGAAGGGTTAAAACTGAGA  
 ATGAAGGGTTAAAACTGAGAAGAAAGAACATGAAGCAGAAAACGATAAGTTAAAAACAACAGAGGGATAC  
 GTTATCTACTCAGAAAGAACTCTTGAAAGAGAAGTACAGAACACGCAATACAATAATGAAACGTTAAAG  
 ATTAAGAATGGTGACTTAATAAAGAGTTGAATAAACTCGACAAGAATTAGCAAATAAACAGCAAGAGA  
 35 GTAAAGAAAATGAAAAGGCCCTTAATGAACTCTTGAAAAGACAGTAAAAGATAAAATTGCTAAGGAGCA  
 AGAAAATAAAGAAACCATTTGGTACCCTTAAAAAATCTTGGATGAGACAGTAAAAGATAAAATTGCTAAG  
 GAGCAAGAAAATAAAGAAACCATTTGGTACCCTTAAAAAATCTTGGATGAGACAGTAAAAGATAAACTTG  
 CGAAAGAGCAAAAAAGTAAACAAAACATTTGGTGCCCTTAAACAAGAATTAGCTAAAAAAGATGAGGCAAA  
 CAAAATTTTCAGACGCAAGCCGTAAGGGTCTTCGTCTGACTTAGACGCATCGCGTGAAGCTAAGAAGCAA

**NVD008BWO**

TTAGAAGCTGAACACCAAAAACTTGAAGAACAAAACAAGATTTGAGAAGCAAGTCGCAAAGGCCTTCGCC  
 GTGATTTAGACGCATCACGTGAAGCTAAGAAGCAATTAGAAGCTGAACACCAAAAACTTGAAGAACAAA  
 CAAGATTTGAGAAGCAAGTCGCAAAGGCCTTCGCCGTGATTTAGACGCATCACGTGAAGCTAAGAAACA  
 GTTGAAAAAGCTTTAGAAGAAGCAAACAGCAAATTAGCTGCTCTTGAAAACTTAACAAAGAGCTTGAAG  
 5 AAAGCAAGAAATTAACAGAAAAAGAAAAAGCTGAGCTACAAGCAAACCTTGAAGCAGAAGCAAAGCACT  
 CAAAGAACAATTAGCAAAAACAAGCTGAAGAACTTGCAAACTAAGAGCTGGAAAAGCATCAGACTCACAA  
 ACCCCTGATACAAAACCAGGAAACAAAGCTGTTCCAGGTAAAGGTCAAGCACCACAAGCAGGTACAAAC  
 CAAACCAAAACAAAGCACCAATGAAGGAACTAAGAGACAGTTACCATCAACAGGTGAAACAGCTAACCC  
 ATTCTTCACAGCGGCAGCCCTTACTGTTATGGCAACAGCTGGAGTAGCAGCAGTTGTAAAACGCAAAGAA  
 10 GAAAAATTAA

### SEQ ID NO: 69 *Streptococcus pyogenes* emm6 protein

MAKNNTNRHYSRLRLKKGTASVAVALSVIGAGLVVNTNEVSARVFPRGTVENPDKARELLNKYDVENSML  
 QANNDKLTENNNTLDQNKNLTTENKNLTDQNKNLTTENKNLTDQNKNLTTENKELKAEENRLTTENKGL  
 15 TKKLSEAEEEAANKERENKEAIGTLKKTLDETVDKDKIAKEQESKETIGTLKKTLDETVDKDKIAKEQESKE  
 TIGTLKKTLDETVDKDKIAKEQESKETIGTLKKILDETVDKDKIAREQKSKQDIGALKQELAKKDEGNKVSE  
 ASRKGLRRDLASREAKKQVEKDLANLTAELDKVKEEKQISDASRQGLRRDLASREAKKQVEKALEEAN  
 SKLAALEKLNKELEESKKLTEKEKAELQAKLEAEAKALKEQLAKQAEELAKLRAGKASDSQTPDAKPGNK  
 VVPGKGQAPQAGTKPNQNKAPMKETKRQLPSTGETANPFFTAALTMATAGVAAVVKRKEEN

20

### SEQ ID NO: 70 Nucleic acid sequence encoding SEQ ID NO: 69

GATCTAGAAGAGATTGAAAAACAGTATGATGTGATCGTGACAGATGTTATGGTAGGAAAAAGCGATGAGT  
 TAGAAATTTTCTTTTCTACAAAATGATTCCAGAAGCGATTATTGACAAGCTCAATGTGTTTTTAAACAT  
 CAGCTTTGCAGACAGCTTGGCCACTAGAGCAAACCCATCCAAGAACCCCTTGGACTTTCATCGCAAAGAG  
 25 CTTACCTTTACCCACTCCCCCAACAACGTTTTGCACGCCCCCCCCGCACGAAGTTAGACAGCCTAGCCG  
 CAGAACTCAAAAACAGATTTCATCATTAATAGCATTTAGGTCAAAAGTGGCAAAGCTAAAAAGCTGGT  
 CTTTACCTTTTGGCTTTTATTATTACAATACAATTATTAGAGTTAAACCCTGAAAATGAGGGTTTTTCC  
 TAAAAAATGATAACATAAGGAGCATAAAAAATGGCTAAAAATAACACGAATAGACACTATTCGCTTAGAAA  
 ATTAAAAAAAGGTACTGCATCAGTAGCAGTGGCTTTGAGTGTAATAGGGGCAGGATTAGTTGTCAATACT  
 30 AATGAAGTTAGTGCAAGAGTGTTCCTAGGGGGACGGTAGAAAACCCGGACAAAGCACGAGAACTTCTTA  
 ACAAGTATGACGTAGAGAACTCTATGTTACAAGCTAATAATGACAAGTTAACAACCTGAGAATAATAACTT  
 AACAGATCAGAATAAAAACTTAACAACCTGAGAATAAAAACTTAACAGATCAGAATAAAAACTTAACAACCT  
 GAGAATAAAAACTTAACAGATCAGAATAAAAACTTAACAACCTGAGAATAAGGAGTTAAAGCTGAGGAGA  
 ATAGGTTAACAACCTGAGAATAAAGGGTTAACTAAAAAGTTGAGTGAAGCTGAAGAAGAAGCAGCAAATAA  
 35 AGAGCGAGAAAAATAAAGAAGCCATTGGTACCCTTAAAAAAACCTTGGATGAGACAGTAAAAGATAAAATT  
 GCTAAGGAGCAAGAAAGTAAAGAAACCATTTGGTACCCTTAAAAAAACCTTGGATGAGACAGTAAAAGATA  
 AAATTGCTAAGGAGCAAGAAAGTAAAGAAACCATTTGGTACCCTTAAAAAAACCTTGGATGAGACAGTAAA  
 AGATAAAATTGCTAAGGAGCAAGAAAGTAAAGAAACCATTTGGTACCCTTAAAAAAATCTTGGATGAGACA  
 GTAAAAGATAAAATTGCGAGAGAGCAAAAAAGTAAACAAGACATTGGTGCCCTTAAACAAGAATTAGCTA  
 40 AAAAGATGAAGGAAACAAAGTTTCAGAAGCAAGCCGTAAGGGTCTTCGCCGTGACTTGGACGCATCAGC

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TGAAGCTAAGAAACAGGTTGAAAAAGATTTAGCAAACCTTGACTGCTGAACCTTGATAAGGTTAAAGAAGAA  
 AAACAAATCTCAGACGCAAGCCGTCAAGGTCCTCGCCGTGACTTGGACGCATCACGTGAAGCTAAGAAAC  
 AAGTTGAAAAAGCTTTAGAAGAAGCAAACAGCAAATTAGCTGCTCTTGAAAACTTAACAAAGAGCTTGA  
 AGAAAGCAAGAAATTAACAGAAAAAGAAAAAGCTGAGCTACAAGCAAACTTGAAGCAGAAGCAAAAGCA  
 5 CTCAAAGAACAATTAGCGAAACAAGCTGAAGAACTTGCAAACTAAGAGCTGGAAAAGCATCAGACTCAC  
 AAACCCCTGATGCAAAACCAGGAAACAAAGTTGTTCCAGGTAAAGGTCAAGCACCACAAGCAGGTACAAA  
 ACCTAACCAAAACAAAGCACCAATGAAGGAACTAAGAGACAGTTACCATCAACAGGTGAAACAGCTAAC  
 CCATTCTTCACAGCGGCAGCCCTTACTGTTATGGCAACAGCTGGAGTAGCAGCAGTTGTAAAACGCAAAG  
 AAGAAAACTAAGCTATCACTTTGTAATACTGAGTGAACATCAAGAGAGAACCAGTCGGTTCTCTCTTTTA  
 10 TGTATAGAAGAAATGAGATTAAGGAGGTCACAACTAAACAACCTTTAAAAAGCTGACCTTTACTAATAAT  
 CGTCTTTTTTTTATAATAAAGATGTTAATAATATAATTGATAAATGAGATACATTTAATGATTATGACAA  
 AAGCAAGAAAA

### SEQ ID NO: 71 *Streptococcus pyogenes* MGAS8232 emm18 protein

15 MVRKDANRQYSLRKLKKSTASVAVALSALGVGLAVNQTEVSAAPLTRATADNKDELIKRANGYEIQNHQL  
 TVENKKLKI DKEQLTKENDDLKTEKDQLEQRSEK LATQKENLEKEVAEAKHKNETLNINNDLTKKLNET  
 RQELANKQQESKENEKTLNELLEKTVKDKIAREQKSKQDFGALKQELAKKEEQNKI SEASRKGLRRDLDA  
 SREAKKQVEKDLANLTAELDKVKEEKQISDASRQGLRRDLASREAKKQVEKALEEANSKLALEKLNKE  
 LEESKKLTEKEKAELQAKLEAEAKALKEQLAKQAEELAKLRAEKASDSQTPDAKPGNKAVPGKGQAPQAG  
 20 TKPNQNKAPMKETKRQLPSTGEAANPFFTAAAAATVMVSAGMLALKRKEEN

