

Characterization of *Komagataeibacter* isolate reveals new prospects in waste stream valorization for bacterial cellulose production

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Supplementary figures

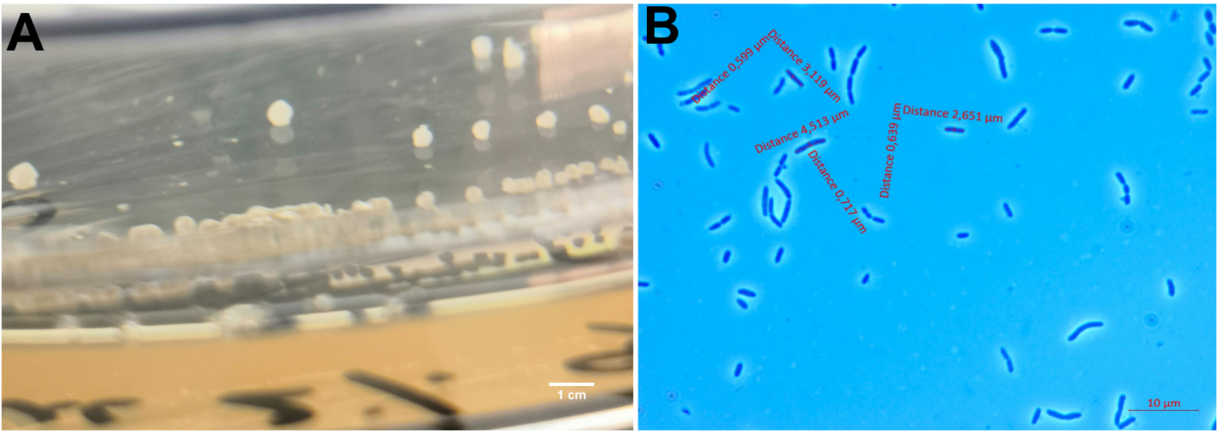


Figure S1: (A) Colony and (B) cell morphologies of ENS9b. The images were cropped and brightness and contrast were adjusted to improve clarity

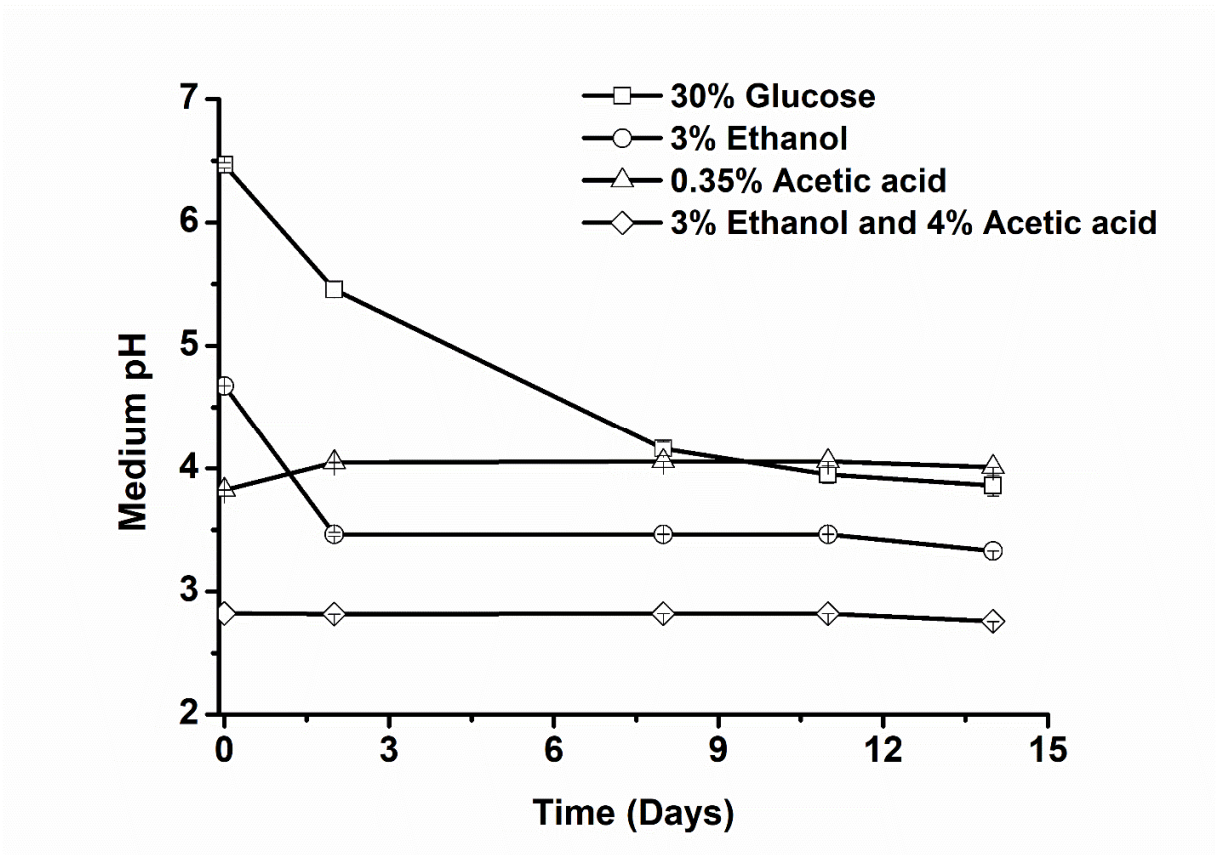


Figure S2: pH changes during cultivations in MA/9 containing 30% glucose and PY medium containing 3% ethanol, 0.35% acetic acid, 3% ethanol and 4% acetic acid. The cultivations were conducted at 30°C and 230 rpm for 14 days. Averaged values and standard deviations from duplicate cultivations are presented. In some cases, the error bars are smaller than the symbol

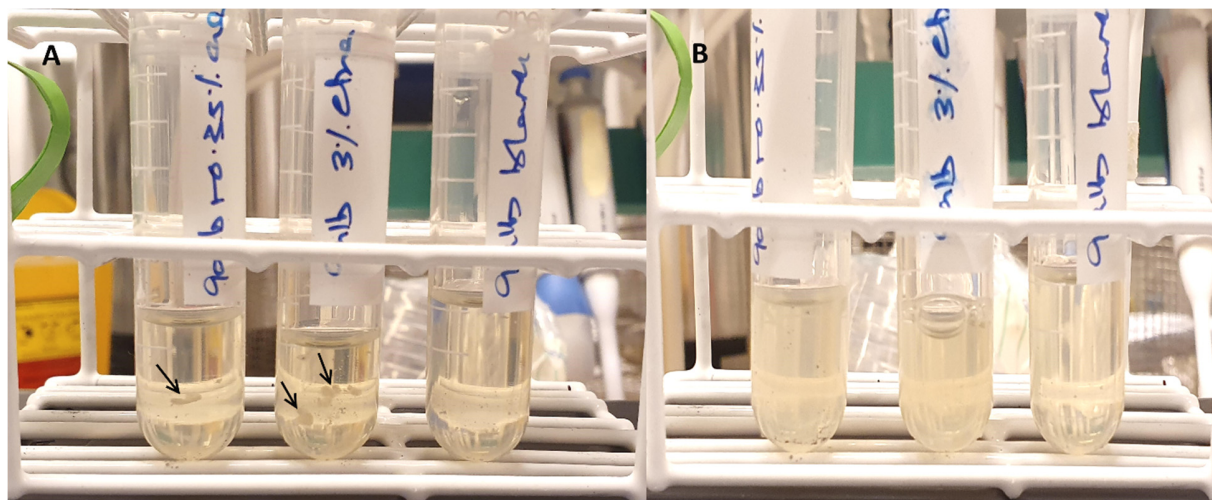


Figure S3. BC pellicle formation in PY medium containing 0.35% acetic acid, 3% ethanol and 4% acetic acid (A). Verification of BC pellicle, produced after 14-day cultivation in PY medium individually containing the above-mentioned carbons sources, were conducted using 1% cellulase. Lysis of BC pellicle and release of cells after the cellulase treatment is shown in B. The images were cropped and brightness and contrast were adjusted to improve clarity.

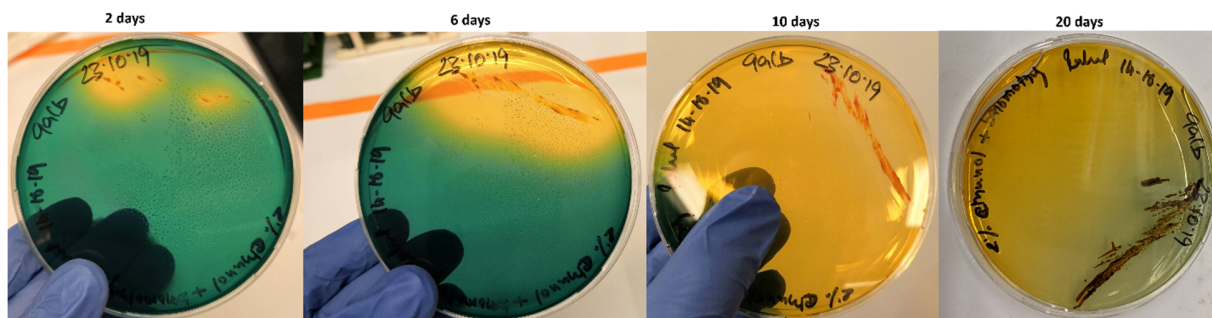


Figure S4: Overoxidation of acetic acid by ENS9B. Single colonies were streaked onto PY medium containing 2% ethanol and 0.0002% bromothymol blue as the pH indicator. Figures (from left to right) shows the acidification (blue to yellow coloration) and neutralization (yellow to blue) of PY agar during 2, 6, 10 and 20 days of incubation at 30°C. The images were cropped and brightness and contrast were adjusted to improve clarity.

