

NA32→ NA42→

BLLJ_1840 1 MKINNKGKGA¹IAA¹TTAAAT¹LLSCG¹----LAAASASAAGVDY¹LPTIGQVPTYTKFQPTAD

Ct1,3Gal 1 MVKKN¹VGLRFLS¹IL¹LLMALL¹IGNVQSFNVAAAEGV¹IVNGTQF-----

Sa1,3Gal 1 ----MILFALCLAFAGALTTAGPA¹----RAAAQTLTNGTQF-----

Fo1,3Gal 1 ---MMPRF¹FSTLLA¹VLAAS¹TVQ¹-----ASLD¹IVSGATW-----

Ss1,3Gal 1 -----ASFTL¹GATR-----

Il1,3Gal 1 ----MLWLRK¹VIPV¹FLSLV¹VAAR¹-----AETQ¹IVSGAAW-----

Pc1,3Gal 1 ----MQIFAH¹LLLPALS¹LLPAY¹-----AQNQ¹IVSGAAW-----

BLLJ_1840 57 PGKNASDYFQPYWYAKNANDNGG⁵⁷THIQAHGG⁵⁷QVVKVGD⁵⁷DAYWYGEDRSNGYD⁵⁷---NSPGV

Ct1,3Gal 43 -----KDT⁴³S-GNVI⁴³HAHGG⁴³MLKHG⁴³DYYYWYGEY⁴³RDDSN⁴³---LFLGV

Sa1,3Gal 34 -----TD³⁴T³⁴S-GNGV³⁴HAHGG³⁴VIKVG³⁴GYYYWFGEDRNADN³⁴---TFKYV

Fo1,3Gal 31 -----TA³¹TNT³¹GEHV³¹QA³¹HGH³¹GLIEVD³¹GTY³¹MI³¹GEDK³¹TDGT³¹---YFQNV

Ss1,3Gal 10 -----TD¹⁰QN¹⁰-GNT¹⁰L¹⁰QLHGL¹⁰GII¹⁰KVG¹⁰STWY¹⁰GF¹⁰GEDK¹⁰TGET¹⁰SSD¹⁰TS¹⁰FQDI

Il1,3Gal 31 -----TD³¹T³¹S-GNVI³¹QA³¹HGAG³¹ILKVG³¹STFY³¹WFGEDK³¹TENSA³¹---LFHAV

Pc1,3Gal 31 -----TD³¹TA³¹-GNT³¹IQAHGAG³¹ILQVG³¹STFY³¹WFGEDK³¹SHNSA³¹---LFKAV

BLLJ_1840 114 HAYMSTDLYNWTDLGVALRAVTSKSQLT¹¹⁴DKSNADYAYFDKAYNLT¹¹⁴TKSDGSVDAAKADAI¹¹⁴F

Ct1,3Gal 81 SCYRSKDLVNWEYRGEVLSRNS-⁸¹AP⁸¹ELNHCN-----

Sa1,3Gal 72 DAYRSTD⁷²LKNWEFRSHVLTQAG⁷²-ASELASAN-----

Fo1,3Gal 70 NCYSS⁷⁰TNLVEW⁷⁰TYRGALLSRTSEAGDLGPNR-----

Ss1,3Gal 52 PCYTSTD⁵²LSSW⁵²TYQGVALAKQA⁵²-SGDLG⁵²PSR-----

Il1,3Gal 70 SCYTSTD⁷⁰LTNWTRQSNALSPVA⁷⁰-NIMISSNN-----

Pc1,3Gal 70 SCYTSSDLVNWSRQNDALSPIA⁷⁰-GTMISTSN-----

*Glu196 (General base)