### SEQ ID NO: 72 Nucleic acid sequence encoding SEQ ID NO: 71

ATGGTTAGAAAAGATGCAAATAGACAGTATTCGCTTAGAAAATTAAAAAAAGTACTGCTTCAGTAGCGG  
 TTGCTTTGAGTGCCTTAGGGGTAGGATTAGCGGTTAACCAAACAGAAGTTAGCGCAGCACCTCTTACTCG  
 25 AGCTACAGCAGACAATAAAGACGAATTAATAAAAAGAGCTAACGGTTATGAGATACAGAACCATCAGTTA  
 ACAGTTGAGAATAAAAAATTAAAAATTGATAAGGAACAGTTAACAAAAGAGAATGATGATTTAAAACTG  
 AGAAGGATCAGTTAGAACAACGGAGTGAGAAGTTAGCTACTCAGAAAGAAAATCTTGAAAAAGAAGTAGC  
 GGAAGCGAAACACAAGAATGAAACGTTAAACATTAATAATGATGACTTAAC TAAAAAGTTGAATGAAACT  
 CGACAAGAATTAGCAAATAAACAGCAAGAGAGTAAAGAAAATGAAAAGACCCTTAATGAACTCTTGAAA  
 30 AGACAGTAAAAAGATAAAATTGCGAGAGAGCAAAAAAGTAAACAAGACTTTGGTGCCCTTAACAAGAATT  
 GGCTAAAAAAGAAGAACAAAAAAAATTTTCAGAAGCAAGTCGTAAAGGTCTTCGTCGTGACTTAGATGCA  
 TCACGTGAAGCTAAGAAACAAGTTGAAAAAGATTTAGCAAACCTTGACTGCTGAACCTTGATAAGGTTAAAG  
 AAGAAAAACAAATCTCAGACGCAAGCCGTCAAGGTCTTCGCCGTGACTTGGACGCATCACGTGAAGCTAA  
 GAAACAAGTTGAAAAAGCTTTAGAAGAAGCAAACAGCAAATTAGCTGCTCTTGAAAACTTAACAAAGAG  
 35 CTTGAAGAAAGCAAGAAATTAACAGAAAAAGAAAAAGCTGAGCTACAAGCAAACTTGAAGCAGAAGCAA  
 AAGCACTCAAAGAACAATTAGCAAAACAAGCTGAAGAAGCTTGCAAACTAAGAGCTGAAAAAGCATCAGA  
 CTCACAAACCCCTGATGCAAAACCAGGAAACAAAGCTGTTCCAGGTAAAGGTCAAGCACCACAAGCAGGT  
 ACAAAACCTAACCAAAACAAAGCACCAATGAAGGAACTAAGAGACAGTTACCATCAACAGGTGAAGCAG  
 CCAACCCATTCTTTACAGCAGCAGCTGCAACAGTGATGGTATCTGCGGGTATGCTTGCTCTAAAACGCAA  
 40 AGAAGAAAACTAA

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**SEQ ID NO: 73 *Borrelia burgdorferi* 64b ErpA, protein\_id="ZP\_03097639.1"**

MNKKMKMFIIICAVFILIGACKIHTSYDEQSNGEVKVKKIEFSEF  
 TVKIKNKNNSNNWADLGDLVVRKEKDGIEGTGLNAGGHSATFFSLEEEEINNFIKAMTE  
 5 GGSFKTSLYYGYNDEESDKNVIKNKEIKTKIEKINDTEYITFLGDKINNSAGGDKIAEYA

**SEQ ID NO: 74 Nucleic acid sequence encoding SEQ ID NO: 73**

1 atgaataaga aaatgaaaat gtttattatt tgtgctgttt ttatacttat aggtgcttgc  
 61 aagattcata cttcatatga tgagcaaagc aatggagagg taaaggtaa aaaaatagaa  
 10 121 ttctctgaat ttactgtaaa aattaaat aagaataata gtaataactg ggcagactta  
 181 ggagatttag ttgtaagaaa agaaaaagat ggtattgaaa cgggtttaaa cgctggggga  
 241 cattcggcta cattcttttc attagaagag gaagaaatta ataactttat aaaagcaatg  
 301 actgaagggtg gatcatttaa aactagtttg tattatggat ataatgacga agaaagtgat  
 361 aaaaatgtca ttaagaataa agagataaaa acaaagatag aaaaatttaa tgatactgaa  
 15 421 tatattacat ttttaggaga taaaattaat aacagtgcgg ggggagacaa aatagctgaa  
 481 tatgcaa

**SEQ ID NO: 75 *Borrelia burgdorferi* strain BL206 plasmid cp32-2 ErpC (erpC)**

MNKKMKMFIIICFIFALISSCKNHTLYDGQSNGEAKVKKIEFSEF  
 20 TVKIKNKNNSNNWADLGDLVVRKEEDGIEGTGLNVGKGDSDTFAGYTATFFSLEESEVN  
 NFIKAMTEGGSFKTSLYYGYKDEQSNANGIQNKEIITKIEKIDDFEYITFLGDKIKDS  
 GDKVVEYAILLEDLKKNLK

**SEQ ID NO: 76 Nucleic acid sequence encoding SEQ ID NO: 75**

1 atgaataaga aaatgaaaat gtttattatt tgctttat ttgctttgat aagttcttgt  
 61 aaaaatcata ctttatatga tgggcaaagt aatggagagg caaaggtaa aaaaatagaa  
 121 ttctctgaat ttactgtaaa aattaaat aagaataata gtaataactg ggcagactta  
 181 ggagatttag ttgtaagaaa agaagaagat ggtattgaaa cgggggttaa tggtgggaag  
 241 ggagactctg atacattcgc aggatacacc gctacattct tttcattaga agagtcagaa  
 30 301 gttaataact ttataaaagc aatgactgaa ggtggatcat ttaaaactag tttatattat  
 361 ggatataagg acgaacaaag taatgcaaat ggtatccaaa ataaggagat aataacaaaa  
 421 atagaaaaaa ttgatgattt tgaatatatt acatttttag gagataaaat taaggattca  
 481 ggagataaag ttgtgaata tgcaatacta ctagaagatc ttaaaaaaaaaa tttaaaatag

**35 SEQ ID NO: 77 *Borrelia burgdorferi* B31 erpP/BBN38**

MNKKMKMFIVCAVFILIGACKIHTSYDEQSSGEINHTLYDEQSN  
 GELKLKKIEFSKFTVKIKNKDNNNSNWTDLGDLVVRKEENGIDTGLNAGGHSATFFSLK  
 ESEVNNFIKAMTKGGSFKTSLYYGYKYEQSSANGIQNKEIITKIESINGAEHIAFLGD  
 KINNGVGGDKTAEYAIPLVLKKNLK

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**SEQ ID NO: 78 Nucleic acid sequence encoding SEQ ID NO: 77**

1 atgaataaga aaatgaaaat gtttattggt tgtgctgttt ttatacttat aggtgcttgc  
 61 aaaattcata cttcatatga tgagcaaagt agtgggtgaga taaaccatac tttatatgat  
 5 121 gagcaaagta atgggtgagtt aaaacttaaa aaaatagaat tctctaaatt tactgtaaaa  
 181 attaaaaata aagataataa tagtaactgg acagacctag gagatttagt tgtaagaaaa  
 241 gaagaaaatg gtattgatac gggtttaaac gctgggggac attcggctac attcttttca  
 301 ttaaaagaat cagaagttaa taactttata aaagcaatga ctaaaggcgg atcatttaaa  
 361 actagtttgt attatggata taagtacgaa caaagtagtg caaatggat ccaaaacaaa  
 10 421 gagatcataa caaaaataga aagtattaat ggtgctgaac atattgcgtt ttaggagat  
 481 aaaattaata acggtgtggg gggagataaa acagctgaat atgcaatacc actagaagt  
 541 cttaaaaaaa atttaaaata g

**SEQ ID NO: 79 Streptococcus pyogenes MGAS2096 fibronectin-binding protein**

15 MVSSYMFARGEKMNNKMFLNKEAGFLVHTKRKRRAVTLVGVFF  
 LLLACAGAIGFGQVAYAADEKTVPNFKSPDPYPWYGYDSYRGIFARYHNLKVNKGS  
 KEYQAYCFNLTKYFPRPTYSTTNNFYKKIDGSGSAFKSYAANPRVLDENLDKLEKNIL  
 NVIYNGYKSNANGFMNGIEDLNAILVTQNAIWYSDSAPLNDVNKMWEREVRNGEISE  
 SQVTLMREALKKLIDPNLEATAANKIPSGYRLNIFKSENEYQNLLSAEYVPDDPPKP  
 20 GDTSEHNPKTPELDGTPIPEDPKRPDESSEPALPPLMPELDGEEVPEVPSESLEPALP  
 PLMPELDGEEVPEVPSESLEPALPPLMPELDGEEVPEVPSESLEPALPPLMPELDGEE  
 VPEVPSESLEPALPPLMPELDGEEVPEKPSVDLPIEVPRYEFNNKDQSPLAGESGETE  
 YITEVYGNQQNPVDDIDKKLPNETGFGSGNMVETEDTKEPEVLMGGQSESVEFTKDTQTG  
 MSGQTPQVETEDTKEPEVLMGGQSESVEFTKDTQTGMSGQTPQVETEDTKEPGVLM  
 25 GGQSESVEFTKDTQTGMSGQTPQVETEDTKEPGVLMGGQSESVEFTKDTQTGMSGFS  
 ETVTIVEDTRPKLVFHFDDNNEPKVEENREKPTKNITPILPATGDIENVLAFLGILILS  
 VLSIFSLKKNKQNNKV

**SEQ ID NO: 80 Nucleic acid sequence encoding SEQ ID NO: 79**

30 1 atggtaagct catatatggt tgcgagagga gagaaaatga ataacaaaat gtttttgaac  
 61 aaagaagccg gttttttggt acacacaaaa agaaaaaggc gatttgctgt cacttttagt  
 121 ggagtctttt ttctgctttt ggcattgtcg ggtgctatcg gttttggtca  
 agtagcctat181 gctgcggatg agaagactgt gccgaatttt aaaagcccag atccagatta  
 35 tccctgggtat241 ggttatgatt cgtatagagg aatatttgca agatatcaca atttaaaagt  
 aaatctaaaa  
 301 ggaagtaagg agtatcaagc gtattgtttt aacctaacaa aatactttcc tcgccccact  
 361 tatagtacta caaataattt ttacaagaaa attgatggga gtggatcagc gttcaaact  
 421 tatgcagcga atcctagggt tttagatgag aatttagata aattagaaaa aaatatactg  
 481 aatgtaattt ataattggata taaaagtaat gcaaatgggt ttatgaatgg tatagaagat  
 40 541 cttaatgcta tactagtaac tcaaaacgct atttggtact attcagatag tgctccatta