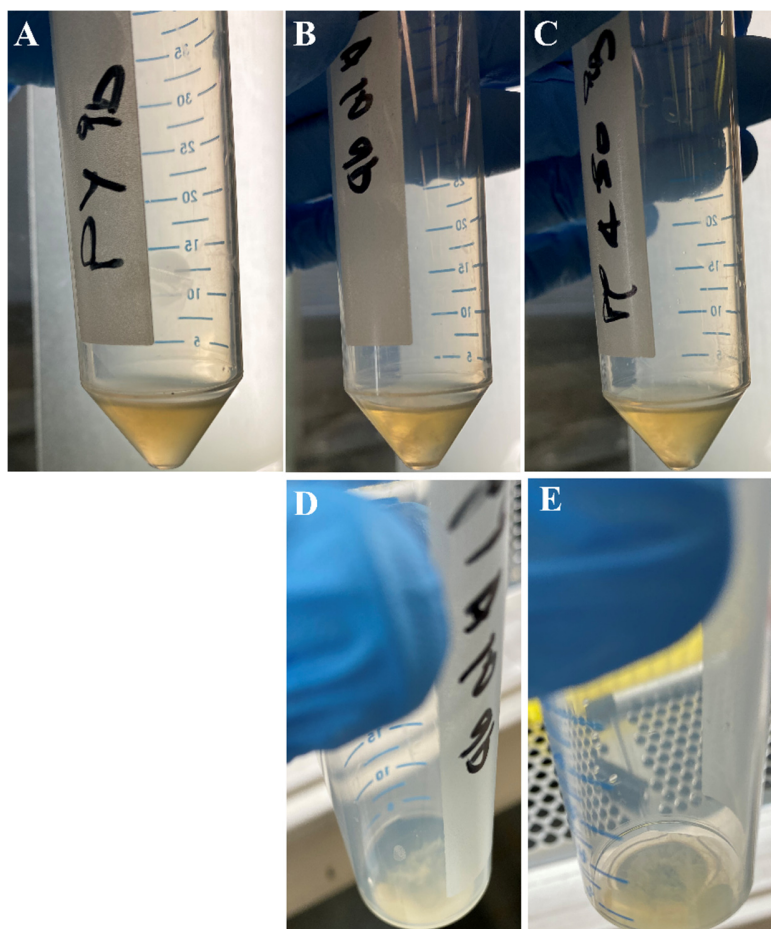


Figure S5: BC pellicle production by *K. rhaeticus* ENS9b cells statically grown in 50-ml tubes containing 10 ml (A) PY substrate control (i.e., devoid of acetate), (B) PY medium supplemented with 10-mM acetate and (C) PY medium supplemented with 50-mM acetate for 14 days at 30°C. (D) and (E) are the top-view images of sub-figures (B) and (C), respectively, showing the cellulose pellicles. The images were cropped and brightness and contrast were adjusted to improve clarity.

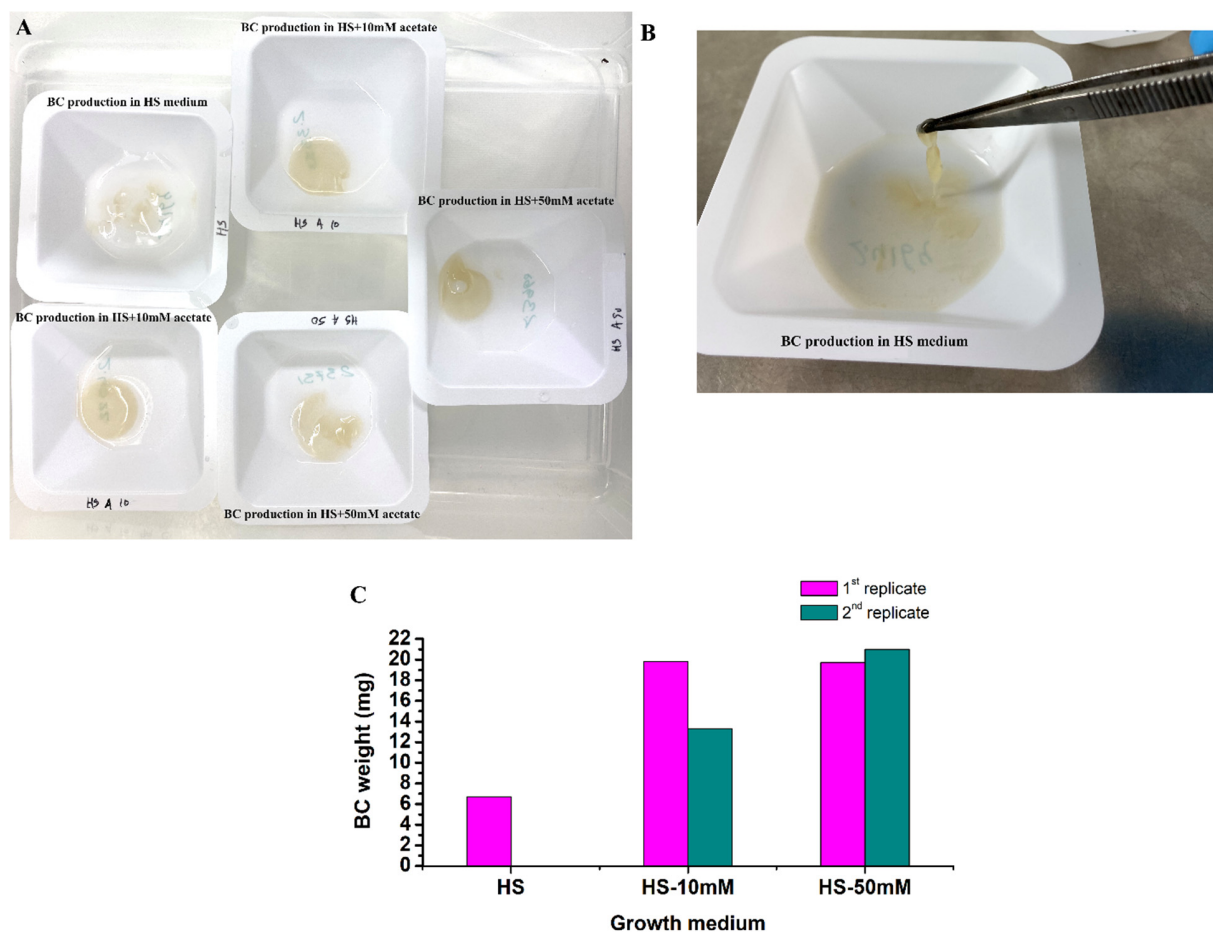


Figure S6. BC production by *K. rhaeticus* ENS9b cells grown statically in HS control (HS, without acetate) and sample (A10 and A50, medium containing 10-mM and 50-mM acetate) cultivation medium. (A) and (B) presents the pristine BC pellicles and the fragile pellicles produced from the control cultivation, respectively, placed on 46 x 46 x 8 mm pre-weighed weighing boats. The images were cropped and brightness and contrast were adjusted to improve clarity. (C) BC pellicle weights produced from HS medium with and without acetate supplementation. The BC pellicles produced from respective cultivations were collected and dried O/N at 60°C. The graph presents the BC weights (in milligrams) obtained from each replicate. The pellicles were not treated with alkali and MQ. Thus, the medium components present in the pellicles may alter the titers and thus, the BC weights are presented.

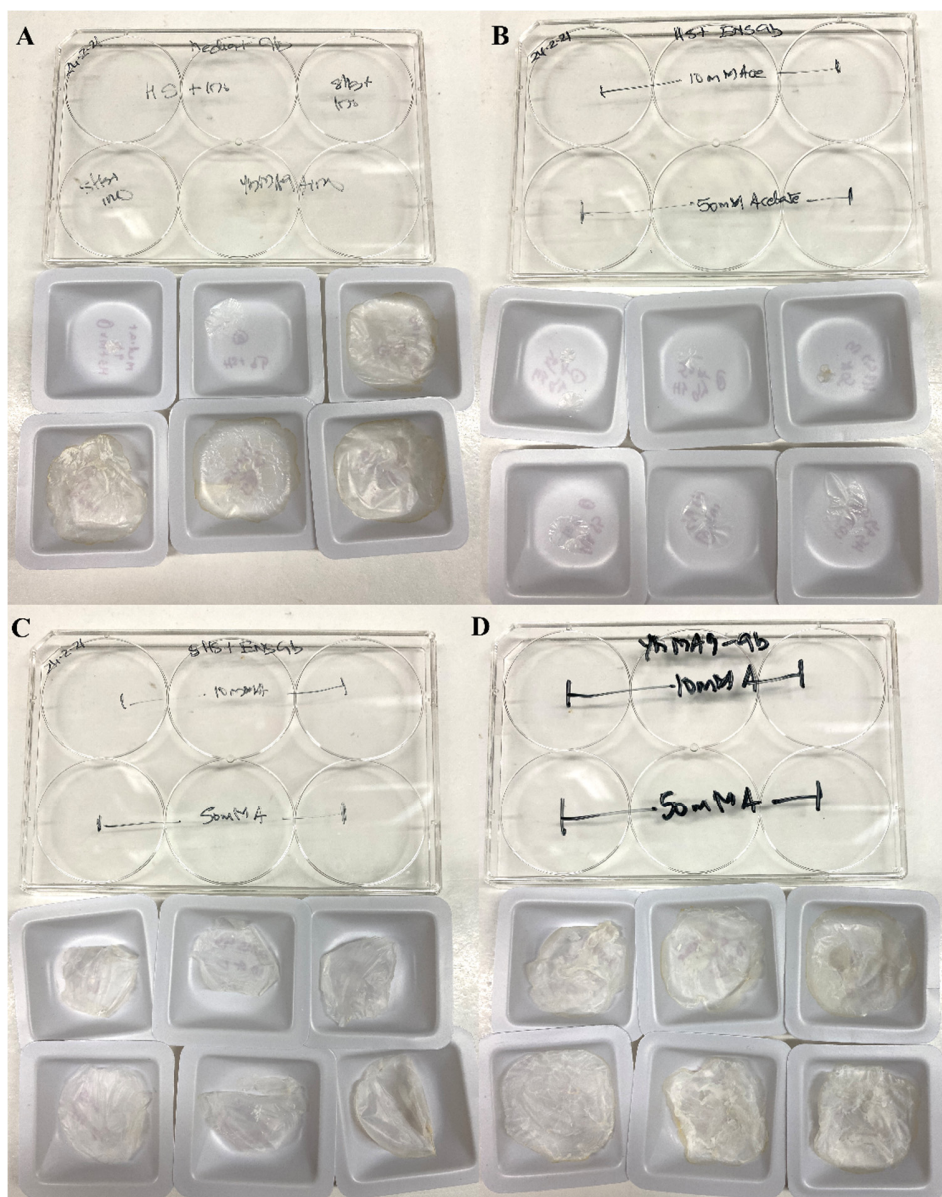


Figure S7. Dried BC sheets. BC pellicles produced by *K. rhaiticus* ENS9b grown statistically in (A) control cultivations devoid of acetate, (B) HS medium, (C) sHS medium and (D) YhMA/9 containing 10-mM and 50-mM acetate. The BC pellicles washed with alkali and ultra-pure water were placed on 46 x 46 x 8 mm pre-weighed weighing boats and dried O/N at 60°C. The images were cropped and brightness and contrast were adjusted to improve clarity.