BLLJ_1840 174 PYLNTNPDQDGDGAVDSVQGI¹⁷⁴FERP¹⁷⁴KIIYNKKNQ¹⁷⁴YVLW¹⁷⁴WHS¹⁷⁴DGSTTPGG¹⁷⁴SNYARALAGV

Ct1,3Gal 111 -----I¹¹¹-ERP¹¹¹KVMYNAST¹¹¹GEFV¹¹¹M¹¹¹M¹¹¹HW¹¹¹E-----NGIN¹¹¹Y¹¹¹GQARA¹¹¹AV

Sa1,3Gal 102 -----I¹⁰²-ERP¹⁰²KVMYNAST¹⁰²GKFV¹⁰²M¹⁰²M¹⁰²M¹⁰²HK¹⁰²E-----NG¹⁰²T¹⁰²DYSEARA¹⁰²AV

Fo1,3Gal 101 -----I¹⁰¹VERP¹⁰¹KVIYND¹⁰¹QTKK¹⁰¹Y¹⁰¹V¹⁰¹LY¹⁰¹M¹⁰¹H¹⁰¹ID-----SPDY¹⁰¹KDARV¹⁰¹GI

Ss1,3Gal 82 -----I⁸²VERP⁸²KVIYNAST⁸²STY⁸²V⁸²M⁸²M⁸²H⁸²ID-----ST⁸²NYGDARV⁸²GV

Il1,3Gal 100 -----I¹⁰⁰VERP¹⁰⁰KVLFN¹⁰⁰KKNQ¹⁰⁰EY¹⁰⁰VM¹⁰⁰WF¹⁰⁰H¹⁰⁰SD-----SS¹⁰⁰NYGAAMV¹⁰⁰GV

Pc1,3Gal 100 -----I¹⁰⁰VERP¹⁰⁰KVIFN¹⁰⁰QKNSEY¹⁰⁰VM¹⁰⁰WF¹⁰⁰H¹⁰⁰SD-----SS¹⁰⁰NYGAAMV¹⁰⁰GV

(Modulator of general acid) *Asp274

BLLJ_1840 234 AVSDNPAGPFTMVGAYRLPNQNNWKEAAGNPSWGENGDSRD²³⁴MTV²³⁴FVD²³⁴PKD²³⁴-DSAYVLYSS

Ct1,3Gal 145 AYSKTPDGKFTYIRSF¹⁴⁵R-PMQDTGVM¹⁴⁵DHGLPGY¹⁴⁵----MSRDCNV¹⁴⁵FVD¹⁴⁵TDG¹⁴⁵---KCYFISAA

Sa1,3Gal 136 AVSD¹³⁶TV¹³⁶DG¹³⁶TY¹³⁶TW¹³⁶QGSF¹³⁶Q-PLGQ-----Y----MSRDITV¹³⁶FVD¹³⁶TDG¹³⁶---TGYMVSAA

Fo1,3Gal 135 ATGDSVCGK¹³⁵YTY¹³⁵HR¹³⁵SFR-PLGK-----QSRDMGL¹³⁵FKDD¹³⁵DG¹³⁵---SAYLL-TE

Ss1,3Gal 116 ATSS¹¹⁶TPCGPY¹¹⁶SYRGS¹¹⁶SFR-PMGN-----LSRDMN¹¹⁶LFQD¹¹⁶TDG¹¹⁶---TGYLL-SE

Il1,3Gal 134 ATAK¹³⁴TPCGPY¹³⁴TFKGS¹³⁴FK-PLGA-----DSRDEGL¹³⁴FQDD¹³⁴SAQ¹³⁴TAYLLYAS

Pc1,3Gal 134 ATAK¹³⁴TPCGPY¹³⁴TYKGS¹³⁴FK-PLGA-----DSRDESI¹³⁴FQDD¹³⁴SAQ¹³⁴TAYLLYAS

BLLJ_1840 293 E²⁹³ANATLYIAKLND²⁹³DYTN²⁹³VKTTNVDQSEGQKQYSADGQYPYILADATTDAPV²⁹³RGEDFQIV

Ct1,3Gal 198 NENMDLHLYELTPDYKNI-----ASL¹⁹⁸KAK¹⁹⁸LFV¹⁹⁸G-----

Sa1,3Gal 179 RENYDLQ¹⁷⁹TYRLTADY¹⁷⁹TGI-----DSL¹⁷⁹VAD¹⁷⁹PWH¹⁷⁹G-----

Fo1,3Gal 176 DREY¹⁷⁶GTRIMALSDDY¹⁷⁶LVN-----TE¹⁷⁶ITYE¹⁷⁶WQ-----

Ss1,3Gal 157 DRN¹⁵⁷GLHIYKLSADY¹⁵⁷LSV-----DS¹⁵⁷AVALL¹⁵⁷GGSG-----

Il1,3Gal 178 DNN¹⁷⁸QNFKISR¹⁷⁸LD¹⁷⁸NY¹⁷⁸YNV-----TA¹⁷⁸QASV¹⁷⁸LTG-----

Pc1,3Gal 178 DNN¹⁷⁸QNFKISR¹⁷⁸LD¹⁷⁸NY¹⁷⁸YNV-----TA¹⁷⁸QVS¹⁷⁸VM¹⁷⁸NG-----

*Glu359 (General acid)

BLLJ_1840 353 KQNGSLEAPAVFQYDGRYNI³⁵³IASGATGWAPNK³⁵³QTY³⁵³YTAD³⁵³SMLGN³⁵³WTRGVEKDDVNENTWY

Ct1,3Gal 226 ---Q²²⁶REAP²²⁶CLIKRNG²²⁶Y²²⁶YLITS²²⁶GCTGWNPNQAKYAYS²²⁶KDLASGWS-----QLY

Sa1,3Gal 207 ---CH²⁰⁷REAP²⁰⁷ALFKRGGVYF²⁰⁷MLTSGATGWNPNQ²⁰⁷QYATATSLAGPWT-----AMT

Fo1,3Gal 202 ---Y²⁰²FAES²⁰²PAM²⁰²LKONGY²⁰²YFIFGSHLTGWNANDNI²⁰²YSYAKSLSGPWS-----NWT

Ss1,3Gal 186 --S¹⁸⁶ASFEAPAMVKSNGTY¹⁸⁶YLLASHLTG¹⁸⁶WSTNDNVYTTATSLSGTWA-----PMR

Il1,3Gal 205 ---AT²⁰⁵LEAPGIVKHS²⁰⁵GKYFLIASHTSGWAPNPNK²⁰⁵FFSASSLSGPWS-----SQQ

Pc1,3Gal 205 ---AT²⁰⁵LEAPGIVKHNGEY²⁰⁵FLIASHTSGWAPNPNK²⁰⁵WFSASSLAGPWS-----AQQ

Fig. S1. (Continued)

