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NahK_JMC1217 : 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 : 60
NahK_ATCC55813 : 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 : 60
NahK_ATCC15697 : 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 : 60
NahK_JMC1217 : 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 : 120
NahK_ATCC55813 : 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 : 120
NahK_ATCC15697 : 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 : 120
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NahK_ATCC15697 : 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 : 180
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NahK_ATCC15697 : 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 : 240
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NahK_ATCC55813 : 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 : 300
NahK_ATCC15697 : 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 : 300
NahK_JMC1217 : 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 : 359
NahK_ATCC55813 : 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 : 359
NahK_ATCC15697 : 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 : 359
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FIG. 1

(57) Abstract: The present invention provides a one-pot, multi-enzyme method for preparing UDP-sugars from simple sugar starting materials. The invention also provides a one-pot, multi-enzyme method for preparing oligosaccharides from simple sugar starting materials.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/047875**A. CLASSIFICATION OF SUBJECT MATTER****C12P 19/04(2006.01)i, C12N 9/04(2006.01)1, C12N 9/12(2006.01)1, C07H 3/06(2006.01)1, C08B 37/10(2006.01)1**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C12P 19/04; C12P 19/26; C12P 19/30; C12N 1/21; C12P 19/00; C12Q 1/68

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: nucleotide-sugar-pyrophosphorylase, UDP-sugar, sugar synthesis

Google, PubMed

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	wo 2006-043525 A1 (YAMASA CORPORATION et al.) 27 April 2006 See entire document .	1-3 , 6, 8, 10, 12 4-5 , 7, 9, 11, 13-28
A	KLECZKOWSKI, L. A. et al. UDP-sugar pyrophosphorylase : A new old mechanism for sugar activation. Plant Physiology. 28 March 2011 , vol . 156 , pp.3-10 . See the pages 3, 5; figure 2.	1-28
A	US 05824472 A (BETLACH, M. R. et al.) 20 October 1998 See entire document .	1-28
A	US 06040158 A (TAKENOUCI, K. et al.) 21 March 2000 See entire document .	1-28

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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PCT/US2012/047875

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2006-043525 A1	27.04.2006	CA 2582686 A1 CN 10 1052724 A EP 18 16206 A1 EP 18 16206 A4 JP 4606419 B2 KR 10-1 123062 B1 KR 20070068365 A US 0790 1912 B1	27.04.2006 10.10.2007 08.08.2007 26.10.2011 05.01.2011 15.03.2012 29.06.2007 08.03.2011
US 05824472 A	20.10.1998	EP 0380470 A1 EP 0380470 B1 JP 02-996975 B2 JP 03-074629 B2 JP 2000-032982 A JP 2996975 B2 Wo 87-05937 A1	08.08.1990 15.02.1995 29.10.1999 09.06.2000 02.02.2000 11.01.2000 08.10.1987
US 06040 158 A	21.03.2000	CN 1200765 AO EP 08675 16 A1 EP 08675 16 A4 JP 03-23 1791 B2 KR 10- 1999-006748 1 A Wo 98- 11248 A1	02.12.1998 30.09.1998 25.10.2000 14.09.2001 25.08.1999 19.03.1998