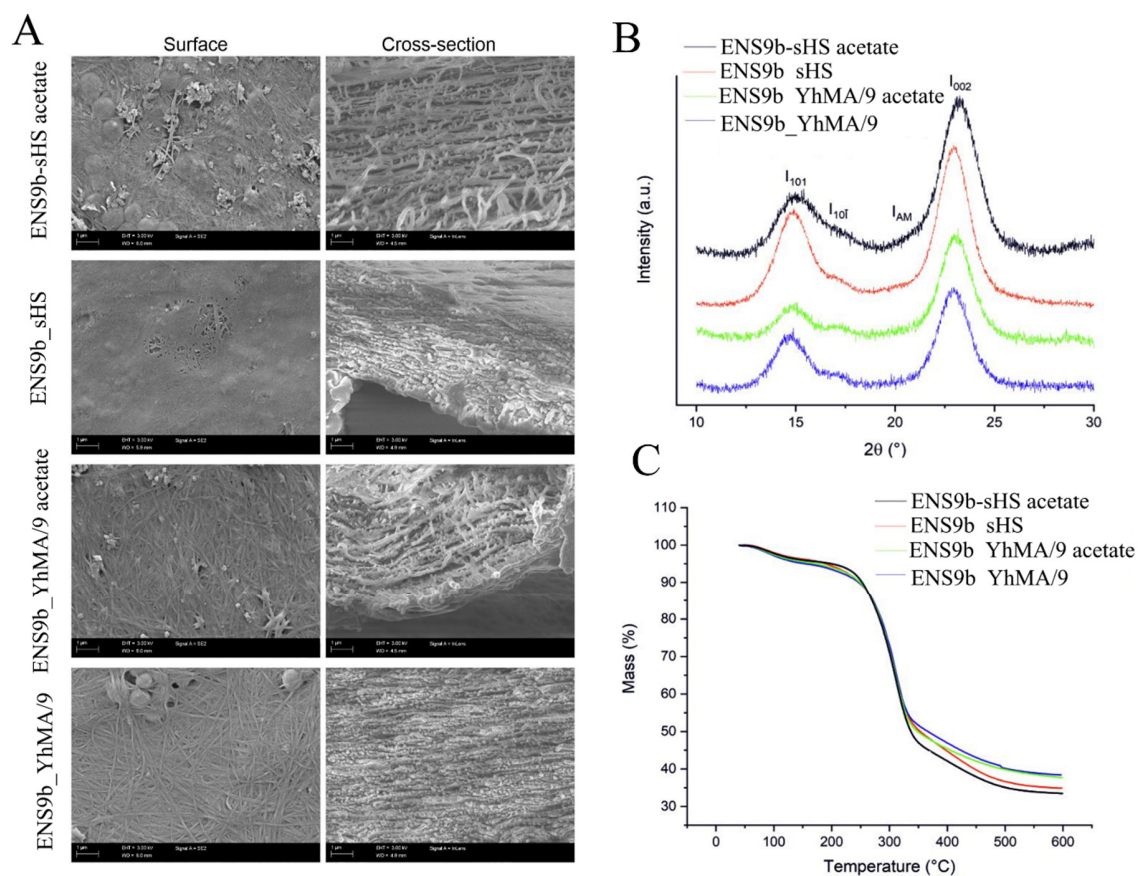


Figure S8. BC film characterization. (A) TGA (B) XRD diffractograms and (C) SEM analysis of BC films synthesized from acetate supplemented sHS, YhMA/9 medium and respective control cultivations devoid of acetate (ENS9b_YhMA/9 and ENS9b_sHS).

Supplementary Table

Table S1 General genome and assembly statistics of <i>K. rhaeticus</i> ENS9b genome	
Attribute	Value
N50 (shortest sequence length at 50% of the genome)	200461 bp
L50 (smallest number of contigs comprising of 50% of the genome)	6
Contigs unplaced in the genome	7 (90 kbp)
Bowtie2 mapping	94%
Chromosome	3645912 bp (GC content, 63.1%)
Origin of replication	At genomic position 1099952:1100308 bp
Number of protein-coding genes	3302
Number of repeat DNA	120
Number of rRNA	3
Number of tRNA	46
Number of gene annotations to KEGG orthology	1646
Predicted plasmids	5 [p9b_1 (18826 bp, GC 59%), p9b_2 (13375 bp, GC 60%), p9b_3 (9758 bp, GC 60%), p9b_4 (3007 bp, GC 66%) and p9b_5 (2295 bp, GC 67%)]

Amino acid sequences

Enzymes involved in carbohydrate uptake and metabolism

>Carbohydrate-selective porin 1, OprB family (encoding gene at position 1261539:1263020 bp)

MCVVVSFYCNLSWARKPVPDHAARTQSGLLVSQPHAEVRETPAAPHASVSTRLNSIFRTEGLSILLTNR
EDALRVRDLSAGYYASSEAPGHILPQIGALRSRLQNRGVTFQFTYKGEAMADVGGGISRGMMDYVHELT
LQTQFDLGRFLGFTGWTVHTLLMERVGREVS HDRVGDYNISLMEVYSLSGHSAHLTDMYAQKSFLH
NTVDLAFGRMALTHVFATSPLLCSFMMTCSAPVAIKLDAGFSVYPKATWGGRVRLRPTRDTLVQIGAY
SVSPLNEDISGWAWAGEKSTGLMIPVEFAWQPFPGPRKLPGHYVLGF AHDTRYADNIGDVPAGSAIR
PHGGEARDTFYLEADQMLYRKGGASQMAGGYVLAGYIHNTPDVSVISDEFYVGSLLGIIPHRPHDRF
GVMYSYRMSRPTLGGQQLRMDAGMALGVHVNPGQTHAAVLEAYYGVPVYPGILVQPEFQYMMRP
GETAHIPNAEVVGLKVICTL

>Carbohydrate-selective porin 2, OprB family (encoding gene at position 1287655:1289154 bp)

MCVIKTCANNENKSAIKWNFIPVRIRLLAVAVGMLFIGCTLTSEVLAQTETAKTAFTTHYDPAAFPMT
MGQVAIGPLVPMLTASPHLFGDWGGIQPWL TNRGIFLNVTVNEEYMGNV TGGRQRANVAAGQVAG
ALDIDWQRLAGVPSFWTHMLVVNGHGSSLSNAIGDSITNPEEY GARGNVVAHLVDMYADKGFLRDR
IILSVGVIPTGSFFNQDYLACSF MNVSVCGNPAPSKYVPGGRDWPSGNLGAVLRVRPTLR TYIMGGIFAV
SPHAYNGGISGWALGQDGLGKLSSQVEIGWSPSFRHLLGHYKIGYWDNSRYPNLYADINGNSFQ
ATGLPRRYESGMNAAWFLFNQMIHRSGDGLANGLVIGGADYTQGSQVAMRDHEWIGLLQSGTPWG
RPLDQVGAMFQYMEMGHTVTLQQESSLALGLPYLSNQWGAVYGIQSHENVWEAFYSIHVARGTAFQ
PDFQYLQRP GATTTFHDAAVIGFQFTTNL

>Carbohydrate-selective porin 3, OprB family (encoding gene at position 1433875:1435551 bp)

MTHSILTKRILAGPSRFVPPFHTPHGSMCRQGLCAASCALGMGLIFSTSGMAQTQIEEDRARLGNSTPLI
QQIDPANVRDSERAQADVEEKAAGDGDKLDTSGNLLGNMWGARPWLYKHGITFDIQEVDEVWGNG
TGGSASGNDGAGSGTG PAYDGV TMPTLTIDTEKLFGLKGGLFNVSALQTRGRSISQDHLANFNVPVSG
FEADRSTRLFELWYQQSFLKGTLDVKIGQQDLDT EFLISDYASLYLNANFGWPMAPSVNLYGGGPSWP
LASPAIRIRYRPSEKFTFMFAAADNPPGNRYNSTPIQQATGSVSGYNSDPTSQTYDGANGTNFNMGTG
ALLITELQYALNPQPADMSNVTKNPGLPGVYKLGGYYDTAKFADYRYNRNGGSLGAASVNP DSTESD
LTPRWDRGNWMVYGIIDQMIWRPSIRSARSVGIFARATGNSGDRNMISFAVDAGINLKAPFRGRDNDT
LGLGWGIGRASSGQRQFDRDSCSYVQGNENHLELTYQAQVTPWMVMQPDFQYIWHPSGGVADWTG
LRRVGNEAVFGLHSSITF

>Carbohydrate-selective porin 4, OprB family (encoding gene at position 2853448:2854926 bp)

MKYAIDTRMTRPFPRFLVSLPLFFLALFALCESASAQAIPGEGQGVVGAQPSLVNSRRNVSVNDPGSFF
SAPYGNQHFFGDWAGLQPFLLKHGVHIEADVHEELAGNFRGGAKQGVTDAGQVGEIDIDWHKLA
GAPKNFWTHTMIVNGHGRNASTDYIHDSL AGVQQIYGARGNVVAHLVYMYAEQSLFHNRLDISAGW
IPVGSFFAASPLFCDFMNV SICGNPAPGKYVPGGRDWPSGNLGVMRVMPTVD TYIMASMF AVSPHSY
NGGISGWSWAQSGLGKFSTPVEIGWLPEFGRNHLAGHYKAGYGYDNSQYNDLYSDINGNSAVLTGQP
FRKQSGVSTAWFQADQMIMRNGAGPTNGLILLAGYMYTSGKVSAMKDHTWAGIVETGAKWGRPLD