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601 aatgatgtta ataaaatgtg ggaaagagag gttcggaatg gggagattag tgagtcacaa  
 661 gttactttta tgcgtgaggc attgaaaaaa ctaattgatc ccaatttaga agctactgca  
 721 gctaataaaaa tcccatcagg atatcgttta aatatcttta agtctgaaaa tgaagattac  
 781 caaaatcttt taagtgtga atatgtacct gatgatcccc ctaaactgg tgatacgtca  
 5 841 gaacataatc ctaaaactcc cgagttggat ggcactccaa ttcccgagga cccaaaacgt  
 901 ccagatgaga gttcagaacc tgcgcttccc ccattaatgc cagagctaga tggatgaagaa  
 961 gtcccagaag ttccaagcga gagcttagaa cctgcgcttc cccattgat gccagagcta  
 1021 gatggtgaag aagtcccaga agttccaagc gagagcttag aacctgcgct tccccattg  
 1081 atgccagagc tagatggtga agaagtccca gaagttccaa gcgagagctt agaactgcg  
 10 1141 cttcccccat taatgccaga gctagatggt gaagaagtcc cagaagttcc aagcgagagc  
 1201 ttagaacctg cgcttcccc attgatgcca gagttagatg gtgaagaagt ccctgaaaaa  
 1261 cctagtgttg acttacctat tgaagttcct cgttatgagt ttaacaataa agaccagtca  
 1321 cctctagcgg gtgagtctgg tgagacggag tatattaccg aagtctatgg aaatcaacag  
 1381 aaccctgttg atattgataa aaaacttccg aatgaaacag gtttttcagg aaatatggtt  
 15 1441 gagacagaag atacgaaaga gccagaagtg ttgatgggag gtcaaagtga gtctgttgaa  
 1501 tttactaaag acactcaaac aggcattgagt ggtcaaaciaa ctctcaggt tgagacagaa  
 1561 gatacgaaag agccagaagt gttgatggga ggtcaaagt agtctgttga attactaaa  
 1621 gacactcaaa caggcatgag tgggtcaaaca actcctcagg ttgagacaga agatacga  
 1681 gagccaggag tgttgatggg aggccaaagt gagtctgttg aatttactaa agacactcaa  
 20 1741 acaggcatga gtggtcaaac aactcctcag gttgagacag aagacacgaa agagccagga  
 1801 gtgttgatgg gaggtcaaaag tgagtctgtt gaatttacta aagacactca aacaggcatg  
 1861 agcggtttca gtgaaacagt gaccattgtt gaagatacgc gtccgaagtt agtgttccat  
 1921 tttgacaata atgagcccaa agtgggaagag aatcgggaaa agcctacaaa aaatataaca  
 1981 cctatccttc ctgcaacagg agatattgag aatgttttgg ctttcttgg aatccttatt  
 25 2041 ttgtcagtac tttctatatt tagcctttta aaaaacaaac aaaacaataa agtctga

### SEQ ID NO: 81 B.pertussis FhaD (CDS 758..1492)

MARWRRRLGVAALGAAMLASLAPAARASLVITGTRVIYNAGSPE  
 TTVKMSNEGQAPALMQAWIDDGNAEAKPDEVQVPFFLTPPLARVDPGKGQTLRIFFNG  
 30 YPDGKTLPSDRESVFWLVNLEVPKATPEEGHGVQLTIRSRLKLFYRPGLSGNPLT  
 AAADLTFKRKPNGVLEVHNPTPYVNLQKLEVGENGAHGSKTPWMLAPLSSDELRLKG  
 TGAHSVQYWAIDDFGGVTPYQAAIAD

### SEQ ID NO: 82. B.pertussis FhaA (CDS 1555..4176)

35 MKQIPLILAMSLAFAAAKGESAPDMQAAVNFDsAMLWGGANGA  
 DLSRFNYSNALRPGNYIVDIYANNYPLIRQQVRFVAAQTSQGLKTAPAVACFTYQGL  
 EAMQVRLRALDPALVADLKSSGRCEVLGKLFPSDRESFDFGENRLEVSIPQAYTINRF  
 RRDISPDEWDSGITAFRLGYQYNYADYIGGLRAGRRLDLNLYSGFNFKGWYLRNSSTL  
 GWGQGRFTRRSQRTSLQTDIPSWRARLVFGDVFSSGEYFAPYSMRGMLVGSdTAMLPY  
 40 SERLYRPTIRGVARTRANVKVYQAGVLVFQDAVPPGPFaIDDYSPASYGGDLRVVVTE

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ANGAVQFTFTVPYASAVRLILPGQTQWSFSAGRYRNYRNDGQDRPWVTQLTGRHGVDG  
 VNLYGGLLIAQAYQAGLAGLSWNTPWGAMAADATLSRSQLSTTGNANGSSLRFSYSKT  
 LSGTNTAIRLATLRYSSSGFWNFADAVNAGPVETNGRNGRFGLYSLLGRERPRGDFSV  
 TLSQPLGGYGSLYVSALRRTYWGSSRVDQQTQLGYSTQVGRVGVNLDVSR TENRRSTE  
 5 HQVMLNLSIPLYGATSSGVVTGSLARTGSAPVQQSVNYSGMSGERDQYTYGLGVQRAG  
 TSAQYALNGSWSGTYGEVSGQLTHGRSYSQYQINGSGGLVAHAGGVTFGQYQAGTIGL  
 IQAEAAAGAKVVNTRNAAVDRSGYGLVSLTPYSLNEVELSPQDLPLDVQLESTVEQVI  
 PRAAAVVALRFPTRHDVAAMLVAEPGSEGALVFGTEVRDGAGKVVG VAGQGASALVRG  
 VSASGTLEVTRADGSICRATYDLKSAGQAVHGLPRIALACAPQGGGERGARAAGQAVA  
 10 QPSAISISGKDHEPDIR

**SEQ ID NO: 83. *B. pertussis* FhaE (CDS 4157..5287)**

MSQIFADRRRAAVPARVISFCGAALAVWAGLAVQPAMAVDPPVDC  
 GRALGLHFWSSASLISDQTPDGT LIGKPVVGRSLLSKSCKVPDDIKEDLSDNHDGEPV  
 15 DIVLELGSNYKIRPQSYGHPGIVVDLFPFGSTEETGIAIYIDFGSSPMQKVG ERQWLYP  
 QKGEVLFDVLTINGDNAEVRYQAIKVGPLKRPRKLVLSQFPNLFTYKWWFMRGTSQER  
 VLAQGTIDTDVATSTIDLKTCRYTSQTVSLPIIQRSALTGVGTTLGMTDFQMPFWCYG  
 WPKVSVYMSATKTQTGVDGVALPATGQAAGMASGVGVQLINGKTQQPVKLG LQGKIAL  
 PEAQQTESATFSLPMKAQYYQTSTST SAGKLSVTYAVTLNYD

**SEQ ID NO: 84. Nucleic acid sequence encoding SEQ ID NOS: 81(CDS 758..1492), 82(CDS 1555..4176), 83 (CDS 4157..5287)**

1 tcgcggcctg ccgcggctcg gcgcattggg attcgcaggg ttctcatg cgcccaatg  
 61 ccg gatagcg gtgcaattgc cgaccatttc gcgcaccg cg ctcaaggac tagggctgac  
 25 121 ggcaggcggg acagtttttg acgtgaaact gaccgagtgt ccgcaggcat tgaatggtca  
 181 gcaagtggga ttgttcttcg aatctggtgg cacggttgac tatacgtcgg gaaacctgtt  
 241 tgcgtatcgg gccgatagtc agggcgctga acaggtaccg cagacgaaag ccgacaacgt  
 301 gcaagccaat ctggatggtt ccgctattca tttgggccgc aacaagggtg cgcaggctgc  
 361 tcagacgttt ctggtatcgc agacggctgg gtcgctgacg tacggggcga ccctgcgcta  
 30 421 tctggcatgc tacatccgtt cgggcgctgg ttccattgtt gcggggaatc tccgcagtca  
 481 ggtgggggttc tccgtgatgt atccgtagcc cgtgaaagag gggtcacca ctgcggggg  
 541 ccccggtacg ggatggtcgg cttgtcacga gattcttgtt ttccatttct ttcttttcac  
 601 tcggctgcag cgccggcttg atgcatgcaa agcatcgata gctacgaacg gccgcgattc  
 661 ttgaatcatg aatacatagc cttgtgacgg ggcgctcgcg cagagccggc ccaggggatg  
 35 721 gtttacgcct gcatttacgg taaagcgga aggcggcatg gcgcgctggc gccggcggct  
 781 gggcgctcgc gcgctgggcg ccgccatgct ggcgagcctg gcgcgggccg cccgggccag  
 841 cctcgatc acgggtacgc gcgtgatcta caacggggc tcgcccgaga ccacggtgaa  
 901 gatgagcaac gaggggcagg ccccgcgct gatgcaggca tggatcgatg acggcaatgc  
 961 cgaggcgaag ccggacgaag tccaggtgcc gttcttctcg acgcctccgc tggcgcgggg  
 40 1021 ggaccggggc aaggggcaga ccttgcgcat tttcttcaat ggctaccg atggcaagac

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1081 gctgccgtcc gaccgcgaat cgggtttctg gctgaacggt ctggaagtgc cgccaagggc  
 1141 gacgcccagag gaaggccacg gggtcctgca gctgaccatc cgctcgcgcc tgaagctggt  
 1201 ctatcggccc aagggcctgt ccggcaaccc gctgacggcc gccgcgacc tgaccttcaa  
 1261 gcgcaagccc aacggcgtgc tggaggtgca caaccgcagc ccgtactacg tgaacctgca  
 5 1321 aaaactggag gtgggcgaga acggcgcgca cggcagcaag acgccgtgga tgctggcgcc  
 1381 gctttcctcg gacgagctgc gcctgaaagg gacggggggc aagtcggtgc agtactgggc  
 1441 catcgacgac ttcggcgggc tgacgccata tcaggcgggc atagcggact gacaagacgg  
 1501 gggcaccggg actggcgcgc gtcattggga cgttgccgaa accgacgctg aatcatgaaa  
 1561 cagataccac tgattctcgc gatgagcctt gccttcggcg ccgcggcgaa gggcgaaatcc  
 10 1621 gcgcccagata tgcaggcggc ggtcaacttc gactcggcca tgctgtgggg cggcgccaat  
 1681 ggcgcggatc tgagccgatt caactacagc aacgcgctgc ggccgggcaa ctacatcgtc  
 1741 gacatttacg ccaacaacta tccgctgacg cggcagcagg ttcgattcgt cgcggcgag  
 1801 acgtccgggc agggcttgaa gacggcgccg gcggtggcgt gtttcaccta tggccagctg  
 1861 gaagcgatgc aggtccggct gcgcgcgctc gatccggcct tggtcgcca cctcaaatacc  
 15 1921 agcgggagct gcgaggtgct gggcaagctg ttcccgata gccgcgagtc gttcgatttc  
 1981 ggcgagaacc gcctggaagt cagcattccg caagcctata cgatcaaccg cttccggcgc  
 2041 gacatctcgc ccgatgagtg ggatagcggc attactgctg tccgcctggg ataccagtac  
 2101 aactatgccg attacatcgc cggcttgcg gcggggcggc ggctggacct gaacctctac  
 2161 agcgggttca atttcaaggg ctggtacctg cgcaacagct cgacgctggg atggggccag  
 20 2221 ggccgcttca cgcgccgag ccagcgcacc agcctgcaga cggatatccc gtcctggcgg  
 2281 gcgcgcctgg tgttcggcga cgtgttctcc agcggcgagt acttcgcgcc gtactcgatg  
 2341 cgcggcatgc tggtcggcag cgataccgcc atgctgccgt actcggagcg cctgtaccgg  
 2401 ccgaccatac gcggcggtgc gcgcactcgg gccaacgtca aggtgtatca ggccggcgctg  
 2461 ctggttttcc aggacgccgt gcctcccggg ccgttcgca tcgacgatta cagtccggcc  
 25 2521 tcgtatggcg gcgacctgcg ggtggtggtg accgaggcga atggcgcggt ccagacgttc  
 2581 accgtgccgt acgccagcgc ggtgcgcctg atcctgccgg gccagacgca gtggtcgttc  
 2641 agcgcggggc gctatcgcaa ctatcgcaac gatgggcagg accgtccctg ggtgaccag  
 2701 ctgacggggc gccatggcgt ggccgacggc gtcaacctgt acggcgccct gctgatcgcc  
 2761 caggcgtaac aggccggcct ggccggcctg agctggaaca cgccctgggg ggcaatggcg  
 30 2821 gcggacgcca cgtgtcgcg cagccagctg tccaccaccg gcaatgcaa cgggtcgagc  
 2881 ctgcggttct cctacagcaa gacctgtcc ggcaccaaca cggcgatccg gctggctacg  
 2941 ctgcgctact cgtcgagcgg gttctggaat ttcccgatg cggtaaatgc cggcccggtc  
 3001 gagacgaacg ggcgcaacg gcggttcgga ctctattcgc tgctggggcc cgagcggccg  
 3061 cgcggcgatt tcagcgtcac gctgagcaa ccgctgggtg gatacggcag cctgtacgtg  
 35 3121 tcggcgctgc ggcggacctg ctgggggtcg tcgcggtcg accagcagac ccagctgggc  
 3181 tattcgacct aggtcggccg cgtaggcgtg aacctggatg tctcgcgtac ggagaatcgt  
 3241 cgcagcaccg agcatcaggt catgctgaat ctgtccattc cgctttatgg cgcgacctcc  
 3301 agcggcggtg tgacgggatc gctggcgctg accggctcgg cgcccgta gcaaagcgtc  
 3361 aactacagcg gcatgtcggg cgagcgcgat cagtacacct atggcctggg cgtgcagcgc  
 40 3421 gccggcacga gcgcgcagta cgcgttgaac ggctcctggt caggcacgta cggggaggtg

