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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

Published:

— with international search report (Art. 21(3))

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

— with sequence listing part of description (Rule 5.2(a))

(88) Date of publication of the international search report:

27 December 2012

(15) Information about Correction:

Previous Correction:

see Notice of 8 November 2012

(54) Title: OVER-EXPRESSION OF HADH-DEPENDENT OXIDOREDUCTASE (FUCO) FOR INCREASING FURFURAL OR 5-HYDROXYMETHYLFURFURAL TOLERANCE

(57) Abstract: The subject invention pertains to the discovery that the NADH-dependent propanediol oxidoreductase (FucO) can reduce furfural. This allows for a new approach to improve furfural tolerance in bacterial and/or yeast cells used to produce desired products. Thus, novel biocatalysts (bacterial, fungal or yeast cells) exhibiting increased tolerance to furfural and 5-hydroxymethylfurfural (5-HMF) are provided as are methods of making and using such biocatalysts for the production of a desired product.



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/031082**A. CLASSIFICATION OF SUBJECT MATTER***C12N 15/53(2006.01)i, C12N 15/63(2006.01)i, C12P 7/10(2006.01)i, C12P 7/16(2006.01)i, C12P 7/18(2006.01)i, C12P 7/40(2006.01)i*

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)

C12N 15/53; C12P 7/26; C12P 7/18; C12P 7/10; C12N 1/21; C12P 7/02; C12P 7/06

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: increased NADH-dependent propanediol oxidoreductase activity, FucO activity, furfural resistance, 5-HMF resistance

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2010-101665 A1 (UNIVERSITY OF FLORIDA RESEARCH FOUNDATION, INC.) 10 September 2010. See abstract, claims 1, 3-19, 25.	1-3, 17-20, 25-42 , 52-54, 56-59, 64
A	ELLIOT N. MILLER et al., `Furfural inhibits growth by limiting sulfur assimilation in ethanologenic Escherichia coli strain LY180`, Appl Environ Microbiol., Vol. 75(19), pp. 6132-6141 (14 August 2009). See abstract, pages 6132.	1-3, 17-20, 25-42 , 52-54, 56-59, 64
A	WO 2008-116853 A1 (METABOLIC EXPLORER) 02 October 2008. See abstract, claims 1, 6, 32, 33.	1-3, 17-20, 25-42 , 52-54, 56-59, 64
A	WO 2010-059616 A2 (UNIVERSITY OF FLORIDA RESEARCH FOUNDATION, INC.) 27 May 2010. See abstract, claim 26.	1-3, 17-20, 25-42 , 52-54, 56-59, 64
A	US 2010-0261239 A1 (PHILIPPE SOUCAILLE et al.) 14 October 2010. See abstract, claims 1, 4.	1-3, 17-20, 25-42 , 52-54, 56-59, 64

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

30 OCTOBER 2012 (30.10.2012)

Date of mailing of the international search report

30 OCTOBER 2012 (30.10.2012)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/031082

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	X. WANG et al., 'Increased furfural tolerance due to overexpression of NADH-dependent oxidoreductase FucO in Escherichia coli strains engineered for the production of ethanol and lactate', Appl Environ Microbiol., Vol. 77(15), pp. 5132-5140 (17 June 2011). See abstract, pages 5132, 5133.	1-3,17-20,25-42 ,52-54,56-59,64

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/031082**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.: 5-15, 44-46, 48, 50, 66-68, 70 and 72
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Since claim 5-15, 44-46, 48, 50, 66-68, 70 and 72 directly refers to claims 4, 43, 43, 47, 49, 65, 66, 69 and 71 which are not drafted in accordance with the second and/or third sentence of Rule 6.4(a), this international search report of the claims has not been established.
3. Claims Nos.: 4, 16, 21-24, 43, 47, 49, 51, 55, 60-63, 65, 69, 71 and 73-78
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/031082

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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