TVGAMFHYYEMSASILQQESSVLAGTPFLNNQWGKVGWGIQTHENVYEVFYNIHTARGMSFQPDFQYI
NRPGGTTTTYHDAAVMGLQFNCIL

>Carbohydrate-selective porin 5, OprB family (encoding gene at position 3040876:3042462 bp)

MKIPDPPPPRWTALSRLFLSCMLIGPCGATTAAHAQVPRTQIADDRARLGNSTPLIQQIDPATVRDSERA
QADAQAPPSADALDTSGSLLGNMGGARPWLYRHGISFDLQDVNELWGNATGGSASASDGAGGAGT
GPAYDGVMTPTLTIDTEKLFGLKGGLFNVSALQTRGRSISQDHLADFNVPVSGFEADRSTRLFELWYQHS
FLGGKLDVKIGQQDLDEFLISDYGALYLNANFGWPMGPSNLNYAGGPSWPLASPAVRVRYRPDETFT
FMFAAADDNPPGNSSNSFVIQNGGNRADPTSQTTNDGSGTQFNMGTGALLITELQYALNPQPADMG
ATRNPGLPGVYKLGYYDTARFPDYRYNMQGRPLGTYGGMPRQDRGNWLLYGIIDQMIWRPSLASPR
SLGVFARATGNSGDRNMISFAIDAGLNLKAPFRGRNNDTIGLGWIGGRASSGLREYDRTSGALLQGSE
NHLELTYYAQVTPWMVMQPDFQYVWHPSGRVADWSGLRRVGNEVVCGLHASLTF

>Carbohydrate-selective porin 6, OprB family (encoding gene at position 3439017:3440453 bp)

MSVPGHAQTIPVAARDVWQADEIPASESQDTPSAAGGSLLGDMGGLRPWLARYGMTLGIQDVNELW
GNATGGIASTSGDGRGAGTGASYIGVTMPDLTADLEKLMGLVGGTFNVSALQIRGRAITQDHLADFN
ISGFEADRSTRLFELWYQQSFLKDTLDIKIGQQDLDEFLISDYASQYLNASFGWPMGPSANLYAGGPS
WPLAAPAIRLRYRPGGNYTVMFAASDDNPSGNRDSNVFVGTSNPADPTSQTMNDGSGTQFNMGTGA
LLITEIQYALNPRSGDRPGAVRHAGLPVYKLGYYDTARFPDYRYNMQGGQSLGAYGGTPRWDRGN
WLIYGIVDQLIWRPSEGARALGVFVRATGNSGDRNIISFAIDAGLNLKAPFAGRTNDTLGLGWIGRA
TSGVRAYDRARGALVQGNENHFELTYAQVTPWMVLQPDFQYVLDPSGGLGNPSRPMRRIGNEAVF
GLHTNVNF

>Carbohydrate-selective porin 7, OprB family (encoding gene at position 3440518:3441825 bp)

MVVFLAVLSPAYAQTVPVSVPSAGVTPRQSVDPHDIPRTRLSGDWGGMRNWLLAQGIDIRISDTDELW
ANPVGGAQASENYIGSTAVEMVTDLHALTGALGTFDISAMEIRGRPFSNAPLYVFNQTSNIEADDNG
RLYELWYSQKFLRERLALRIGKLDLGHDFMVSSVGLTFLNASFSWPIMPNDNDLYDQGPVSPVTTPAIRLR
YTLSPRWNFLFAAADDNPVGGPFINVRDPWNQNRDPGGTRFSFSTGALFFGEVQYRRDISGRQGTYKL
GGYFDTGRFPDQSDFAKSHKTNWAVYGIVDQTLRHFGRITTLDAFIRGNWTADTDNRNQIVYAVDGGIA
LSAPFHRRGDVLGLGAGLGAASPCLAADRRSGLPAQGNEYHLELTYYAQVTPWFMLQPDIIQIVSPS
GGVLDDRGRRVHDEAIFGLHGSVTF

>Aquaporin Z_1 (encoding gene at position 1386137:1387120 bp)

MKYIEIHGKRRSAYPTCRSTLFPHPPCSFKNIRGLEKGQKAHSPFPSNDNKRIKWANMLKNRQFLGELI
AECIAVAIIVMIGDSVAAMYALYDPSPYKLAYWGVCIWGLSVTIAIYITGSVSGTHANPAVSVALALYR
GFPWRKVPAYCAAQILGGVIGAALVYTLYQPVIDHYNQLHALTRADGGAAGVFFTHPGEFITPFHAFV
DETILTGLLVFGIFAVTCEYNTVAPQANSALIIIGLLVASIGACSGYLEAWAINPARDFGPRLFCFLAGW
GDSALPGPDHFWVVPVAGPVLGGVLGAGCYQFLIRPFIPRQASPAVPPVS

>Aquaporin Z_2 (encoding gene at position 1847677:1848606 bp)

MRLPHLHLPYLHVHVHDRPLAGDPPHPNPFHWKLYFCETVATAILMVLGLSGVILLTAPGSPLSPPLL
HHPYVQTALCGLVFGLSGTAAAMTPFGKVSGAHINPSVTLAFSLAKRIGGVDALNYMIAQVIGAFLLT
AVVYGLGRLVTWWGSMVAVAVRYGATVPYGRISIWWAMWSEMFVTAALIAMLYWLAHPRWKFITP

WSGGLFFLIMNPFTAWLSGNSVNFARTLAPALFSGQWTGLWVYVVGPFAGASLAVMAIRMNLMGRL
HLL EARLVNFGHHGRVPGLD DPHRKL NHPDDPDHVPPGTGPA

>Aquaporin Z_3 (encoding gene at position 3161790:3162686 bp)

MTATRPPGGS AITDRPLAGAPHPDHPLHWKLYGCEMVATMVLMLCGIVSVTLLTTPQTPVGRMLAPH
PVIQTMLCGLFFGLAGTVAAAYTPFGRVSGAHVSPSVSLAFSLARRLGWVDLCGYVAAQMLGACLA AV
LLAGVGHVLPVWGKMAQDATAATVPFSGVAVVWPLVTEMVLTCLLVIMLCALAAHPVLKWFTPW
AGGVFFCLCNPVSAWLSGNSNLARSFGPAVVTGQWDSFWIYALGPFTGAAMAIWLLRSRLLGRIEVE
EARLVNFGHHGRIPSL LHPGRRMEGGPAKYD

>Quinoprotein glucose dehydrogenase_1 (encoding gene at position 1924182:1926572 bp)

MNTPLRSAPLLAA AIGVCALAGLYLLGGGLWLCAIGGSFYV VAGALLVTAFLFRRQAVALT VYAA
LLLGTMAWAVNEAGLDFWALAPRGDILVPIGIVLLL PWVTRHLQPATPGARLPLLGAIGA AVVIGAA
LMGDPQDIAGSLPPVAQNAPEPGDAHQMPDEDWQAYGRTQFGDRFSPLRQINTGNVSRLKVAWTFR
TGDMRGPNDPGEITDEVTPIKVRDTLYLCTPHQILFALDARTGKQRWKFD PQLQYNPTFQHLCRGVS
YHEDRVEAQADGAPAPAPAECARRIFLPTNDGQLFALDAESGARCASFGNNGVVDLRDGMPVRTLG F
YEPTSPPVVTDTTVIVSGAVTDNYSTHEPSGVTRGFDVHTGALRWAFDPGNPDPNEMPSEHHTFVPNS
PNSWITSSYDAKLDLIYPMGVQTPDIWGGNRGADAERYASAIVALNATTGRLVWSYQTVH HDLWDM
DIPAQPSLVDIRNEHGEVIPTLYAPAKTGNIFVLDRRNGQLVVP APEQPVPQGAAPGDHLSPTQPF SRTL
FRPSQKLTADMWGGTMFDQLVCRIMFHRLRYEGTFTPPSLQGT LVFPGNLGMFEWGGLAVDPERQI
AIANPIAIPFVSKLIPRGPNNPATPDRSLPSGSESGVQPQFGVPYGV DLHPFLSPLGLPCKQPAWGYMSGI
DLRTNKIVWKHRNGTIRDSAPLPLPIWMGVPSLGGPLTTAGGVAFLTSTLDYYIRAYDVTTGRVLWQD
RLPAGGQSTPMTYAVDGRQYIVTADCGHGSFGTKLGDYIVAYTLADQN

>Quinoprotein glucose dehydrogenase_2 (encoding gene at position 2594170:2596791 bp)

MRQDLPFESHAREIPRNPSGAACLHHA VQTRWPHTGIESIMFPRPIENFRKNAGMREGKQKLF SIITSAL
LALVGLFLFFGGAQLMVLGGSWFYVLAGCLLLAVAVTGVKAPQLAMRVYAAFLVVATI WALTETGFN
IWGLEVRLLAPIGFGAWMLLPWVWRSGGNWLADKRDMLGAIGLAVVVLVISCFTSYSIDGTVPDDRM
AAQQQADPAADGVADADWQAYGR TMGGDRYSPLAQITRGNVSHLKRAWVTRTGDVEQDGE GTVA
GPDQGHEFNLEVTPLKVGDTLYMCTPHSWVMALDATTGKV KWKFDPHPDTADLAKNVYLACRGVS
YYRIPDEIQTSCRTRIYSPVADV RIVALDAETGKPCDDFGDHGFISMRAYLGHVPHGFHFITS PPLVAKN
RLITGGWIFDNQANFEP SGAIRAFDATTGEIAWAWDAGHSPETWKP GPTDVLTRDTPNAWGVYTADP
ALGMVYIPTGNAPPDNW GGSRRPFDDATSSATIALDIVTGERRWTYQTVH HDLWDM DIPSGPSMVEL
PGPNGESIPALVQSTKRGEFFVLD RRTGAPVPGYPVEERPVP TAGAAPDDRVSPTQPYPAAMP SLTPPN
LKESDMWGATLLDQMICRIQYRQSAYEGQFTPPHVGR TTIVYPAFYGVVDWQGITIDPQRKIMLANAS
YLPFRIKLEKRQGLEGKGVLP RWNGQGE EPAAKGDALSVPDYGTPIYALTNPWL NPLQIPCKGPVWG
TIT AIDLVTKKIVWQHVPVGTTRDTGPFRT HNNLPLPTGMYNIGGSIVTRGGLVFMGATADDY LRAFDL
ATGKVIWTDRLPAGGQATPMSYEIGGKQYVLIAAGGHGGLGTRSGDYIIAYTL DGEKGAASAQ