3481 agcggacagc tcacccatgg gcgcagctac agccagtacc agatcaacgg cagcggcggc  
 3541 ttggtggcgc acgcggggcg cgtgaccttc ggccagtacc aggcggggcac catcggcctg  
 3601 atccaggccg aggcggcggc aggcgcaaag gtcgtcaata cgcgcaacgc cgccgtggac  
 3661 cgcagcggct atgggctggt gtcgctgacg ccgtattccc tcaacgaggt cgaactgtct  
 5 3721 ccgcaggacc tgcccctaga cgttcagctg gagtccacgg tggagcaagt catcccggcg  
 3781 gcggccgcgc tcgtggcgct gcgctttccg acgcgccatg acgtcgccgc catgctggtt  
 3841 gccgaacccg gcagcgaagg cgcgctggta ttcggcaccg aagtgcgcga cggcgccggc  
 3901 aaggtggtgg gcgtggccgg ccaggggcgca agcgcgctgg tcagaggcgt gtcggcatcg  
 3961 ggcacgctgg aggtgacgcg cgcagacggt tcgatatgcc gcgccacgta cgacttgaaa  
 10 4021 tcggccgggc aagccgtgca tggcctgccg cgcattgcgc tggcgtgcgc gccgcaaggc  
 4081 ggcggcgaac gtggtgcgcg ggcggcgggc caggccgtgg cgcagccatc agctatctcc  
 4141 atttcgggta aagatcatga gccagatatt cgctgaccgc cgggcccgcg tgcccgcgcg  
 4201 cgtaatttcc ttctgcgggg ccgcgcttgc cgtctgggca ggcttgccg tcagcccgc  
 4261 catggccgct gatccgcggg tggactgcgg ccgggcgcta ggcttgcat tctggtcgag  
 15 4321 cgcctcgctc atctccgacc agacacccga tgggacgctg atcggcaagc ccgtggtcgg  
 4381 gcggtccctg ctgtccaaga gctgcaaggt gccggacgac atcaaggaa acctcagcga  
 4441 caaccatgac ggcgaaccgg tcgacatcgt gctggaactg ggcagtaact acaagatccg  
 4501 gccgcagtcc tatggccatc cgggcatcgt ggtcgacttg ccgttcggct ccacggagga  
 4561 gaccggcatc gccatctata tcgatttcgg cagttcgccg atgcagaagg tcggcgaacg  
 20 4621 gcagtggctg tatccccaga aaggcgaagt gcttttcgac gtgctacca tcaacggcga  
 4681 caacgcggag gtctgctatc aggcgatcaa ggtcgggcca ctcaagcggc cgcgcaagct  
 4741 ggtgctgtcg cagtttccga acctgttcac ctacaagtgg gttttcatgc gcgggaccag  
 4801 ccaggagcgc gtgctggcgc aggggaccat cgacaccgac gtcgccacca gcaccatcga  
 4861 cctgaaaacc tgccgtata cctcgcagac ggtcagcctg cccatcatcc agcgttccgc  
 25 4921 gttgaccggc gtcggtacga ccctggggat gaccgatttc cagatgccgt tctggtgcta  
 4981 tggctggcca aaggtatcgg tgtacatgag cgcgacgaag acgcagaccg gcgtagacgg  
 5041 cgtggcggtt ccggcgaccg gccaggcggc cggcatggcc agcggcgtag gcgtccagtt  
 5101 gatcaacggc aagacgcagc agccggtcaa gctgggcctg cagggcaaga tcgccttgcc  
 5161 cgaggcgcag cagactgagt cggcgacggt ctgcgtgccc atgaaggcgc agtactacca  
 30 5221 gacctcact tcaacctcg cgggcaagct gtccgtcacc tacgccgtga  
 ccttgaacta5281 tgactgacgc aacgaaccgt ttccggccgg gcctggttg tcgggcgctg  
 gtccgggcag  
 5341 gcctgctggt cgcggtggcc gcctgtgcgc aggcgcagct gctgccgggc gcgcgcgacc  
 5401 tcaaccgtat cgacgatcgc cagcgaagg agcagctgca g

35

### SEQ ID NO: 85 *Borrelia hermsii* isolate YOR factor H binding protein (fhhA)

MQLTKKYLLVIFLLLSLASCDLFNKNKKLDADLLKTLNLLKTL  
 DNNQKQALIYFKDKLQDKKYLNDLMEQQKSFLDNLQKKKEDPDLQDRLKKTINSEYDE  
 SQFNKLLNELGNAKAKQFLQQLHIMLQSIKDGTLTFSSSNFNDLQNLQKKERALQY  
 40 INGKLYVEYYFYINGISNADNFFETIMEYLKT

NVD008BWO

**SEQ ID NO: 86 Nucleic acid sequence encoding SEQ ID NO: 85**

1 atgcaattaa caaaaaaata ttactagta atttttttat tattaagcct tgctagctgt  
 61 gatttattca ataaaaacaa aaaattagat gctgatttac taaaaactct tgataattta  
 121 ctaaaaactc ttgataataa tcaaaaaacaa gctctcattt acttttaaaga taaacttcaa  
 5 181 gataaaaaat atttaaataa tttaattgaa caacagaaaa gttttttaga caatttacag  
 241 aaaaagaaaag aagatcctga ttgcaagat agacttaaaa aaacactaaa ctctgagtat  
 301 gatgagagtc aattcaataa attacttaat gaacttgaa atgctaaggc taaacaattc  
 361 cttcaacaat tgcatataat gctacagtct attaaagacg gcacgcttac aagcttttca  
 421 tcttcaaatt tcaatgactt gcaaaattta gagcaaaaaa aagaacgggc attgcaatat  
 10 481 atcaatggta aattatatgt tgaatactat ttctatatca atggaattag caatgcagac  
 541 aatttttttg aaactataat ggaatattta aaaacttaa

**SEQ ID NO: 87 *Saccharomyces cerevisiae* Gpm1p protein Tetrameric phosphoglycerate mutase, mediates the conversion of 3-phosphoglycerate to 2-phosphoglycerate during glycolysis and the reverse reaction during gluconeogenesis**

15 MPKLVLRHGGQSEWNEKNLFTGWVDVKLSAKGQQEAAAGELLKEKKVYPDVLYTSKLSRAIQTANIALE  
 KADRLWIPVNRSWRLNERHYGDLQGDKAETLKKFGEEKFNTYRRSFDVPPPPIDASSPFSQKGDERYKY  
 VDPNVLPETESLALVIDRLLPYWQDVIKDLLSGKTMIAAHGNSLRGLVKHLEGISDADIKLNIPGTI  
 PLVFELDENLKPSKPSYYLDPEAAAAGAAVANQGKK

**SEQ ID NO: 88 Nucleic acid sequence encoding SEQ ID NO: 87**

ATGCCAAAGTTAGTTTTAGTTAGACACGGTCAATCCGAATGGAACGAAAAGAACTTATTCACCGGTGGG  
 TTGATGTTAAATTGTCTGCCAAGGGTCAACAAGAAGCCGCTAGAGCCGGTGAATTGTTGAAGGAAAAGAA  
 GGTCTACCCAGACGTCTTGTACACTTCCAAGTTGTCCAGAGCTATCCAACTGCTAACATTGCTTTGGAA  
 25 AAGGCTGACAGATTATGGATTCCAGTCAACAGATCCTGGAGATTGAACGAAAGACATTACGGTGACTTAC  
 AAGGTAAGGACAAGGCTGAAACTTTGAAGAAAGTTCGGTGAAGAAAAATTCAACACCTACAGAAGATCCTT  
 CGATGTTCCACCTCCCCCAATCGACGCTTCTTCTCCATTCTCTCAAAAGGGTGATGAAAGATACAAGTAC  
 GTTGACCCAAATGTCTTGCCAGAACTGAATCTTTGGCTTTGGTCATTGACAGATTGTTGCCATACTGGC  
 AAGATGTCATTGCCAAGGACTTGTGAGTGGAAGACCGTCATGATCGCCGCTCACGGTAACTCCTTGAG  
 30 AGGTTTGGTTAAGCACTTGAAGGTATCTCTGATGCTGACATTGCTAAGTTGAACATCCCAACTGGTATT  
 CCATTGGTCTTCGAATTGGACGAAAACCTGAAGCCATCTAAGCCATCTTACTACTTGGACCCAGAAGCTG  
 CCGCTGCTGGTGCCGCTGCTGTTGCCAACCAAGGTAAGAAATAA

**SEQ ID NO: 89 *Streptococcus pneumoniae* factor H-binding inhibitor of complementsurface protein PspC (pspC11.4)**

MFASKNERKVHYSIRKFSIGVASVAVASLFMGSVVHATEKEVTT  
 QVATSSNKANKSQTEHMKAQVDEYIEKMLSEIQLDRRKHTQNVGLLTKLGAIKTEY  
 LRGLSVSKEKSTAELPSEIKEKLTAAFEQFKDITLKS GKVAEQKKAKDQKEAKQEI