BLLJ_1840 413 **N**NMPEGADGLLS**V**GDTRGTT**F**GSQSAS**V**LAVDQEK**G**--HF**I**Y**L**GDRW**D**SGK---AD**S**T**Y**
 Ct1,3Gal 272 **N**-----L**G**N--S**T**TYRSQ**P**TF**I**IPVQ**G**SS**G**T--SY**L**Y**M**GDRWAGAW**G**GK**V**ND**S**Q**Y**
 Sa1,3Gal 253 **N**-----V**G**D--S**T**AYGSQ**T**AY**V**LPVQ**G**TS**G**T--SY**L**Y**L**GDRW**G**NS**F**GG**S**VND**S**SR**Y**
 Fo1,3Gal 248 **E**-----F**A**PV**G**SK**T**Y**Q**SQ**V**SY**I**Q**P**L---G**N**G**N**A**I**Y**I**GDRW**V**ST**N**---L**A**A**S**T**Y**
 Ss1,3Gal 233 **N**-----F**A**AP**G**TH**T**Y**N**SQ**T**A**N**I**I**TVQ**G**SS**G**T--T**Y**I**Y**AGDRW**N**AS**D**---L**G**NS**Q**L
 Il1,3Gal 251 **D**-----I**T**TAS**T**RT**W**Y**S**Q**N**AF**D**L**L**PL---G**N**-N**A**I**Y**M**G**DRW**R**PS**L**---L**G**SS**R**Y
 Pc1,3Gal 251 **D**-----I**A**PSA**T**RT**W**Y**S**Q**N**AF**D**L**L**PL---G**S**-N**A**I**Y**M**G**DRW**R**PS**L**---L**G**SS**R**Y
←CΔ762

BLLJ_1840 467 **V**WL**P**L**T**I**G**EN**T**I**E**M**H**N**P**AQ**E**GE**P**D**G**W**D**LS**Y**W**G**N**H**GS**A**K**G**L**V**N**W**T**V**ET**G**DD**L**P**K**T**V**NT**G**
 Ct1,3Gal 318 **V**WL**P**L**N**F**I**S**D**T**T**I**E**L-----P**Y**Y**D**SV
 Sa1,3Gal 299 **V**WL**P**L**T**F**P**T**S**T**S**L**S**M-----S**W**Y**P**EV-----
 Fo1,3Gal 290 **V**WL**P**L**K**V-D**G**T**K**V**T**L-----S**W**Y**D**SW-----
 Ss1,3Gal 278 **I**W**L**P**M**T**I**-R**G**T**V**V**N**V-----G**Q**Y**P**SW-----
 Il1,3Gal 292 **I**W**Y**P**I**D**F**-S**S**G**S**P**Q**L-----V**H**A**D**V**W**-----
 Pc1,3Gal 292 **I**W**Y**P**L**D**F**-S**S**G**A**P**Q**I-----V**H**A**D**V**W**-----

BLLJ_1840 527 **G**T**V**T**L**P**D****T**V**N**V**K**E**G**DD**T**I**A**T**K**V**T**W**N**V**E**GG**T**A**V**S**K**S**T**K**A**AG**N**T**Y**A**F**N**V**P**G**A**Y**T**I**T**G**T**L**A**E**S
 Ct1,3Gal 339 -----K**I**D**A**SS**G**-----I**I**S**E**Y**I**P**D**T**T**RY**K**L**V**N**K**NS**G**K-----
 Sa1,3Gal 320 -----T**V**D**T**V**A**G-----T**I**S**G**T**S**A**T**Y**E**T**L**T**A**R**H**S**A**K-----
 Fo1,3Gal 310 -----S**P**N**L**S**K**G-----T**W**S**E**T**K**M**T**K**I**E**G**E**T**A**T**M**G**N-----
 Ss1,3Gal 298 -----S**L**D**A**I**A**G-----T**W**T**P**D**S**G**V**P**T**N**A**V**H**T**L**T**D**A-----
 Il1,3Gal 312 -----S**V**N**P**S**A**G-----T**Y**T**V**A**Q**G**T**T**Y**E**A**E**K**G**T**L**G**G-----
 Pc1,3Gal 312 -----S**V**N**V**Q**A**G-----T**Y**S**V**A**S**G**T**S**Y**E**A**E**N**G**Q**R**G**G-----