>Glycerol uptake facilitator protein (encoding gene at position 1285133:1285972 bp)

MNRVFLGELISEALAVFIIIAFGDSVAAMYLLYDPSPYLHAYWGVCIWGLGVTVAIYATGSVSGTHAN
PAVTLALATYRAFPWKKVIPYWFAQIVGGFLGAALVYALYYPVIDHFNDMHQLARMSGGGAGVFFTA

PAPGITLWHAFSDEIILTAILVFGIFAITEQYNEMAPGANFGALIIGFLVAAIGASMGYLEAWAINPARDL
GPRLFAYVAGWHEAALPAAGHYWLVVPVAGPLIGLLGATAYEYLIYPFLPAQLRARQALQGKIAEETII
IGE

>Glycerol kinase_1 (encoding gene at position 1286008:1287507 bp)

MTDYVGAIDQGTSSRFMIFDRKGTIVSVAQKEHRQIYPRPGWVEHDPHIEILENTNEMIGAAMARANL
GAASLVSVGITNQRETAVLWDRRTGLPLHNAIVWQDTRVDQLVSEYGRDGGQDRFRAITGLPLASYFA
GLKLRWLLDNVEGARQKAESGQALFGTVDSWLSWNLTGGTRGGIHITDVTNASRTQLMNLKTCAWD
EDMLAAFSIPAACLPRIVPSSQVYGTITIPSLQGTKLAGILGDQQAALVGQTCFSPGEAKNTYGTGSFLL
MNTGTDPVQSKAGLLTTVAYQFGTEEPYALEGSIITGALVQWLRDNLKLFDLATQIEPLARSVADN
GGVYIVPAFSGLYAPYWKENARGVIVGLTRYVTRAHFARATLEATAYQVRDVVAAMEEDSGIVLRSLK
TDGGMVANELLMQFQADILNVPVVRPKVVETTALGAAYAAGLAVGYWKNIDDLRANWEVDRTWQ
PTMPPEQRARYLAWWKKAVQKSFDWAE

>Glycerol kinase_2 (encoding gene at position 1389048:13890547 bp)

MNKKNRILAIQGTSTRSIVFDRDIAALSVARVEFAQHYPNQGWVEHDAEEIWSNVLSTAREAIKV
GGPATIAGIGITNQRETIVVWDRKTGSPVHRAIVWQDRRTTPVCMRMHEQGYEPLVRERTGLLLDPYFS
ATKIAWILDNVEGARARAERGELACGTIDSFLLWRLTGGRVHATDTTNASRTLLFNIHTCAWDDELLA
LFNVPRAILPEVRTNSEIFGETEADLFGEPLKVAGMAGDQNAAMVGCACFKPGTAKATYGTGCFALL
NTGTTTPVNSENRMLTTIAYRIGDETVYALEGSIFVAGAAIRWLRDGLGLITHASQTDDMATRVPHSHGV
YMVPGFVGLGAPHWDPDARGLICGMTLGSTAAHIARAALSVAYQTLDLMEAMREDGGGKLNALRV
DGGMSVNDWFCQFLADMLQTPVERPRQVETALGA AFLAGLATGVWSSIPELEGTWTRGHLFRPTMD
KAQRDSMVAGWHLAVRRTLSTVAA

>Glycerol dehydrogenase_1 (encoding gene at position 1201435:1203437 bp)

MRRYRFLAMGMAAAWLCLPVSSHAQFAAAGSGGPPGASIPGPGRADPAEQTPADPGYFAGPSPYAP
QAPGVNAANLPDIGSVAADSLPAMLPQAGAAPAPGDWATYGRDDAQTRYSPLAQITPENVS HLQVA
FTYHTGSYPRPGQTNKWAAETTPIKVGDGLYMCSAQNDIMKLDPATGKEIWRRNLGEKEYEAIPTAAC
KGVTYFTSSQVPQGQPCHNRILEGTLDMLVAVDAATGEFCPGFGHGGQVNLMMQGMGESVPGFVAM
TVPPTVVNGVVVVNHQVLDGQRRWAPSGVVRGYDAESGRFVWAWDVKHPDDHDQPTGNRHYSRG
TPNSWAAMTGDDALGLVYVPTGNAAGDYFSGYRSAAENAVSTSIVALDVRTGSPRWVFQTVHKDVW
DYDMGSQVTMMDMPGTDGQTVPAIIVPTKRGQTFVLDRTGQSILPVEERPAPAGDVAGDTRAPTQP
WSVGMPSLHMPDLREQDMWGMSPIDQLYCRIFRRAHYVGEFTPPSLDRPWIMYPGNNGGSDWGSM
AYDPQTGILMMLREYGGKPLVEWLVL LLGVVIFLVGLVFVAGGAELALLGGS LYLLCGLVLLASGTA
MLMGRTLGALLYLAALAYTWAWSVWEVGFSPVDLLPRAFGPTLLGLPVLF SIPVLRRMATRRAIGGIC

> Glycerol dehydrogenase_2 (encoding gene at position 1673449:1676036 bp)

MSRTPMPRGLLLGATIITGLSCATALAQVPPADQPPGTGNATVPPAQPTPPADAFSAPSPNGPQAPGV
NAANIPDGPPAEPSEATPMVEQVVANPAHDDWPGYARDDRATRYSPLDQITPANISHLKRAFIYHTGS
KPGPGQV NKWAAETTPIKVGDGM MYMCSALNDMMRIDPATGKEVWHFHANEKYESIPYTAACKAVV
YYTSSTVPEGEHCHHRILEATLDERLIEVDSEDGKVCEGFGWHGMVNLMMKGMGESVPGFVAETAPPI
VNGAIITNQEILDGQRRWAPSGVIRGYDAETGRFLWAWDVNRPHEHGEPKEGEHYSRGTPNSWAAMI

GDNALGLVYVPTGNSAADYYSAMRSPEENKVSSAVVAIDVKTGEPRWVFQTVHKDVWDYDIGSQPTL
MDFTKPDGSSVPALIMPTKRGQTFVLDRRTGEPVLPVEERPAPSPGMVPGDPRAPTQPWSVGMPRLGF
APLKEADMWGMSPIDQLYCRLKYRRAHYVGEFTPPSIDKPWLEYPGYNGGSDWGSVAYDEKTGILIAN
WNNTPMYDQLVSRKKADQLGLMPVDDPNYKPGGGGAEGAGAMAETPYGIVVSPFWDEYTGMMCN
RPPYGMITAIDMHTQKVLWQHPLGSARANGPFGLPHTLPLTIGTPNNGGPVITAGGLIFVAATTDNMI
HAFDIHTGREVWNDVLPGGGQATPMTYEYKKGQYVAIMAGGHHFMMTPVTDDL VVYALDNVNMS
AFVTPQTPAGWATLGLAVIILLGLPLLYMGAELAFIGGSWYYVIVGLAVTVAGLLMAMGRVAGGLLY
LAAVAFTWLWALWEVGDLGWGLLPRVFGPTLLALGVLACLPVLKRAEAARSTLVREVA

>Dihydroxyacetone kinase (encoding gene at position 1848749:1850380 bp)

MKRFFNTRETIVTEALDGFLRSAAGQHLCRLDGYPDTCVIMQREPERGLVSVISGGGSGHEPAHAGFVG
RGMLTAAVCGALFASPCVDAIVAAILATTGEAGCLLVKNYTGDRLNFGLA AERARALGKQVEMVIV
GDDIALPDSATPRGVAGTVLAHKL AGYGAAQGWPLTRVAQFVRDGAGRMRTIGMALED CNPYEPGR
ASRLAADEAEGLGLIHGEPGAQRIALASASDLMRRVTETLEASLPATVRNTRFAVVLNNLGCVPEVEM
ALLLEAFSHTRLARRVSHVIGPAPLMTALDMNGFSLTIELDESITHALQAPAQPPAWPGMVPLGSPAV
APMPVMPDAFPYPASTDPTVRAMLEHGAKVLIANEAPLNELDGKIGDGDAGSTFAGAAREITAALDR
LPMADPHQLMTTVSNILTQHAGGSSGVLF AIMFSAAGRSRAPWREALREGLEHMMACGGAKPGDRT
MIDALYPAL EALARTGSLTDAALAARKGADATTTMETARAGRAAYVPSAHVRNVDPGAEAVARLL
EGLARG

>Triosephosphate isomerase (encoding gene at position 2116868:2117611 bp)

MKQIIVGNWKMNGLSADADALVDALATGLAALPARADVVCPPFTQLARLAPKLKAAGMALGAQD
CHKDRSGAHTGDISAPMLVDLGV EYVILGHSEERRAEHGELDET VREKAVAAMAAGLTPIVCVGENAD
QRDSGDSQEKVGVWQIQGSLPQGFTGIVAYEPVWAIGTGQAASQQDIADMSAFIRAELVRQFGEAGKTI
RILYGGSVNERNVTDILPVENV DGALVGNASLKADAFVPLVRAARAS

Enzymes involved in BC biogenesis

>bcsA1 (encoding gene at position 666919:669156 bp)