**NVD008BWO**

EALIVKHKGREIDLDRKKAKAAVTEHLKKLLNDIEKNLKKEQHTHTVELIKNLKDIEK  
 TYLHKLDESTQKAQLQKLIASQSKLDEAFSKFKNGLSSSSNSGSSTKPETPQPETPK  
 PEVKPELETPKPEVKPEPETPKPEVKPEPETPKPEVKPELETPKPEVKPEPETPKPEV  
 KPPEETPKPEVKPEPETPKPEVKPELETPKPEVKPELETPKPEVKPEPETPKPEVKPE  
 5 LETPKPEVKPEPETPKPEVKPELETPKPEVKPEPETPKPEVKPELETPKPEVKPEPET  
 PKPEVKPEPETPKPEVKPEPETPKPEVKPELETPKPEVKPELETPKPEVKPEPETPKP  
 EVKPELETPKPEVKPELEIPKPEVKPDNSKPQADDKKPSTPNNLSKDKQSSNQASTNE  
 NKKQGPATNKPKSLPSTGSGISNLALEIAGLLTLAGATILAKKRMK

10 **SEQ ID NO: 90 Nucleic acid sequence encoding SEQ ID NO: 89**

1 aatgagaaac gaatccttag caatggcggg aaagaatttg gagttgagaa tacaaaacga  
 61 ttaactatgg ctcatattgt tttttatctc tcttgcttgg ttgaggcaat ggtgcacaag  
 121 acaatttttg atggcatggg catggttggg ttagtcttgc ttatTTTTTc tatgctgatg  
 181 ttgatgttgg tgattcactt gttgggagat atttggacag tgaagcttat gcttgtcaat  
 15 241 aatcacaaat atgtagatca tatcttgttt aggacagtaa aacaccctaa ttacttttta  
 301 aatattttac ctgagttgat tggcttgacc ttgttgagtc atgcctatat gacttttgtt  
 361 ttagtTTTTc cagtttatgc agttattttg tatcgacgaa tagctgaaga ggaaaagcta  
 421 ttacatgaag ttataatccc aaatggaagc ataaagagat aaatacaaaa ttcgatttat  
 481 atacagttca tattgaagtg atatagtaag gttaaagaaa aaatatagaa ggaaataaac  
 20 541 atgtttgcat caaaaaacga aagaaaagta cattattcaa ttcgtaaatt tagtattgga  
 601 gtagctagtg tagctgttgc cagtcttttt atgggaagtg tggttcatgc gacagagaag  
 661 gaggtaacta cccaagtagc cacttcttct aataaggcaa ataaaagtca gacagaacat  
 721 atgaaagctg ctaaacaagt cgatgaatat atagaaaaaa tgttgagtga gatccaatta  
 781 gatagaagaa aacataccca aaatgtcggc ttactcacia agttggggcg aattaaaaacg  
 25 841 gagtatTTTgc gtggattaag tgtttcaaaa gagaagtcga cagctgagtt gccgtcagaa  
 901 ataaaaagaaa agttaaccgc agcttttgag cagtttaaaa aagatacatt gaaatcagga  
 961 aaaaaggtag cagaagctca gaaaaaagcc aaggatcaaa aagaagctaa acaggagata  
 1021 gaagctctaa tcgttaaaca taaggggcca gaaatcgatt tagatcgaaa gaaggcaaaag  
 1081 gctgcagtta ctgaacatct aaaaaaatta ttgaatgaca tcgagaaaaa tttaaaaaaa  
 30 1141 gagcaacata ccatactgt agagttaatt aaaaacttga aagatattga aaaaacgtat  
 1201 ttgcataagt tagatgaatc aacgcaaaaa gcccaactac agaaactgat cgcagaaaagt  
 1261 caatcaaaaac tagatgaagc tttttctaaa tttaaaaatg gcttatcttc ttcgtcgaat  
 1321 tcaggctcct ccaactaaacc agaaactccg cagccggaaa caccaaaacc agaggttaaa  
 1381 ccagagctgg aaacacaaaa accagaggtt aaaccagagc cggaacacc aaaaccagag  
 35 1441 gttaaaccag agccggaaac accaaaacca gaggttaaac cagagctgga aacacaaaaa  
 1501 ccagaggtta aaccagagcc ggaaacacca aaaccagagg ttaaaccaga gccggaaaca  
 1561 ccaaaaccag aggttaaacc agagccggaa acacaaaaac cagaggttaa accagagctg  
 1621 gaaacaccaa aaccagaggt taaaccagag ctggaaacac caaaaccaga ggtaaacca  
 1681 gagccggaaa caccaaaacc agaggttaaa ccagagctgg aaacacaaaa accagaggtt  
 40 1741 aaaccagagc cggaacacc aaaaccagag gttaaaccag agctggaaac accaaaacca

1801 gaggttaaac cagagccgga aacaccaaaa ccagaggtta aaccagagct ggaaacacca  
 1861 aaaccagagg ttaaaccaga gccggaaaca ccaaaaccag aggttaaacc agagccggaa  
 1921 acaccaaaac cagaggttaa accagagccg gaaacaccaa aaccagaggt taaaccagag  
 1981 ctggaaacac caaaaccaga ggtaaacca gagctggaaa caccaaaacc agaggttaaa  
 5 2041 ccagagccgg aaacaccaaaa accagaggtt aaaccagagc tggaaacacc aaaaccagag  
 2101 gttaaaccag agctggaaat accaaaacca gaggttaaac cagataatag caagccacaa  
 2161 gcagatgata agaagccatc aactccaaat aatttaagca aggacaagca atcttctaac  
 2221 caagcttcaa caaacgaaaa caagaagcaa ggtccagcaa caaataaacc gaagaagtca  
 2281 ttgccatcaa ctggatctat ttcaaatact gcacttgaaa ttgcaggtct tcttaccttg  
 10 2341 gcgggggcaa ccattcttgc taagaaaaga atgaaatagt gattgattca ttcaaaaatg  
 2401 tttgtaaaaa gtattcggct tagaaagaaa agagtctggg ataaaaagat tttgatttta  
 2461 ggaattcttt attataaatt tttaaaatcg atagattaga caaaaagcg aacaagacag  
 2521 aattctgagt gtcagataac tgattttgtt cgctttttat atttaatat atacttttgt  
 2581 cctaggctct tttttgcatt atactttttc taattgcaag agggcttcaa tctctgctag  
 15 2641 ggtgctagct tgcgaaatgg ctccacggag tttggcagcg ccagatgttc cacggagata  
 2701 gtgaggagcg aggccgcgga attcacgaac tgcgacgttt tctcctttga ggtaaatcaa  
 2761 tcgtttcaag tggtcgtagg cgatcttcat ctt

**SEQ ID NO: 91 *Leptospira interrogans* serovar Pomona lenA, or LfhA, (CDS 2418..3140)**

20 MNLKQGNKILKTIFLTLIGSVVCALYSCGDKKEEDNSELLLFL  
 LNSLGSSNNTSTPVVTSCKDASFCRTFIATNNGAGYNGNLGGISGADAKCAAASSSL  
 TGAYKALIVDGPTGRQVISALDGSVDKDWVLYSNKQYRRSDGTTITFTTNANSIVID  
 NLQNGIDSGAQKFFWNLGNNVGFLWEPLSNCNNWNSADGLITGQAGNTTELQADITP  
 EGAFTVDNHACNTNLNLLCVEQ

25

**SEQ ID NO: 92 Nucleic acid sequence encoding SEQ ID NO: 91 (CDS 2418..3140)**

1 aattaatggtt tttttaatat tcataagtgt acaatggtgg gctcagtatt attctgatgg  
 61 ctcggggtat ttggctcaaa gaatacacac cgcaaaaaat ccaaaagaag  
 cagaaaaggg  
 30 121 atctcttttg ttaacatag ccaattttat ggttcgcacc tggccttgga  
 tattaactgc  
 181 acttgtaacg ttagttgtgt ttcctttgca cgatccgaca aaatattttt  
 cagaaggatg  
 35 241 gatcgtaggc ggcgatcgtg aaatgggata tccgatttta atgaaattga  
 tattacccaa  
 301 tggaattttg ggaattgtat ttgcgagttt gatggccgct tttatgtcta  
 cggctgacac  
 361 tcatatcaat tggggtgcga gttatcttgt aaacgatttt tatttgagat  
 ttgtacatcc  
 40 421 aaaagcggac gataaaactt tggtgaaagc gagtagaatt gcagtagtca  
 ctatgtctat



5	481	catcgccatt	ttggtagcca	ctcagattca	atctatcgcg	aacgcttgga
	aatttttggtt					
	541	ggcatttgct	tccggaatgg	gattacctca	aatactaaga	tggatttggt
	ggaggactaa					
	601	cgcttggact	gaactttccg	gaatgatcac	cgcgttgac	ctttctatga
10	661	ttcttatcca	aatgttcgat	cggaatatct	tttattttgg	gttgcgatag
	gttctgttgc					
	721	ggtttcgac	ctagttacgt	ttttaacccc	gccggttcca	caaaacacgt
	tagacgattt					
	781	tataaaaaga	gttgatccta	tccgattttg	gaaaggagaa	gataataaaa
15	aaagactcga					
	841	ggatttttat	aaaaaatct	ttctttggct	tttaggaacg	gtcgctttat
	tttttggaat					
	901	gttttcttta	gggtattttt	tcttattaca	gttttggcaa	gggttctttt
	gtttgtttgg					
20	961	ttttgtgttt	ttagggatct	tgtattggaa	aaaagaattt	ggtagaaatt
	gataaattat					
	1021	agtaaaataa	aattattataa	taaactaata	ataaatattt	atcgtaaaat
	gtgtataaac					
	1081	ggtgcctagg	tatacathtt	gttcttgaat	aaattatttt	tcgaatcaaa
25	gacttttgta					
	1141	gcattagtcg	gtaatagagt	tttagcgaac	ttatattaac	gtaagaaaat
	cctagggtcaa					
	1201	ttttttcgta	aaaaaataga	tgtgggaact	actatgaata	ccaaaagaat
	catcggtccaa					
30	1261	tccgattttt	gcagccatct	ttaaaattta	aatcccagtt	taacatgagt
	tcgactgaga					
	1321	aaaaattttt	ctaaaagtat	aaattcctat	aatttttagaa	tttggttcgta
	aaatcgtgat					
	1381	ttgtaatagt	tcccacattt	tacaggcaaa	cctaaatttt	gtgtgagctc
35	gcatgcctga					
	1441	atatgacata	tttaattatt	ataaatttct	attttaaaag	ttgtaatagt
	tcccacattt					
	1501	aaaaaatcaa	tctatgaagt	tctgattcca	acttttttca	gcatcatggg
	ttttttatgt					
40	1561	cgaattcacg	ttaaatagtc	tttgaaaatg	tggaaactct	tgcaattttt
	aagagtgaag					
	1621	agctttttaa	aagtcagaaa	ctgcgtaaag	agacttacta	ctcgggtgca
	tgaagataac					
	1681	actaaaatta	acgcataatt	ccagcaagaa	tacaaagggt	ctcaaaaaact
45	aggcctaacc					
	1741	cagattttta	gcttttttgt	ggtagatccc	acattctaac	ttttaaaaca
	agttcacgat					
	1801	agtgttggtc	tgatatgtcc	gagtaagtaa	tctgtgggaa	ctaccatatt
	gggttttatag					
	1861	agagatttaa	agttgatttc	ttttaaagct	ttttggatgg	agacttgcag
	agaattccta					