BLLJ_1840 587 **S**N**F**N**P**G**R**T**F**R**R**T**I**D**V**S**C****S**N**P**I**S**G**S**W**K**E**A**H**W**K**G**S**A**C**Q**V**S**A**S**G--G**A**Y**D**F**T**I**T**D**N**A**N**R**C**V**W**
 Ct1,3Gal 367 -----V**L**D**V**L---D**G**S**V**D**N**A**A**Q**I**V**Q**W**T**D**N**G--S**L**S**Q**Q**W**Y**I**V**D**V**G**G**G**Y**K**
 Sa1,3Gal 346 -----C**A**D**V**P---S**Q**S**L**L**T**G**V**A**L**T**Q**Y**T**C**N**G--G**N**N**Q**K**F**W**F**K**S**V**A**G**G**Y**Y**
 Fo1,3Gal 336 -----D**A**R**I**I---S**C**S**E**C**S**G**G**Q**A**V**G**Y**I**G**G**D**K**K**G**T**L**T**F**K**N**I**K**S**S**G**G**T**A**T
 Ss1,3Gal 324 -----G**S**S**M**L**M**D**V**A**G**G**S**T**A**T**G**A**K**V**I**Q**W**Q**S**N**G**--G**D**N**Q**K**W**T**L**N**R**V**A**D**N**V**Y**
 Il1,3Gal 338 -----S**S**K**L**L---S**N**S**G**F**S**G**G**S**A**V**G**Y**L**G**H**G--G**T**V**T**I**N**N**V**Q**G**N**G**G**A**H**W**
 Pc1,3Gal 338 -----S**S**T**I**L---S**G**S**G**F**S**G**G**K**A**V**G**Y**L**G**H**G--G**T**V**T**I**N**N**V**Q**S**N**G**G**S**H**W**

BLLJ_1840 645 **T**D**R**N**E**G**S**A**V**Y**Q**P**D**A**L**D**V**N**E**T**L**E**T**T**V**K**P**L**D**L**G**G**N**D**P**R**A**G**L**V**V**R**N**L**A**D**A**N**G**G**K**G**Y**A**T**L**L**A
 Ct1,3Gal 405 **K**I**V**N**V**K**S**G**R**A-----L**D**V**K**D**E**S**K**E**D**G**G**V**I**I**Q**Y---T**S**N**G**G**Y**N**Q**H**W**K**F**T
 Sa1,3Gal 384 **E**L**M**G**R**G**S**S-----L**C**L**T**E**N**V**T**A**V**T**Q**E--N**C**T**A**A**T**S**Q**Q**W**S**L**T
 Fo1,3Gal 376 **I**N**V**K**Y**R**N**G-----D**N**G**S**R**Y**A**T**V-----N**V**N**G**E**S**Q**K**L**A**F**L**S
 Ss1,3Gal 366 **T**L**V**S**V**K**S**G**L**C-----L**D**V**P**N**K**S**T**A**E**N**V**Q**L**Q**Q**W---T**C**N**G**G**A**N**Q**-Q**F**A**A**
 Il1,3Gal 376 **V**A**I**Y**F**A**N**G-----D**S**T**Y**R**N**V**T**V-----S**V**N**G**G**S**S---V**L**V
 Pc1,3Gal 376 **V**A**I**Y**F**A**N**G-----D**S**T**Y**R**N**V**T**V-----S**V**N**G**G**P**S---V**L**V

BLLJ_1840 705 **S**L**S**G**V**Y**M**Q**Y**D**S**N**A**D**G**Y**I**D**K**E**T**S**H**V**G**T**G**F**G**D**Q**V**Q**L**K**L**E**R**I**S**T**D**T**L**K**G**Y**W**R**A**S**A**N**D**E**W**Q**D**V**A
 Ct1,3Gal 445 **D**-----I-----G**D**G**Y**Y**K**I**S**R**H**C**G**K**L**I**D**V-----
 Sa1,3Gal 418 **T**-----S**G**G**Y**V**S**L**K**S**R**A**S**G**E**C**L**D**V**-----
 Fo1,3Gal 406 **T**-----S**H**L**S**Q**T**G**L**S**R**G**F**F**D**L**K**E**G**---S**D**-----
 Ss1,3Gal 405 **D**-----L**V**G**S**L**T**G**T**K**F**M**L**V**N**V**N**S**L**N**I**G**V**-----
 Il1,3Gal 403 **D**-----Q**P**D**S**G**G**G**V**V**I**S**V**P**V**K**V**N**L**N**N**G**A**-----
 Pc1,3Gal 403 **D**-----Q**P**D**S**G**G**G**N**V**V**I**S**V**P**V**K**L**N**L**N**S**G**E-----
←CΔ457

BLLJ_1840 765 **T**V**T**L**T**G**A**D**V**T**G**L**D**A**G**A**F**A**T**S**N**S**N**A**G**A**F**T**V**A**F**N**G**T**A**F**G**S**Q**T**A**A**V**E**S**I**A**A**K**G**P**E**T**T**I**A**K**R**Q**T
 Ct1,3Gal 465 -----
 Sa1,3Gal 437 -----
 Fo1,3Gal 427 -----
 Ss1,3Gal 429 -----
 Il1,3Gal 427 -----
 Pc1,3Gal 427 -----