MSEVQSSAPAESWFDRLSNKILSLRGASYIVGAIGLCALLAATTVTLSVNEQLIVALVCVVVFFIVGRRKS
RRTQIFLEVL SALVSLRYLTWRLTETLDFDTWLQGT LGVTLLLAELYALYMLFLSYFQTISPLHRAPLPLSP
NPEDWPTVDIFIPTYDESLGIVRLTVLGALGIDWPPDKVNVYILDDGKREEFARFAEECGARYIARPDNA
HAKAGNLNYAIQHTSGEYILILDCDHIPTRAFLQISMGWMVEDKKIALMQTPHHFYSPDPFQRNLAVG
YRTPPEGNLFGYVIQDGND FWDATFFCGSCAILRRKAIEEINGFATETVTE DAHTALRMQRRGWSTAYL
RIPLASGLATERLVTHIGQRMRWARGMFQIFRVDNPM LGPGLKLGQRLCYLSAMTSFFFAIPRVIFLASP
LAFLFFSQNIIAASPLAVLAYAIPHMFH SVATAAKVNKGWRYSFWS EVYETVMALFLVRVTIVTMMFPS
KGKFNVTEKGGVLENEEFDLGATYPNIIFAVIMAIGLMRGLFALAFQHLDIISERAYALNCVWSVISLIIL
LAAIAVGRETKQIRHSHRVDARIPVTYDYEGNSSHGITQDVSMGGVAIHMPWRNVTPDQP VQTVVH
AVLDGEVVNL PATMIRCANGKAVFTWNITSLPIEASVVRVFGRADVWLQWNDYEHDRPLRSLWSLIL
SIKALFRKKGRMMIHSRPQNKPIALPVERREPTSSQGGQKQEGKISRAAS

>bcsB1 (encoding gene at position 669157:671572 bp)

MRPRDMKMVSLIALLVFATGAQAAPVASKAPAPQPAGDNLPLPAAAPAAAAAPAGQQPAGAASA
APAVDPAAASAADAMVDNAENATGVGSDVATVHTYSLRELGAENALTMRGAAPLQGLQFGIPGDQ
LVTSARLVVSGAMSPNLQPDNSAVTITLNEQYIGTLRPDP SHPAFGPLSFDINPIFFVSGNRLNFNFSAGS
KGCTDPSNGLQWASVSEHSELQITTIPLPPRRQLSRLPQPFFDKNVRQKTVIPFVLAQTFDAEVLKASGIL
ASWFGQQTDFRGVNFPVFSTIPQTGNVAVVGVADELPSALGRPAISGPTLMEVANPSPDPNGTILLVTGR
DRDEVITASKGIGFSSSTLPVAARMDVAPIDVAPRAPNDAPSFIPTSRPVRLGELVPVSALQGEGYTPGVL
SVAFR TAPDLYTWRDRPYKLNVRFRAPDGPVLDLARSHLDVGINNTYLQSYSLHEKDSVVDQLVQRFG
GRGQTSQVQQHTLTIPPWMVFGQDQLQFYFDAAPLTQPGCRPGPSLIHMSVDPDSTIDLSNAYHITRM
PNLAYMASAGYPFTTYADLSHSAVVLDPHNPNGTVVSAYLDLMGFMGATTWYPVSGLDIVSADHVND
VADRNLIVLSTLANSGEVSSLLSNSSYQIADGRLHMGMRSTLSGVWNIFQDPMAAINNTHTPTVEVETLS
GGVGAMVEAESPLASGRTVLALLSADGQGLDNLVQILGQRKNQAKIQGDLVLAHGDDLTYSRSSPLYT
VGTLPMPWMPDWYMHNPVRVIVVGLFGCLLVAVLVRALLRHALLFRRRQLQEERQKS

> bcsC1 (encoding gene at position 671575:675549 bp)

MNRRYVFSLSAGLLASSCMTVLVAVPLARAQQA STAMTGTQASGGSAA PRQILLQQARFWLQQQQY
DNARQALQNAQRVAPDAPDVLEVQGEYQTAIGNREAAADTLRHLQQVAPGSTAANSLDLLHERSIS
TSDLSQVRSLAASGHNAQAVQGYQKLFNGGKPPHSLAVEYYQTMAGVPAEWDQARAGLAGIVASN
QDYHAQLAFAQALTYNTATRMEGLARLKD LQGFRSQAPVEAAAASQSYRQTL SWLPVTPTTQPLMQ
QWLD SHPNDELREH MVHPPGGPPDKAGLARQAGYQQLNAGRIAAAEQSFQSALQINSHDADSLGG
MGLVSMRQGDAAEARRYFQEAMAADPKTADRWRPALAGMEISGDYAAVRQLIAAHQYDAAKQRLS
ALARQSGQFTGATLMLADLQRTTGQMGA AEQEYQSVLARDPNSQLALMGLARVEMAQGKTAEARQ
LLSRVGSQYATQVGEIEVTGLMAAASQTS DSARKVSILREAMAQAPRDPWVRINLANALQQQGDMAE
ANRVMQPILSNPVTAQDRQAGILFTY GSGNDAMTRRLLAGLSPEDYS PAIHAIATEMEIKQDLASRLSM
VANPVPLIREALSPPDPTGARGVAVADLFRQRGDMIHARMALRIASTRTLDLSADQRLAYATEYMKIS
NPVAAARLLAPLGDGSGTGAGNALLPEQVQTLQQLRMGIAVAQSDLLNQRGDQAQAYDHLAPALQ
ADPEATSPKLALARLYNGQGKSGKALEIDLAVLRHNPQDL DARQAAVQAAVN SGRKSLATRLAMDG
VQESPM DARAWLAMAVADQADGHGHRTISDLRRAYDLRLQQVEGTRAVASGTGEQESLEPPSSNPFR
HHGYGRQTEL GAPVTGGSYSMEATSPEASDQMLSSIAGQITTLREN LAPSIDGGLGFRSRSGEHGMGRL
TEANIPIVGRLPLQAGESSLTFSITPTMIW SGQLNTG SVYDVPRFGTDMATQAYNQYVSYISQNNSSSTL
HSELVKGGEAEAGFAPDVQFGNSWVRADLGASPIGF PITNVLGGVEFS PRVGPVTFRVSAERRSITNSVL
SYGGMRDPNYNTTLGRYARQLYGKELSSQWSEEWGGVVTNHFHGQVEATLGNTIVYGGGGYAIQTG
KHVQRNDEREAGIGVNTLVWHNANMLVRIGVSLTYFGYANNQDFYTYGQGGYFSPQSYAAATVPIRY
AGQHKRLDWDVTGSGYQVFHEHSSPFFPTSSLLQSGAQYIADSYVQNATSSDYLSQETVNSAAYPGDS
IASLTGGFNARVGYRFTHNLRDL SGRWQKAGNWTESGAMISAHYLIMDQ

> bcsD (encoding gene at position 675549:676019 bp)

MTTFNAKPDFSLFLQALSWEIDDQAGIEVRNDLLREVGHGMAGRLQPPLCNTIHQLQIELNSLLAMIN
WGYVQLELLPEDHAMRIVHEDLPQVG SAGEPAGTWLAPVLEGLYGRWITSQPGAFGDYVVT RDVD AE
DLNSVPSQTHILYMRTRSSN

> bcsZ (encoding gene at position 664722:665759 bp)

MGRRSFLSVMAAAGSIPFLSTALAADDPAINAQWAIKRAKYFHPDGRIIDTGNSESHSEGGYGMFLFA
ATAGDQATFEAMWSWTRANLQHKTDALEFSWRYLDGHNPPVADKNNATDGDLLIALGLVRAGRLW
KRADYIQDAIAIYGDVLKMLTLQVGPYLVLLPGGVGFATKDSVTNLNLSYYVMPSLMQAFALTGDARW
QKVMGDGLIINQGRFGEWKLPDWLSINRQNGHFSIANGWPPRFSDAIRVPLYLYWAHMLSPDLLA
DFTRFWNHFGASALPGWIDLNGARSPYNAPPGYLAVATCSGLSSAGGLPTLTKAPDYSAALTLVYI
ARGECCGM

>ccpAx (encoding gene at position 665756:666736 bp)

MTTPNKESTEATPRPVVMDNPQDVTRMLSSGYGLSGEGFHYHSFTRPVMLDMTPELPHDSVDDTEH
HLDDNVTEHESAPATAPVFVFDAPEPAAPPVVAEAPPPPPPPPEPAPPEPPAPPPYTPVVTHVPPP
PPVEETPVPEPVAEAAAPARPRVPPAQPAPDMASTGGRERRGLQPFAAPRAPSEPPVSSRAAAPATPF
VQADDWAPVPAQQRGQRPTGPGFFFAKGNDRVATARLFQPVAVARPAKPSKVTMTKFDKTA
QNAPTGRRPAPSDNSPTLTEVFMTLGGRTDRLVPKPSLRDALLRKREEETGQS

>bglX (encoding gene at position 676251:672452 bp)

MKPSRKSFLLSAVAWGLVAALPAHARHAATAGDPADDQARQVLAHMSLQDKMALLFSVDGGGFNG
SVAPPGGLGSAAYLRAPAGSGLPDLQISDAGLGVRNPAHIRPNGAAVSLPSGLATASTWDVDMARQA
GEMIGREAWLSGFNILLGGGADLTRDPRGGRNFEYAGEDPLQTGRMVGSTIAGIQSQHVISTLKHYAM
NDLETSRMTMSADIDPVAMRESDLLGFEIAIETGHPGSVMCSYNRVNDLYACENPYLLNTTLKQDWH
YPGFVMSDWGATHSSARAALAGLDQESAGDHADARPYFTALLAADVKAGRVPVARIDDMAQRIVRS
LFAAGLVAHPPQRGPLDVVTDTLVAQRDEEEGAVLLRNEGGILPLSPTARIAVIGGHADAGVISGGSS
QVDPIGGEAVKGPCKEWPDPVYFPSSPLKAMRAEAPNAHITYESGTNIAAAVRAARAADVAVVYA
TQFTFEGMDAPSMHLDANADALITAVAAANPRTVVVMETGDPVLMWPNSSVAGVLEAWFPGSGGG
PAIARLLFGKVAPSGHLTMTFPQAESQLAHPDIAAGVTADNVFEMQFKTDQELVYDEGSDVGYRWFD
NHLKPLYPFYGLTYTTFSTDGLAVHRHDAVTVTFTVHNTGNRPGVDVPQVYVGLPDGGARRLAG
WQRVSLAPGESRAVTVQLDPRLLAHFDGKKDRWSIPSGTFRLWLGTSAATDDSQASLHLSGRTFAP

>bglX2 (encoding gene at position 522700:524739 bp)