	1921	taaaacccaa	cttaagaaac	aatgtctat	ataaaacagt	cattttaaca
	accaaaggaa					
	1981	aattataaat	tcattatata	taaatttcta	ataaatgatt	taatgaagtt
	tgtttataaa					
5	2041	tcaataacgt	atcgttttta	aaattcataa	gaacctattt	caaaggtaac
	tcaatggcac					
	2101	tgctctgcgg	atttttggac	gcgctgtaaa	tgggaaactt	tttataaaac
	aaggttttac					
10	2161	tttgataagt	caaaaaaagt	tttatttcca	gatgtagtct	gcatcttata
	aaacaaatct					
	2221	gttcaagata	taatataatg	tctttgttgt	aaactttact	gatagaactt
	aaaaaagttt					
	2281	tttccaatag	atcataaatt	tatttccaaa	aggtgagaaa	tactcacctg
	gatctggtat					
15	2341	ttagttctaa	gttcgtttga	ttttcttttt	aggttaaaag	tttttaaadc
	taaactcgaa					
	2401	aggataaatg	caaacgaatg	aattttaaac	aaggaaataa	aattttgaaa
	acaatatttc					
20	2461	taacattgct	tatcggatcc	gttgatgctg	ctctttattc	gtgtggggat
	aaaaaagaag					
	2521	aagataattc	agaactactt	cttttccttc	tcaattcatt	aggttcttcc
	aataatactt					
	2581	ctactcccgt	cgttacttct	tgtaaggatg	cttctttttg	tagaactttt
	atcgctacca					
25	2641	ataacggggc	gggttataat	ggaaacttag	gtggaatttc	tggagcagac
	gcaaagtgtg					
	2701	ccgctgcaaa	atcttctagt	ttaacgggag	cttataaggc	tttgattgtc
	gacggtccaa					
30	2761	cggaagaca	agttatttct	gcttttagatg	gatcagtaga	taaaaaagat
	tgggtccttt					
	2821	attcaaacia	acaataccgt	agaagcgacg	gcactacaat	tacctttact
	acaaacgcaa					
	2881	attctattgt	tatagataat	cttcaaaatg	gaattgattc	aggagctcaa
	aaattctttt					
35	2941	ggaacggttt	aggaaacaac	gttggaatttc	tttgggagcc	attatcaaac
	tgtaataatt					
	3001	ggaattctgc	ggacggactt	attacgggac	aggctggaaa	tacaaccgaa
	cttcaagcag					
40	3061	atataactcc	agaaggagct	tttaccgttg	ataaccatgc	ttgtaatacc
	aatctaaatc					
	3121	ttctctgtgt	agaacagtaa	gtttttcaaa	aacatcgccc	ttgaaagggc
	gatgtttgat					
	3181	ttctaaagct	tatataaatt	gcagaactta	cttttgagat	aaaagttcca
	tttctttaga					
45	3241	aagacaaagt	agagcgggtca	aatcaaaat	gggagaaacg	ttaggatctt
	tggaagattg					
	3301	tattgatgca	attatggatt	ctaaaagagt	tgaaa	

**SEQ ID NO: 93 *Actinobacillus actinomycetemcomitans* omp100 (CDS 602..1489)**

MTYQLFKHHLVALMVTGAISVNALAKDSFLENPSANLPQQVFKNRVDIFNNETNINENKKDIAINKANIAS  
IEK

5 DVMRNTGGIDRLAKQELVNRARITKNELDIRKNTKSIAENTASIARIDGNLEGVNRVLQNVDRSTENAAR  
SRANEQKIAENKKAIENKADKADVEKNR

ADIAANSRAIATFRSSSQNIAALTTKVDNRNTARIDRLDSRVNELDKVKNGLASQAALSGLFQPYNVGSLN  
LSAAVGGYKSKTALAVGSGYRFNQNVAAKAGVAVSTNGGSATY

NVGLNFEW

**10 SEQ ID NO: 94 Nucleic acid sequence encoding SEQ ID NO: 93 (CDS 602..1489)**

	1	gttcggggcgg	gtgggtgtccg	tgtacatgcc	gggacgcagc	tggacagggtt	cgagggtcttt
	61	taaaacggta	atttcgttgg	cggaataatt	cgttgtcata	atgggttaat	
		tcataaaatc					
	121	gggaagcaaa	attgcgcggg	attatagcaa	aaaacaacgg	aatttttaac	
15		cgcaacttta					
	181	tggatttggc	aaaaagtgcg	gtcgttttgg	cagggtgtttt	atttttttga	
		gtaatggctc					
	241	gtgtggtgat	agcttttaaa	aaggtctcgg	caggtaacta	ttttaaccga	
		ttaaaatata					
20	301	attttttttag	attataagtt	tggagggaaa	gatttaacct	tgtttaaaga	
		aggattaata					
	361	aatgggttttt	taatatgcaa	gattaagtat	tgtttctatt	ttagggtaaa	
		acaatagtcg					
	421	taacctattg	aattgataca	tttatattag	aagggtattca	tatttttttg	
25		tggtataaat					
	481	tcaagccgaa	aaggaggcat	gttaaatacag	actctttttt	aattttatta	
		tggaagaatg					
	541	gttttttcgat	ttcgaaaaat	tagactaaaa	attaaataac	tttatttttt	
		aaggatgaat					
30	601	tatgacatat	caattattta	aacaccacct	cgttgcttta	atgggtcactg	
		gtgcaatttc					
	661	tgtcaatgca	ttggctaaag	actcttttct	ggaaaatcct	tctgctaatac	
		ttccacaaca					
	721	agtcttttaa	aacagggtgg	atatttttaa	taatgagacg	aacattaatg	
35		aaaataagaa					
	781	agatattgct	attaataaag	caaataattgc	tagtatagaa	aaagatgtta	
		tgcgtaacac					
	841	tgggggggatc	gatagattag	ctaagcaaga	gcttggttaac	agggcaagga	
		ttactaaaaa					
40	901	tgagtttagat	attcggaata	atactaaatc	aattgcagag	aatacagctt	
		ctatagcccg					
	961	tattgatgga	aatctggaag	gcgttaatcg	ggtgcttcaa	aatgtagatg	
		tgagatctac					
	1021	cgaaaatgcg	gcaagatccc	gtgctaacga	gcaaaaaatc	gccgagaata	
45		aaaaagcaat					
	1081	tgaaaataaa	gcggataagg	ctgatgtaga	gaaaaacaga	gccgatattg	
		cagcaaattc					

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	1141	cagagcgcatt	gcaaccttta	gatcttcaag	ccaaaacatc	gcggcattaa
		cgaccaaaagt				
	1201	tgatcgtaat	actgcgcgta	ttgatcgatt	agatagccga	gtcaatgaat
		tagacaaaaga				
5	1261	agtaaaaaaac	ggtttggett	cccaagcggc	actaagcggc	ttattccaac
		cgtataatgt				
	1321	cggcagcctt	aacttgagtg	cagctgttgg	tggttataaa	tctaaaacag
		cactagcgg				
10	1381	tggttcaggt	tatcgtttca	atcaaaatgt	agccgcgaag	gccggtgtgg
		cagtaagtac				
	1441	caatgggtggc	agcgcaacct	ataacgtcgg	tttaaacttt	gagtggtaat
		tcacttaaa				
	1501	tgcggtcaga	attttaggtg	tttttggtg	catcaataaa	acaaaacccg
		ttttcaatga				
15	1561	aagcgggttt	ttttgtgttt	cgcgattaac	aattatttcg	caatgcgttt
		atattttaatt				
	1621	cggtgcgggt	taagggcttc	agcaccgaaa	gttttctttt	tccattcttc
		ataatcggag				
20	1681	aaattgcctt	cgtagaaggt	gactttgcct	tcacgcgcgt	aatctaaaat
		gtgggtggcg				
	1741	atacgatcta	agaaccagcg	gtcatgggaa	attaccatgg	cacagcccgg
		gaattccaag				
	1801	atggcatttt	ccagtgcgcg	caaggtttcc	acatcaagat	cgtaggttg
		ctcgtccaat				
25	1861	aacagcatgt	tgccgcgcggc	ttgtaataat	ttcgccaaat	gcaaacgacc
		acgttcaccg				
	1921	ccggagaggt	cgcccacacg	ttttgttga	tccacgcctt	tgaagtt

**SEQ ID NO: 95 *Borrelia burgdorferi* 297 plasmid cp18-2 orf28/p21 (CDS1..558)**

30 MNKKMKMFIVCAVFILIGACKIHTSYDEQSSGEINHNTLYDEQSNGLKLKKIEFSKFTVKIKNKDNNSNWT  
DLGT

LVVRKEENGIDTGLNAGGHSATFFSLKESEVNNFVKAMTEGGSFKTDEYYGYGKEQSNLDNGTSNKEIITK  
IEKIDGTKYITFSGNLIKDSGDKVAEYAILLEDLKKNLK

**35 SEQ ID NO: 96 Nucleic acid sequence encoding (CDS1..558)**

	1	atgaataaga	aaatgaaaat	gtttattggt	tgtgctgttt	ttatacttat	aggtgcttgc
	61	aaaattcata	cttcatatga	tgagcaaagt	agtggtgaga	taaaccatac	
		tttatatgat					
40	121	gagcaaagta	atgggtgagtt	aaaacttaaa	aaaatagaat	tctctaaatt	
		tactgtaaaa					
	181	attaaaaata	aagataataa	tagtaactgg	acagacctag	gaactttagt	
		tgtaagaaaa					
	241	gaagaaaatg	gtattgatac	gggttttaaac	gctgggggac	attcggctac	
		attcttttca					
45	301	ttaaaagaat	cagaagttaa	taactttgta	aaagcaatga	ctgaaggtgg	
		ttcgtttaaa					

361 actgatgagt attatggata tggaaaggaa caaagtaatt tagataatgg  
tactagcaat  
421 aaagagataa taacaaagat agaaaaaatt gatggaacta aatatattac  
attttcagga  
5 481 aataaaaatta aggattccgg ggataaagtt gctgaatatg cgatactact  
agaagatctt  
541 aaaaaaaaatt taaaatag