BLLJ_1840 825 **L**A**H**K**D**V**T**V**T**A**T**L**T**N**G**K**T**R**V**L**E**P**D**E**Y**T**L**E**G**F**D**T**T**K**L**G**E**Q**T**V**T**V**R**L**V**T**D**S**S**V**T**A**T**L**T**V**T**V**E**S
 Ct1,3Gal 465 -----
 Sa1,3Gal 437 -----
 Fo1,3Gal 427 -----
 Ss1,3Gal 429 -----
 Il1,3Gal 427 -----
 Pc1,3Gal 427 -----

Fig. S1. (Continued)

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BLLJ_1840 885 NLARLFCSSAAASKYEPASWASASTADLTCDNNLSTNWSNWTGDTSPWLSYTFDKAYQ
Ct1,3Gal 465 -----RKWSTEDGGII-----QQWSDAG-GTNQHWKLV-----
Sa1,3Gal 437 -----SGASTANSAAL-----ITYTCNG-GTNQQWTRGT-----
Fo1,3Gal 427 -----NTITISNGD-----GWG-PDVDALMPPAA-----
Ss1,3Gal 429 -----DSSSTTAGAGV-----VQLTGTG-ATSQQWTLT-----
Il1,3Gal 427 -----NSITFGSGQ-----SNYA-ADLDKIIVY-----
Pc1,3Gal 427 -----NSITFGSGQ-----SNYA-ADLDKIIVY-----

BLLJ_1840 945 LGKLSVAVDKAKGEAAPKSFTVSYLAEDNATWTDATLPAVTVNGAAGAVTEADVSAIPAT
Ct1,3Gal 492 -----LVSSPEPSPSPSP-----
Sa1,3Gal -----
Fo1,3Gal -----
Ss1,3Gal -----
Il1,3Gal -----
Pc1,3Gal -----

          ←CΔ257
BLLJ_1840 1005 KGIRLNFTYADGNDYAKIAEVRIAEGEATPEPQPSSNANLADLTVDGKTVDFGFSADITEY
Ct1,3Gal 505 QVVKGDVNGDLKVNSTDFSMRLRRYLLKTI DNFPTENGKQAADLNGDGRINSSDLTMLKRY
Sa1,3Gal -----
Fo1,3Gal -----
Ss1,3Gal -----
Il1,3Gal -----
Pc1,3Gal -----

BLLJ_1840 1065 AGALAGDAASYPTVEATAADAKATVQVEQASTENSGVATVTVTAE DGTAEYTVTFGELP
Ct1,3Gal 565 LLMEVDL-----
Sa1,3Gal -----
Fo1,3Gal -----
Ss1,3Gal -----
Il1,3Gal -----
Pc1,3Gal -----

BLLJ_1840 1125 QLAEELAVEVTKDSYQVGDKFNAADVKVS AIYKVGDTETLRKLI DPTDGLKFTGFDSATA
Ct1,3Gal -----
Sa1,3Gal -----
Fo1,3Gal -----
Ss1,3Gal -----
Il1,3Gal -----
Pc1,3Gal -----

BLLJ_1840 1185 GTKTITVSYRGVNATFEVTVTATEVTPGPGEQKPGDTN NPGNTAKPGNTATNEPAANGAA
Ct1,3Gal -----
Sa1,3Gal -----
Fo1,3Gal -----
Ss1,3Gal -----
Il1,3Gal -----
Pc1,3Gal -----