MKYASRLRYGLSALRCLIALCMGGLVLSALPVQARAAAGGSAGSAHAADMAARMQPAEQQAVLQAR
PIGGGEGATQAAADGLLAWPGVARLGLPALRMPDFSSPARPADEGGHPMLPWLALAAATWDPDLARR
AGGARARAEWEQGRAVVRVGGIDLLPSGRLQAGEDQVLAGTMAGMIGAGLLSGHVLPVFGSVAGDE
QARADGAVPGRTPAPVPAAWLADGSLLGVAMALEVAHGGALLCGGLAVCQTVTGLGAMVHDAWH
FPGMVMAATPGGLGPAPDDASLLPGALGTGVDMEQVSSREGGHDMFGAPLRQAVRDGAVRPAQLQ
AMGMHVLASFYMAGSLDHPPAFTPAHAAAAPPVADTLVSDVEAEGAVLLQENNRVLPFDPALGPVL
VLVRAPMRHAADLLADELRHAGLGVSVVVAADGANAPGTLPPATAQAARTLVLSGTDADNRMISTL
ADLGGHVVVVLTGDDPDRQMPWLDMDVSVVQAWAWRDAHARPLAALLSGQQEFSGLHPVTLTGG
FYPPGMVDADYRAFERAHVAPLFPFGYGLSARGHLTSLDLHVVRREGTHLNASFSVTNPDGTAVRAIPQ
LYVSPSSDQAAPRRLAAWRSIMVAPGHTLRLTLPVSLRLLAQWNAANWAVAAGDYAFSLGFSSVM
LVRHADVRLPAMHLPAALDMAAD

>bcsAB2 (encoding gene at position 1020008:1024567 bp)

MAQFVDKITRFMEQAATGRVPSWVPVIGVVMMSFVGSVALLPDMQGLISIGTVLLLLVLNRFKGRGITI
FLMMLSLVSMRYVWRLTSTIEFHGWIQSALSILLLLAEVYALSTLCLSYFQMAWPLGRKEHPLPEDTS
SWPHVDIYVPSYNEELSLVRSTVLGALKLDWPEDKLHVYILDDGRRVAFRDFALEAGAGYIIRSQNNHA
KAGNLNHALKITDGQFAVIFDCDHVPTRGFLKRTIGWMIADPKLALLQTPHHFYAPDPFQRNLVAGA
HVPPEGNMFYGLVQDGNDFWDATFFCGSCAVIRRSVVLGIGGFATETVTEDAHTALKMQRRGWRTA
YLREPLAGGLATERLILHIGQVRVWARGMLQIMRVDNPLLGRGLRWEQRLCYLSAMSHFLFAIPRVTF
VSPLAYLFLGQNIIAASPLAISVYALPHIFHSILTLSRIESRWRYSFWSSEIYETSLALFLVRITIVTLLQPHKGT
FNVTDKGGLLEKSYFDVGAVYPNVILAVILFAAFLRGIFIVWQFHDRLALQSFALNTLWVVISLIIVLAS
IAVGRETRQTRAAPRIAVALPVRITDMEGRSFAGHTRDISLGGGLGVDLHWPADVARPDRVMMMEYVNE
RDGIHATVPATVLALDERSMRLQWERRDLEDESQIVDMVFGRNDWANWADFEPDRPLRSIAMVLR
IGGLFKWQAREIPRHVADDEEAKAPVVEAKLEKQSLVLKPVRRSARNGAAASAVLLVALAALSPVAM
AQVQPAASASVPDQGTGVSATPFGDSNTGTVPDMIPVIDQAAADRISDSEVTRTSLFRNLGATSGPLTLR
GYSPLQGLDVIVPANRVVTHARLSISGALSPSLLPEASAVTVTLNEQYIGTIKVDPEHPQFGPLTFDIDPLY
FTGDNKLNFRFAGEYRRDCNDLFNEILWARISDMSQITLTTVRIAPERKLSRLPAPFFDPNLRSTLRVPV
LPDTNSKSSLKAAGLVASWFGKIADFRKLSFPVFTAIPASGNAVEVGENLPVDETGTRPRGPMLAEIAN
PNDRWGTLVVTGRNAQEVEAAARSLVFSADTLGGVAAKVDDVSLEARQPYDAPAFVPTDRLVRFG
ELVGAADLQGGGFTPAGMTLPFHLPPDLTYWRGRPFMLDMWIRAPGGPVVDLETSRVDVSLNNNYL
QSYTLSPPLWQRWSQRLVNLHAGAVGHHTALPTWLLFGQNQLLFNFDARPIDRGACRRTPGDIRMS
VDSSTLDFRRGYHFAELPNLSYFAEAAFPFSRMADLSETTVVLP SHVDAGTAGAFDLMGFFGASTW
YPAAGVQIMTADQVGAAQPGGDIVVLGTAEQLGSATSLLSRSPYVIRDGRIQVGEHMGQLQGIWYLFQD
RDHAGLKNGVTARLNAPIVEAGLMLAAQSPYDHARSVVAFGTGTPERIHDVLVSLRNKTDLP SLQGD
VIKNGNQFTSYRTAPTYTVGSLPLWVRADWYLSHHPALALYTLGLAGAALTALGVWGWLRRLSRRRIE
NEELAGEQ

>bcsC2 (encoding gene at position 1026603:1030553 bp)

MTRQYCPARGRQPAVAWRKAPAAWVMRPAACRPSSAWLAGGGWKIICGMVAGVIMAGEIAQAEP
WTAGPDSAASPAGGSTQITVTPDAGQNAANAHLAHAAAVLELLLNQGYWLGQHNLPKARETIQR
ALSIEPDNNEALFLLGRLQMAEGQTKLAAATLGRLIQNGNAPGLVADLRAQIHAGPIDPRGLAEARAL
AAEGKMMMPAMFKYRALFKNGDPPDLAMEYYRVLGATTLG YQEAATRLAAWVARNPRDLDAKLSL
DRILTYHVTSRDEGLEGLRQLARSNASAAIRDGAIAAWRDALLWEPVTGPTIALYNEWLDLHPGDAEII
DRRHKAQDAQNIIDGANYRQQGFVLLSRRNIEGAADLFHRLALAINAHDADSLGGMALVAQARQQPA
LARHYFQQAIQADPDSA AHWRAALKAMEAGGGGGMDPLVARI IQAINSGHYDAAQSDLALLGRRG
NTITLQALQGMLARRQGHMEEAERLYREILRRAPGNADALFN LGGILIETGREAEAQDIIARLAHIRPD
LARHLEVAGLSARSDRTRNNDKLSLLNRAMAMAPTDPWIRLKLARALDEAGNHAQAQAIMDGVTS
GRAVTPDDLQAAILYAMGRHDMARAEQLLARLPPGIESPGMARVAEQIELVRRIQELNRVPRAPNALL
VALADRPDPTGERGMRIANALLDRHAPQDAQQVLATEERLTQPPQPSQLLAYAGVYLR LHSAVDATR
CLNAFDAMARARPTDITADQQEIRNQIAIGLAIMTADGFNRYGQTARAYQVLAPVLQAH PDSAEHL
AMGRVYQTRNMARRALEEDQIALRLKPHNIYALAAARDAGGLHQMAEAKDYSTRLAHEDPDGPM
SWEVRSDIERIEGNTRAQLVDVEHARHAQCTLDGEGTCDGQHESFLPDYRWPEIDSNYINLHGATLPA
TYHYIPEDDGPEAMDRQIVYLRDSVSPQIDANSYVRSRTGTAGLQQLTEFAVPITGTL PFESWEHRLSFSI
VPTLLFTGNPLANPYSAHEFGTYAINGALPGSSHYYTQGVGLSLNYVNHWF SADVGSSPLGFPITNVV
GGVEFAPRLTRNLGLRISGGRRMVTDS ELSYAGMRDPGTGRLWGGVTRMFGHGALEWSEPTWNLYA

GGGFAYLGGTHVVDNTEVEAGAGGSATVWQSHDRQWLRVGLDLMYFGYKRDTYSFTWGQGGYFSP
QQYYGAMIPVEWSGHDRRWTWFLRGEAGFQHYHSNGAPYYPTDSALQALSVAHQPDDYYGDEGESGL
AGNIRGRVVYQFTHRLRLGMEGGYSRAGNWSETSGMWMAHYTFDGQ

>bcsAB3 (encoding gene at position 2139998:2144443 bp)

MIWRILKSPFVTGPLFALLMAVVSITYLTPDHQFFVAVGGGVLFLLVRRHDERWSRCFLMVLSIVVSGR
YLWVRFSTLDDLQSLVLALAVGEIYTTIRVGFTYFQLAWPLRRQIHPLPEDEGTWPVIDVYVPTY
NEDISIVRTTVLGCLSMDWPADRLNVYILDDGRRRAFRDFAGQVGAGYINRAENVHAKAGNLNHAIG
VTSGDIIAIFDCDHVPVRGFLKKTVGWMLADPNLALLQTPHHFYSPDPFRRNMSRGMQVPPESNLFY
LLQDGNDFWNATFFCGSCALLRRRAIVSINGFATETVTEAHTALRMQRKGWGTGYLREPLAAGLETE
TLLLQIQQRVRWARGMFQMLRIDNPMLGRGLRLTQRICYMAAAATNYFFAIPRMMFLLAPLAYLFLGVT
MIAASPYELAVYALPHLFHTTMTMSRLQGRWRYSEIYESMLAPFLVRMTFVTMIAPHKGSFNVT
KGGLLDRERFDWRASYPGVIVAVVLA VGLVSGIWAIVHYHETLVFRAMAVNSIWWLFSLIIVLGGVA
AARETRQRRHSHRVAASLPFELVDAQGQVHACRSVDVSMGGCQLDAATVPGAAGGRVMLRWSLPS
GPATMGATIIARCGRLHLQWVIAGLASERQVVALVFGRDDAWARWSDFPDRPLRSYLLVASICAL
FRPPPRVRDETPHAVARKTAAQDETLPQQVLVIPPDRTVVLRDIGTALVLAAMLLLPAMDARAQAAP
AMADAGPAVVADGSVDAIDNAHMTSADVDEVSHQPVTRTRTLADMGRTEDMVLARANAPLHGLSAG
VGRDIIITAARLGISGTARGAAGRVAVAVSINNQDAGVICPTADGAFGPVDLPLSPMFLDTRNRINFRLF
LRAPQPADPSAPACGPDARGRDGSAAQVSDPGVQVVISPRSTLTLTTVGLVPHRLLSALPYVLDPDAA
RTAAVTFVLPGGRDPAQLEAAGMVASWLGLQSRESGIHFNVAAIPPDQGSAAVAIAPGQPGPWGRAPA
GPALAVMPNPHDRFGTVLVVTGRTPAEVRTAAQALVLGAEHDAFGAFAAAPVVHPPARQPYDAPGV
VRTDRPVTRELVTAAALRTRGLTSGTLDIALSLPDLRSWRSRPFMARLQISAPEGGVLDRAKSRVSITL
NGTYLHSYPLVPLSLNPFRTPGAPVEHDLPLVWKMARHNELRLYFDVHPRHMTDAAAAASDAVVE
LDPSTIDFSKSRHFAVLDPVALFAASAFPFSRMADLSETTVLLPPHPADGTVGAFVDMMGFAGAISRY
ATGVTVRATDMPVDASVTGDILLSTLDGLGNGRAALARAGCVRAPSLARLARVTQGRDVPACDF
TQGALVAAQSPFAAQRSVVAVLGGTPDALSAMVRDLRDPADTPRFQGDMVIRHGARLDSYRTGGLYT
VGNMPAWMLPDWYLGGHPLLLCGLGGLAALCGTSCAMRVLGARSRRRILNDDLTGDL