**SEQ ID NO: 97 *Borrelia burgdorferi* strain LW2 partial ospE gene for outer surface protein E strain LW2.**

MNKKMKMFIICAVFILIGACKIHTSYDEQSNGEVKVKKIEFSEF  
TVKIKNKNNSNNWADLGLVVRKEKDG IETGLNAGGHSATFFSLEEEEINNFIKAMTD  
GGSFKTSLYYGYNDEESDKNVIKNKEIKTKIEKINDTEYITFLGDKINNSAGGDKI

**SEQ ID NO: 98 Nucleic acid sequence encoding SEQ ID NO: 97 (CDS 107..>580)**

1 ttttgttaaa atgtaacagc tgaatgtaac aaaattatat atttaaactt ttgaaatatt  
61 gcattttatta tgtattgtgg tatgattagg acttatggag aaatttatga  
ataagaaaat  
121 gaaaatgttt attatttgtg ctgtttttat acttatagggt gcttgcaaga  
20 ttcatacttc  
181 atatgatgag caaagcaatg gagaggtaaa ggtcaaaaaa atagaattct  
ctgaatttac  
241 tgtaaaaatt aaaaataaga ataatagtaa taactgggca gacttaggag  
atttagttgt  
25 301 aagaaaagaa aaagatggta ttgaaacggg tttaaacgct gggggacatt  
cggctacatt  
361 cttttcatta gaagaggaag aaattaataa ctttataaaa gcaatgactg  
acgggtggatc  
421 attttaaact agtttgtatt atggatataa tgacgaagaa agtgataaaa  
30 atgtcattaa  
481 gaataaagag ataaaaacaa agatagaaaa aattaatgat actgaatata  
ttacattttt  
541 aggagataaa attaataaca gtgcgggggg agacaaaata

**SEQ ID NO: 99 *N.meningitidis* porA**

MRKKLTALVLSALPLAAVADVSLYGEIKAGVEGRNIQLQLTEPL  
QNIQQPQVTKRKSRI RTKISDFGSFIGFKGSEDLGEGLKAVWQLEQDVS VAGGGATRW  
GNRESFVGLAGEFGTLRAGR VANQFDDASKAIDPWDSNNVVASQLGIFKRHDDMPVSV  
RYDSPEFSGFSGVSQFVPAQNSKSAYTPAHFVQQT PQSQPTLVPVVGKPGSDVYYAG  
40 LNYKNGGFAGNYAFKYAKHANVGRDAFELFLGSGSDEAKGTDPLKNHQVHRLTG GYE  
EGGLNLALAAQLDLSENADKTKNSTTEIAATASYRFGNAVPRISYAHGFDFIERGKKG  
ENTSYDQIIAGVDYDFSKRTSAIVSGAWLKRNTGIGNYTQINAASVGLRHKF

**SEQ ID NO: 100 Nucleic acid sequence encoding SEQ ID NO: 99**

atgcgaaaaa aacttaccgc gctcgtattg tccgcactgc cgcttgccgc cgttgccgat  
 gttagcctgt acggcgaaat caaagccggc gtggaaggca ggaacatcca gctgcagttg  
 accgaaccgc tccaaaatat tcaacaacct caggttacta agcgcaaaag ccgcatcagg  
 5 acgaaaaatca gcgatttcgg ctctgtttatc ggctttaagg ggagcgagga tttgggcgaa  
 gggctgaagg ctgtttggca gcttgagcaa gacgtatccg ttgccggcgg cggcgcgacc  
 cgttgggggca acaggggaatc ctttgtcggc ttggcaggcg aattcggtac gctgcgcgcc  
 ggccgcgcttg cgaatcagtt tgacgatgcc agcaaagcca ttgatccttg ggacagcaat  
 aatgttgttg cttcgcaatt gggatatttc aaacgccacg acgatatgcc ggtttccgta  
 10 cgctacgatt ccccccgaatt ttccggtttc agcggcagcg tccaattcgt tccggctcaa  
 aacagcaagt ccgcctatac gccggetcat tttgttcagc agactcctca aagtcagcct  
 actctcgttc cggtgttgt cggaagccg gggtcggatg tgtattatgc cggctctgaat  
 tacaaaaatg gcggttttgc cgggaactat gcctttaaat acgcgaaaca cgccaatgtg  
 ggccgtgatg cttttgagtt gttcttgctc ggacgcggga gtgatgaagc caaaggtacc  
 15 gatcccttga aaaaccatca ggtacaccgc ctgacgggcg gctatgagga aggcggcttg  
 aatctcgcct tggcggctca gttggatttg tctgaaaatg ccgacaaaac caaaaacagt  
 acgaccgaaa ttgccgcgac tgcttcctac cgcttcggta atgcagttcc acgcatcagc  
 tatgcccatg gtttcgactt tatcgaaacg gtaaaaaag gcgaaaatac cagctacgat  
 caaatcatcg ccggcggttg ttatgatttt tccaaacgca cttccgccat cgtgtctggc  
 20 gcttggtgta aacgcaatac cggcatcggc aactacactc aaattaatgc cgcctccgctc  
 ggtttgccgc acaaattcta a

**SEQ ID NO: 101 Streptococcus pneumoniae G54 protein surface protein PspC**

MFKSNIYERKMCYSIRKFSIGVASVAVASLVMGSSVHATENEGTTQAPTSSNRGNESQAEQRRELDLERDK  
 25 VKKEVREYKEKKVKELYSKSTKSRHKKTVDIVNKLQINNEYLNKIIQSTSTYEELQKLMMESQSEVDKA  
 VSEFEKDLSSSSSSSGSSTEPEASDTAKPNKPTELEKKVAEAQQKVVEAEKKAKDQKEEDYRNYPTITYKT  
 LELEIAEFVDVKVEAELELVKVKAKESRDEKKIKQAEAEVESKQAEATRLKKIKTDRKKAEEEAKLKEAV  
 EKNAATSEQGKPKRRVVRGALGEQATPDKKDYFEKDFRPAFNKNQMVAIQESLNKLDGETKTPVPGAKL  
 TGEAGNAYNEVRDYAIKVVSENKLLSQTAVTMDLQMLTKLNDAMSKLREAKAKLVPEVKPQPENPEH  
 30 QRPTTPAPDTPKIPQPEGKKPSVPDINQEKEKAKLAVATYMSKILDDIQKHHLQKEKHRQIVALIKELDE  
 FKKQALSEIDNVNTKVEIENTVHKIFADMDAVVTKFKKGLTQDTPKEPDNKKPSAPKPGMQPSPQPEGKK  
 PSVPAQPGTEDKKPSAPKPGMQPSPQPEGKKPSVPAQPGTEDKKPSAPKPDMPSPQPEGKKPSVPAQPG  
 TEDKKPSAPKPGMQPSPQPEGKKPSVPAQPGTEDKKPSAPKPDMPSPQPEGKKPSVPAQPGTEDKKPSA  
 PKPDMPSPQPEGKKPSVPEINQEKEKAKLAVATEKKLPSTGVASNLVLEIIGLLGLIGTSFIAMKRRK  
 35

**SEQ ID NO: 102 Nucleic acid sequence encoding SEQ ID NO: 101**

ATGTTTAAATCAAATTATGAAAGAAAAATGTGCTATTCTATTCGAAAATTTAGTATAGGAGTAGCTAGTG  
 TAGCTGTTGCCAGTCTTGTTATGGGAAGTGTGGTTCATGCGACAGAGAACGAGGGAACTACCCAAGCACC  
 CACTTCTTCTAATAGGGGAAATGAAAGTCAGGCAGAACACGTAGAGAACTCGATTTAGAACGAGATAAG

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GTAAAGAAAGAGGTCAGGGAATATAAAGAAAAAAAGTGAAAGAGCTCTATTCAAATCAACTAAAAGTC  
 GACATAAGAAGACTGTAGATATAGTTAACAAGTTGCAAAACATTAATAACGAGTATTTGAATAAAATAAT  
 TCAATCAACCTCAACATACGAAGAACTACAGAACTGATGATGGAGAGTCAATCAGAAGTAGATAAAGCT  
 GTGTCTGAATTTGAAAAGGACTTATCTTCTTCGTCAAGTTCAGGCTCTTCCACGGAACCGGAAGCTTCAG  
 5 ATACAGCGAAGCCAAACAAGCCGACAGAACTAGAAAAAAGGTAGCAGAAGCTCAGCAGAAGGTTGAAGA  
 AGCTGAGAAAAAAGCCAAGGATCAAAAAGAAGAAGATTACCGTAACTACCCAACCATTACTTACAAAACG  
 CTTGAACTTGAAATTGCTGAGTTCGATGTGAAAGTTAAAGAAGCGGAGCTTGAAGTAGTAAAAGTGAAAG  
 CTAAGGAATCTCGAGACGAGAAAAAAATTAAGCAAGCAGAAGCGGAAGTTGAGAGTAAACAAGCTGAGGC  
 TACAAGGTTAAAAAAAATCAAGACAGATCGTAAAAAAGCAGAAGAAGAAGCTAAGTTGAAGGAAGCTGTT  
 10 GAAAAAATGCAGCGACTTCAGAGCAAGGTAAACCAAGAGGCGGGTAAAACGAGGAGCTCTTGAGAGC  
 AAGCAACACCTGATAAAAAAGATTATTTTGAAAAAGACTTCCGTCCAGCTTTCAATAAAAACCAGCAGAT  
 GGTAGCCATTCAAGAATCCTTGAACAACTAGATGGTGAAACAAAAGTGTTCAGATGGGGCTAAACTC  
 ACAGGAGAAGCTGGAAATGCCTATAATGAGGTCAGAGATTATGCAATAAAAGTTGTTTCTGAAAACAAGA  
 AACTTCTATCACAGACAGCAGTGACAAATGGATGAAGTGGCAATGCAATTAACCAAAATTGAACGATGCCAT  
 15 GTCTAAATTGAGAGAGGCTAAAGCGAAATTGGTACCAGAGGTTAAACCGCAGCCGGAATCCAGAGCAT  
 CAAAGACCAACAACCTCCAGCTCCGGATACCAAAACCAATCCCTCAACCAGAGGGTAAGAAACCAAGCGTAC  
 CAGATATTAATCAGGAAAAAGAAAAAGCTAAGCTTGCTGTAGCAACCTACATGAGCAAGATTTTAGATGA  
 TATACAAAAACATCATCTGCAGAAAAGAAAAACATCGTCAGATTGTTGCTCTTATTAAGGAGCTTGATGAG  
 TTTAAAAAGCAAGCTCTTCTGAAATTGATAATGTAAATACCAAAGTAGAAATTGAAAATACAGTCCACA  
 20 AGATATTTGCAGACATGGATGCAGTTGTGACTAAATTCAAAAAGGCTTAACTCAGGACACACCAAAAGA  
 ACCAGATAACAAAAAGCCATCTGCTCCAAAACCAGGTATGCAACCAAGTCCTCAACCAGAAGGCAAGAAA  
 CCAAGCGTACCGGCACAACCTGGTACTGAGGATAAAAAGCCATCTGCTCCAAAACCAGGTATGCAACCAA  
 GTCTCTCAACCAGAAGGCAAGAAACCAAGCGTACCGGCACAACCTGGTACTGAGGATAAAAAGCCATCTGC  
 TCCAAAACCAGATATGCAACCAAGTCCTCAACCAGAAGGCAAGAAACCAAGCGTACCGGCACAACCTGGT  
 25 ACTGAGGATAAAAAGCCATCTGCTCCAAAACCAGGTATGCAACCAAGTCCTCAACCAGAAGGCAAGAAAC  
 CAAGCGTACCGGCACAACCTGGTACTGAGGATAAAAAGCCATCTGCTCCAAAACCAGATATGCAACCAAG  
 TCCTCAACCAGAAGGCAAGAAACCAAGTGTACCGGCACAACCCGGTACTGAGGATAAAAAGCCATCTGCT  
 CCAAAAACCAGATATGCAACCAAGCCCTCAACCAGAGGGTAAGAAACCAAGTGTACAGAGATTAATCAGG  
 AGAAAGAAAAAGCTAAGCTTGCTGTAGCAACAGAGAAGAAATTGCCATCTACAGGAGTGGCGTCTAATCT  
 30 AGTTCTTGAGATCATTGGTCTCCTTGGTTTGATTGGAACCTTCATTCATCGCGATGAAAAGAAGAAAATAA