BLLJ_1840 1245 PLSNTGAAVA AIAVVVVALAAAAGALLVIRKRA
Ct1,3Gal -----
Sa1,3Gal -----
Fo1,3Gal -----
Ss1,3Gal -----
Il1,3Gal -----
Pc1,3Gal -----

```

Fig. S1. Multiple sequence alignment of BLLJ_1840 and characterized exo-β-1,3-galactanases. The alignment was created using the MUSCLE program (<http://www.ebi.ac.uk/Tools/msa/muscle/>) and BoxShade 3.21 (http://www.ch.embnet.org/software/BOX_form.html). Identical residues and conservative substitutions are highlighted in black and dark gray, respectively. Asterisks indicate the predicted catalytic residues for BLLJ_1840. The *arrows* indicate the deleted position of deletion mutants.

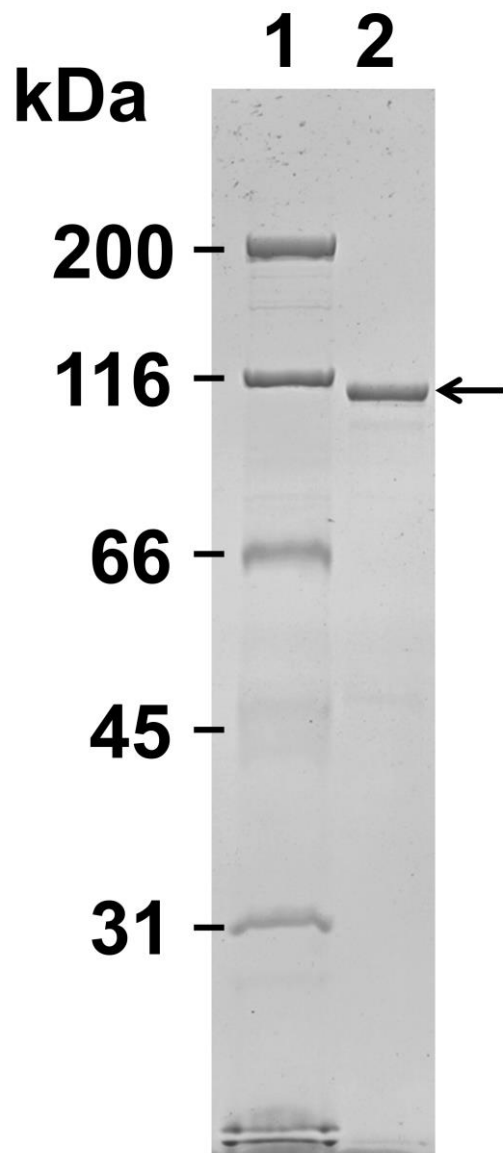


Fig. S2. SDS-PAGE analysis of recombinant BLLJ_1840. Purified BLLJ_1840-N Δ 42C Δ 257 was electrophoresed on a 10% polyacrylamide gel and stained with Coomassie Brilliant Blue R-250. Lane 1, molecular size markers; lane 2, purified enzyme;. The *arrow* indicates the band that corresponds to BLLJ_1840-N Δ 42C Δ 257.