>bcsC3 (encoding gene at position 2136184:2139981 bp)

MPDGFAMPCRAFMPVGRPVRRARMWGGVVLGALCLYMPRAEAQTPLRYAETILDGQIEEGAFWIHH
GDDMHALHALQRALRIEADNLEAGLMLGAVQVHQNDMAGARATLQALQAQPGAQAQVAALRGW
IGQAPIDPAALANARSAADTGKKLQATLLYRAVFQGAHPLPDMELEYDRVLSGSLSGYTEATQRLRAL
GALLPHDLEIRMALAQALSYRPATRPDAIEDMRQLATAATTPDFIRGEVMQSWRRRTLEWMGADPQAE
PYYQEWLALHPDDTEIASRLKAEQAARAQAARLALVGAGYHALAHGELEQAERDFSSSMGTDPPRPE
ALEGLGLVAQRRGDIPAARRWLEQARALAPDDAGIRNALAGLDAPGGDPQLARLWALVARHQYDE
AQAMLPAVEKDHGRIADTLRVRAIIAHARHELPRAEA WRAVLRLVPGDLPAAAALSDVLIIEGRITE
AEGWVARLRAAHYPGVTGLEAGVLGAMAENEPDQARRALLLEQALRDAPHNGWLRLHLAQLWLA
RGQATRARALMAPLCNLPPKTDDETQVCFAFALQDQDMPRADALLARLPRADITAQMADGVAQVR
LWHQISHLPDDAQAVPMLEHMPVVPDPEGTQARLVVNALLTRHAPVTAAAGVLHRLALADSAGHV
SVNQSLSYAGLFMQIDDPVAAQQVLDGLPAVARGRRLTPTQARDLRDMTRSLAIAQADRDDIGGHPD
AARRLLDPLLAQGPDDADLLARGRVEAALRQPAQAVVYDQKALAIRPDDTMAQAALARDSLASGH
EQAARAMARTLQATHPQWGDTWEIQAEIAGLDGRDRRLADVQRARALDCTPRDDGDDSTGYGTRI

DAGCAPYRAHAGDEWPDIGTNFVPGMGAGMPEVYHYDPSLTPVQALDRQADYLQRALVPQADGNL
EIRDRSGQPGLGHMTVVNIPMTAIVPFSSTQHQLALSVMPSVLMMSGDPLASGATAQQYGSVAAGGVRP
GFHVPAAVAGVALSAHYQWRWVAADV GSTPLGFTTTNVLGGIELAPHLTHSLTLRLTGERRAVTDSL
LAYSGARDPATGRVWGGVTRNRGHGQLEWAQPGYNLYAGGGYAVMQGHTTVANHEAEAGAGGS
GLLWHRQDAQHLRLGLDLVYFGYRRNTYFFTWGQGGYFSPHAFMAALVPLTYDGHAGRWTWLFRC
EAGYQHYTEHATAMFPLGEGGAMAGQRYAGQSTGGLAGNVLARAVYQLTPALRLGVEGGYSRSGS
WDEVHGMLMLHYAPG

>bcsAB4 (encoding gene at position 2248494:2253065 bp)

MLRELWLKWGGEALLTPRRQAWLIAALLMVVGAVLCVSVGDITLAPAEQAYISIGTITLFFILNRRPGR
HITCILMMLSLFVSFRYLIWRLGSTVEFHGPLQVAMSLALLGAEGYALSTLCLSYFQMSWPLGRKPHRLP
DDPADWPMVDVYVPSYNEDLELVRSTVLGAMDHLWHPADKLNVIYILDDGRRKAFRDFAVESGAGYIIR
AENNHAKAGNLNHAMQITKGEFVVFDCDHVPTRSFLLKTIGWLWADPKLALLQTPHHFYSPDPFQR
NLAAGYDVPPEGNMFYGLIQDGNDFWDATFFCGSCAAIRRSALLSVGGFATETVTEDAHTALKMQRK
GWGTAYLCQPLAAGLATERLILHIGQVRWRARGMLQIMRRDNPMLGGLRWEQRLCYLSAMSHFLF
AIPRVTFVLVSPLGFLFFGQNIIAASPF AIMVYALPHIFHSIMTSLRIEGRWRYSFWSEIYETSLALFLIRITIVT
LLQPHKGKFNVTDKGGLLARGYFDFSAVYPNAIMAILFGGMVRGIWGMIFQYHQKLAFQSFALNTL
WITVSLIVVLASIAVGRETRQIRHKPRVRVKLPVEVCFADGRVFQAHTTDISLGGAGVTMHLPEQIETPV
DITLRYSKPDDGIDIAVPARILGQQRGSWLHLQWKLDTLEEEREVSVSLVFGRSDAWHNWADFKDDRPL
NSIYQVIKSIGGLAPPYLWSLPSKGQEESSESVHKEETLEKKSLVIPPVPHRLGTGIIMLLVGAMLAIPA
RAQMPPGYSHTGVSHTLPLGDTNSGDIPATDTLDQKLADRVADAEITRTIAFRDLSRFPGPLTLRGFSP
LQGVDDVVVPANRVVTHATLHLSGAISPSLLPEATAITVTLNEQYVGTIRIDPAHPTFGPIEFSIDPLYFTGD
SKLNFRFAGEYRRDCNDLYNDVLWAQISDQSTITLTARIEPVRSLSRLPTPFDSNLKVAMRVPMVLP
SAMAPEVLRAGGLVASWFGRLADTRQLTFPVARTLPDTGNAIEIGPRIAIDDRGTPPSGPTLFEIANPND
KWGTILVVTGRTPAEVEVAARTLVFSPDTLGDLP GAVVEDVTLRPRVAYDAPSFIPTRPVRVFGELVTA
GDLQAGGFAPDTLHVFPFHLPPDLYTWHRLPFLMDLVWRAPGNPVVDIAASRLDVSNNNTYIQSYSL
NNNLWRIWSERMVTEHAGAVGHVTAIPPWLLFGQNDLQFQFDTRPVERGACRRTPDSPHLEIDSDSV
LDFRRGVHFTELPNLSYFAEIGFPFSRMADLGETTVVLPPAPD TDIGAYFDLMGFFGSVTWYPVSGIHL
ATTEDIAHTPPEGDVILLAPVGQMGAATLLSR SAYRIDGDHIRVGQQTGLQGIWYIFQDRDGSGLRN
GVTANLDMPVRNAALMIGSESPYASHRSVLALVGDNGIRIHELVASLHDPKVLPTIQGDLVIKNGEHFT
TYRTSPTYTVGHLPWWMWVDWFLSRHPMLMYLCGVTGAVMLGTGAWLWLRARARRRVKAQEKLD
EETARGEHH

>NAD-dependent malic enzyme (encoding gene at position 1377838:1379562 bp)

MSDTAHFPGQVPLHTALSGRELLDCPVLNKGNAFDRRERDLFGLHGLLPARIATLAEQVDLACMRLA
ALPDNFARHIALREIQDRNETLFYAIIDQAPESWLPIIYTPAIGRACQQFSQIWTRPRGLFLNYTDRGRIA
EILASPQWDGVRVIVASDGG SILGIGDQGANMAIPIGKLSLYTACGGLDPACALPVLLDVGTDNAALL
ADPDYIGWRHARVRGAEYDAFIAEFVTAVAARWPDIALHWEDLSGADALRILRRYRGS LCTYNDDIQ
GTAGVTAGALLAAIRAGAAPLADQRIVIFGAGGAGCGIADLLAQMMVRAGMAAHEARSRFFMVDIN
GLVRHGMIEGVTEGQMPFAQPADVAADWQVADPAHVTLAEVMAHVCPTTLIGTSGQGGAFTRQIVA
PMARQAARPVVFALS NPTANIEALPADLLEWTDGRAIIGTGGPFAPVTHAGRTRPVDQINN SYVFPGV

GLAVMAGGITRMTDGMFLAAADALAGLSPAVGAGGGHDAALLPPVSALRPVAMAVARAVIRQGQA
EGVAPAMPETGIGAMLAAAMWSPRYRPYEKTPPARP

>Pyruvate phosphate dikinase (encoding gene at position 2567253:2569928 bp)

MTKWVYSFGDGLNEGRADMNRNLLGGKGANLAEMAANGLPVPPGFTITTEVCSAFYENGRKYPDELK
AQVDAALQRVEQSMGLRFGDPEAPLLVSVRSGARVSMPGMMMDTVLNLGLNDQTVEGLARSSGDARF
AWDSYRRFIQMYGSVVMGVPHHHFEDVLEQFKRANNVEDDDTAITAGQWRAIVVDYTHIITHTGTDF
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