### SEQ ID NO: 103 *Streptococcus equi* protein Se18.9

MKKLVLARAPALVLTGATVSTGTVSANSSRYNYTGWNQGGYSWKYLRLRNKNPYSRRTLTEDYSQRKNE  
 AKDSIKELSKLRDKEKKNFADRIDALTDTYAISSILSEAKNNNDYLEFDKEYEALFNSNKKYLEIEKIK  
 35 DRVYFDEGYSARQGINDLKSLEN

### SEQ ID NO: 104 Nucleic acid sequence encoding SEQ ID NO 103

TACATGAGTGGTTATTCTTGTGTTTTGTAACACGCTATTAAAAGTATATTGAAGAAGCTTGAAGATAATAG  
 TAAAAATAAACCTAAACTTATTTAATAAATGGAGGATTTTTCACGTGAAAAAATTAGTTTTAGCCCGT  
 40 GCACCAGCACTGTATTAACAGGAGCAACTGTAAGTACAGGAACAGTAAGTGCGAATAGTTCAAGATATA

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ATTATACCGGTTGGAATCAAGGTGGGTACTCATGGAAATATTTGCGCCTAAGAAATAAAAATCCTTATTC  
 ACGTCGTACCCCTTACAGAAGACTATTCTGATCAAAGAAAGAATGAAGCAAAAGATAGTATTAAAGAATTG  
 AGTAAGCTTAGAGATAAAGAGAAAAAGAATTTTGCTGATAGAATTGATGCTTTGACTGACACCTATGCAA  
 TCAGCTCTATTCTATCAGAAGCTAAAAATAAGAATAATGACTATTTAGAATTTGATAAAGAATATGAGGC  
 5 TTTATTCAATTCAAATAAGTATAAGTTAGAAATAGAGAAAAATAAAGGATCGTGTGTACTTTGATGAAGGT  
 TACTCAGCTAGACAAGGGATTAATGACTTGAAAAGTCTGGAGAATTAAACAGTAGACAGATTTATTATTT  
 ATCAAAATAATCCAAGTCTATGTTTTAAGGAAGCTTATTAAGGTATA.

### SEQ ID NO: 105 *Pseudomonas aeruginosa* UCBPP-PA14 tufA

10 MAKEKFERNKPHVNVGTIGHVDHGKTTTLAALTKVCSDTWGGS  
 RAFDQIDNAPEEKARGITINTSHVEYDSAVRHYAHVDCPGHADYVKNMITGAAQMDGA  
 ILVCSAADGMPQTREHILLSRQVGVPYIVVFLNKADMVDDAELLELVEMEVRDLLNT  
 YDFPGDDTPIIIGSALMALEGKDDNGIGVSAVQKLVELDSYIPEPVRAIDQPFLMPI  
 EDVFSISGRGTVVTRVERGIIKVQEEVEIVGIKATTKTTCTGVEMFRKLLDEGRAGE  
 15 NVGILLRGTKREDVERGQVLAKPGTIKPHTKFECEVYVLSKEEGGRHTPFFKGYRPQF  
 YFRTTDVTGNCELPEGVEMVMPGDNIKMVVTLIAPIAMEDGLRFAIREGGRTVGAGVV  
 AKIIE

### SEQ ID NO: 106 Nucleic acid sequence encoding SEQ ID NO: 105

20 gtggctaagg aaaaattcga acgtaacaaa ccgcacgtca acgtcggcac catcggtcac  
 gttgaccatg gcaagaccac tctgaccgct gcactgacca aggtctgctc cgacacctgg  
 ggtggttccg ctcgtgcttt cgatcagatc gacaacgcgc cggaagaaaa ggcccgcggt  
 atcaccatca acacctcgca cggtgaatac gattccgctg ttcgtcacta cgcccacggt  
 gactgccccg gtcacgccga ctacgtgaag aacatgatca ccggtgctgc ccagatggac  
 25 ggcgcgatcc tggtttgctc ggctgccgac ggccccatgc cgcagaccgc cgagcacatc  
 ctgctgtccc gccaggtagg cggtccctac atcgctcgtg tcttgaacaa ggctgacatg  
 gtcgacgacg ccgagctgct ggaactggc gagatggaag ttcgcgatct gctgaacacc  
 tacgacttcc cggcgacga cactccgatc atcatcggtt ccgcgctgat ggcgctggaa  
 ggtaaagatg acaacggcat cggcgtaagc gccgtgcaga agctggtaga gaccctggac  
 30 tctacattc cggagccggt tcgtgccatc gaccagccgt tcttgatgcc gatcgaagac  
 gtgttctcga tctccggccg cggtaccgtg gtaaccggtc gtgtagagcg cggcatcatc  
 aagggtccagg aagagggtgga aatcgtcggc atcaaggcga ccaccaagac cacctgcacc  
 ggcggtgaaa tgttccgcaa gctgctcgac gaaggctcgt ctggtgagaa cgttggtatc  
 ctgctgcgcg gcaccaagcg tgaagacgta gagcgtggcc aggtactggc caagccgggc  
 35 accatcaagc cgcacaccaa gttcgagtgc gaagtgtacg tgctgtccaa ggaagaaggt  
 ggtcgtcaca ctccgttctt caagggttac cgtccgcagt tctacttccg taccaccgac  
 gtgaccggtg actgcgagct gccggaaggc gtagagatgg taatgccggg cgacaacatc  
 aagatggttg tcacctgat cgctccgatc gccatggaag atggcctgcg cttcgcgatc  
 cgcgaaggcg gccgtaccgt tggcgccggc gtggttgcca agatcatcga gtaa

40

**NVD008BWO**



**SEQ ID NO: 107 *Yersinia enterocolitica* YadA protein**

MTKDFKISVSAALISALFSSPYAFANNDEVHFTAVQISPNADPD SHVVI FQPAAEALGGTNALAKSIHSI  
 AVGASAEAAKQAAVAVGAGSIATGVNSVAIGPLSKALGDSAVTYGAASTAQKDGVAIGARAFTSDTGAVAV  
 GFNSKVDAKNSVAIGHSSHVAVDHDYSIAIGDRSKTDRKNSV SIGHESLNRQLTHLAAGTKD TDAVNVAQ  
 5 LKKEIEKTQVNANKKSAEVLGIANNYTD SKSAETLENARKEAFDLSNDALDMAKKHSNSVARTTLETAEE  
 HTNKKSAETLARANVYADSKSSHTLQTANSYTDVTVSNSTKKAIRESNQYTDHKFRQLDNRLDKLDTRVD  
 KGLASSAALNSLFQPYGVGKVNFTAGVGGYRSSQALAIGSGYRVNESVALKAGVAYAGSSDVMYNASFNI  
 EW

**10 SEQ ID NO: 108 Nucleic acid sequence encoding SEQ ID NO: 107**

ATGACTAAAGATTTTAAGATCAGTGTCTCTGCGGCATTAATATCTGCGTTGTTCTCATCTCCATATGCAT  
 TTGCCAATAATGACGAGGTTCA TTTTACAGCAGTTCAAATAAGCCCAAATGCTGATCCTGATT CGCATGT  
 TGTGATATTTCAACCAGCAGCAGAAGCCCTAGGCGGGACCAATGCTCTCGCTAAGAGTATCCATAGCATT  
 GCGGTTGGTGCTAGTGCTGAAGCAGCGAAACAAGCTGCAGTTGCTGTGGGCGCTGGTTCAATTGCAACAG  
 15 GAGTTAATTCTGTTGCAATTGGTCCTTTAAGTAAGGCATTGGGAGATT CGGCAGTTACTTATGGGGCAGC  
 TAGTACCGCCCAGAAAGATGGAGTAGCTATCGGTGCGAGAGCATTCACTTCAGATACTGGTGTCGCTGTC  
 GGTTTTAACTCGAAAGTTGATGCAAAAACTCTGTTGCCATTGGACACTCTAGTCACGTTGCGGTAGATC  
 ATGATTATTCAATTGCAATTGGGGATCGTTCTAAAAC TGACCGAAAAAATAGTGTATCCATTGGTCATGA  
 AAGCCTTAATCGCCAATTGACACATCTTGCGGCTGGCACTAAAGACACTGATGCAGTGAATGTCGCGCAA  
 20 TTAAAGAAAGAAATTGAAAAACACAGGTAAATGCAAATAAAAAATCAGCTGAGGTGCTAGGGATCGCAA  
 ATA ACTATACTGATAGTAAAAGTGCTGAAACATTGGAAAATGCGCGTAAAGAGGCTTTTGACCTGTCTAA  
 CGATGCTTTGGATATGGCAAAAAACACTCAAATAGTGTGCTAGAACAACTTTAGAAACTGCTGAAGAA  
 CATACAAATAAAAAATCAGCTGAGACGTTAGCAAGAGCTAATGTGTATGCAGACAGCAAGTCTTCTCACA  
 CACTACAAACTGCAAATAGCTATAACCGATGTGACTGTAAGTAATTCGACTAAGAAAGCAATCCGTGAATC  
 25 GAATCAATACACAGATCATAAATTCCGTCAACTTGACAACCGTTTAGATAAACTTGACACACGAGTTGAC  
 AAAGGTTTAGCCAGTTCAGCCGCTTTAAACAGCTTGTTCCAGCCATATGGTGTGGGGAAAGTAACTTTA  
 CTGCAGGTGTCGGGGGATATCGCTCTAGTCAGGCATTAGCAATTGGTTCTGGCTATCGTGTAATGAGAG  
 TGTGCGCACTTAAAGCCGGTGTGGCTTATGCCGGTTCCTCGGATGTCATGTACAATGCATCATTTAATATC  
 GAGTGGTAA

30