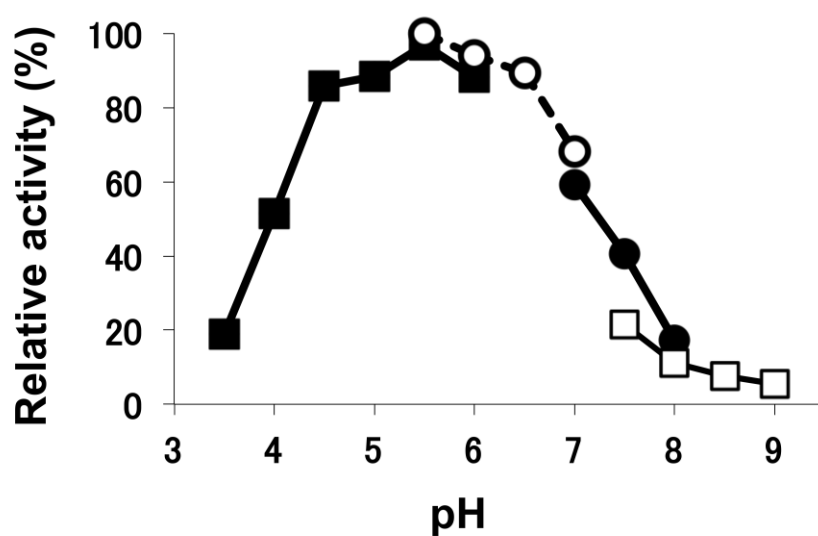
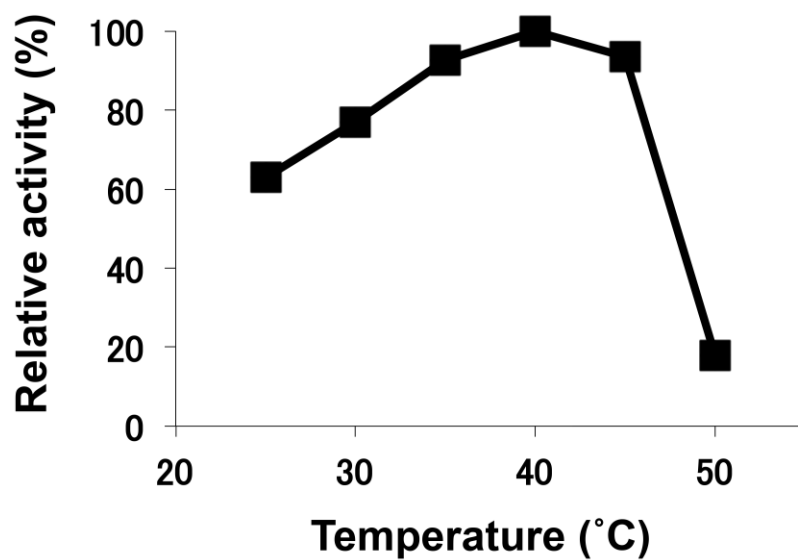
A**B**

Fig. S3. Effects of pH and temperature on the activity of BLLJ_1840. (A) pH dependence of BLLJ_1840 activity in various buffers at 40°C for 20 min. Enzyme activities were expressed as the percentage of activity in MES buffer at pH 5.5. (B) Temperature dependence of BLLJ_1840 activity for 20 min. The enzymatic activities were expressed as the percentage of the activity at 40°C. Buffers: sodium acetate (closed square), MES (open circle), HEPES (closed circle), Tris-HCl (open square).

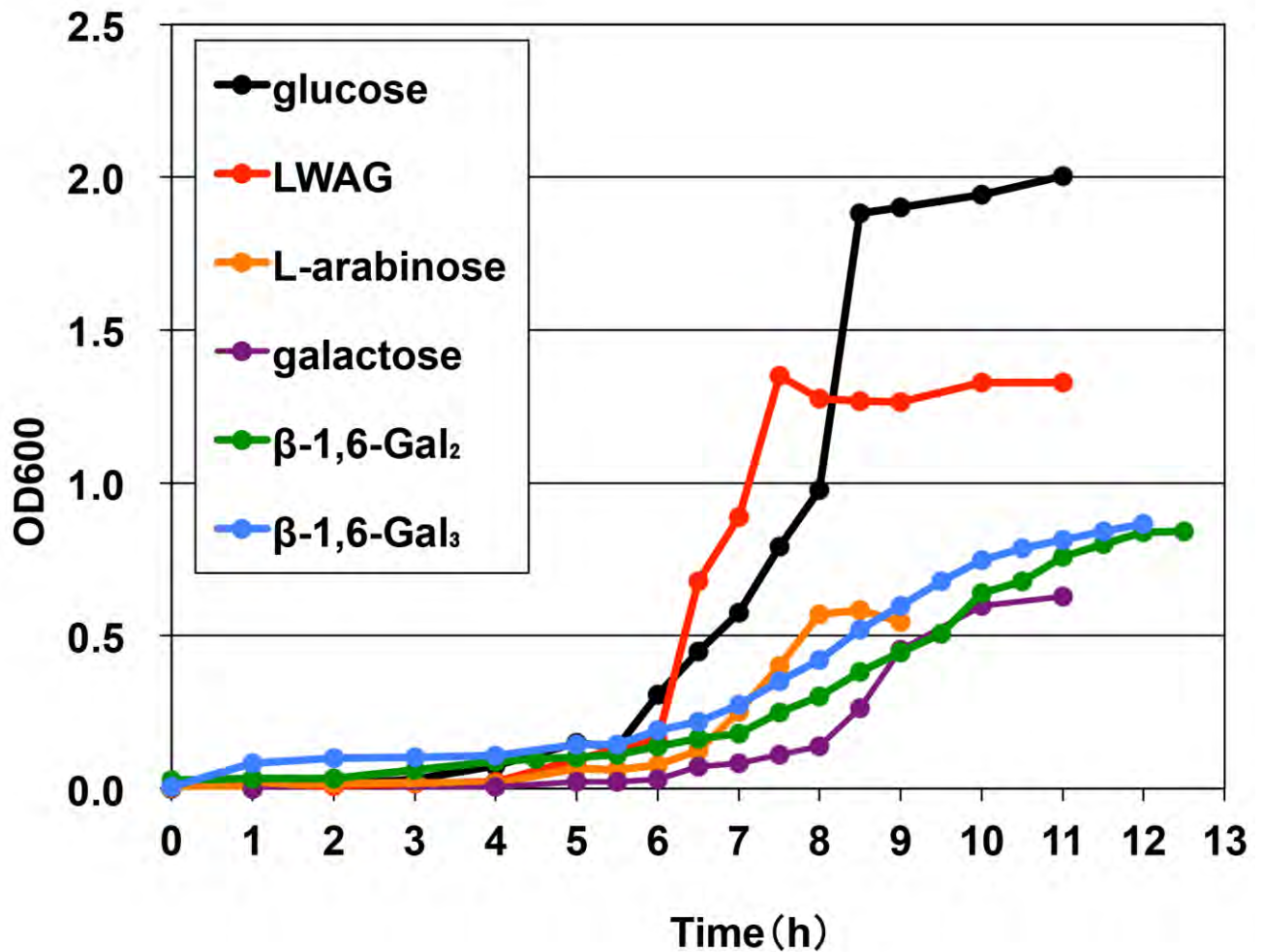


Fig. S4. Growth curves of *B. longum* JCM1217 using several carbohydrate sources. *B. longum* JCM1217 was grown on PYF medium containing 1.0% L-arabinose, glucose, galactose, β -1,6-Gal₂, β -1,6-Gal₃, or LWAG.

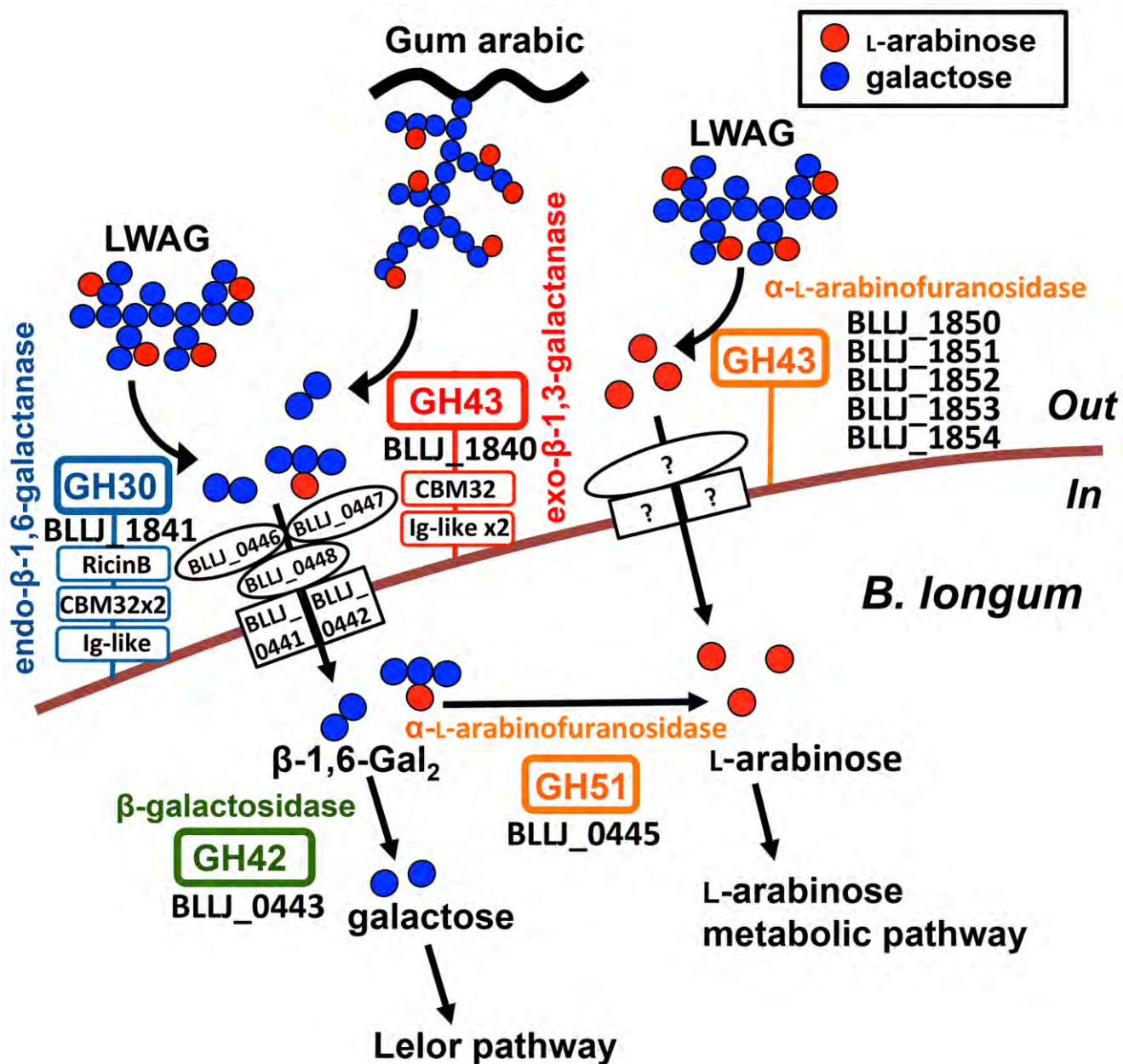


Fig. S5. Schematic AG-II metabolic pathway in *B. longum* subsp. *longum*.

Table S1. The primers used for deletion mutagenesis and quantitative real-time PCR.

Primers	Sequence of oligonucleotide primers
NΔ reverse ^a	5'- CATGGTATATCTCCTTCTTAAAGTT -3'
NΔ42 forward ^a	5'- CAAGTGCCGACATACACCAAGTTCC -3'
CΔ forward ^a	5'- CTCGAGCACCACCACCACCACCTG -3'
CΔ257 reverse ^a	5'- TTCAGCGATCTTGGCATAGTCATTGC -3'
CΔ457 reverse ^a	5'- ACCGAACGCAGTGCCGTTGAAGGCCAC -3'
CΔ762 reverse ^a	5'- GCCGGTTTCCACAGTCCAGTTGACCA -3'
rpoB forward ^b	5'- CGTCGACGATATCGATCACTTC -3'
rpoB reverse ^b	5'- CGCAGCTGGTTCTGAATCAG -3'
BLLJ_1840 forward ^b	5'- GCACCATCGAAATGCACAAT -3'
BLLJ_1840 reverse ^b	5'- GGTTGCCCCAATAGCTCAGA -3'
BLLJ_1841 forward ^b	5'- CACAGTCGGCACGAAGGTT -3'
BLLJ_1841 reverse ^b	5'- TTACATTGCGCAGAGTCCATGT -3'

^aThe primers used for deletion mutagenesis.

^bThe primers used for quantitative real-time PCR.