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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, 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, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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(54) Title: METHODS AND COMPOSITIONS FOR MODIFYING LEVELS OF LIGNIN AND INCREASING THE DIGESTIBILITY OF CELLULOSE BY THE RECOMBINANT OVEREXPRESSION OF LIGNOCELLULOLYTIC ENZYMES

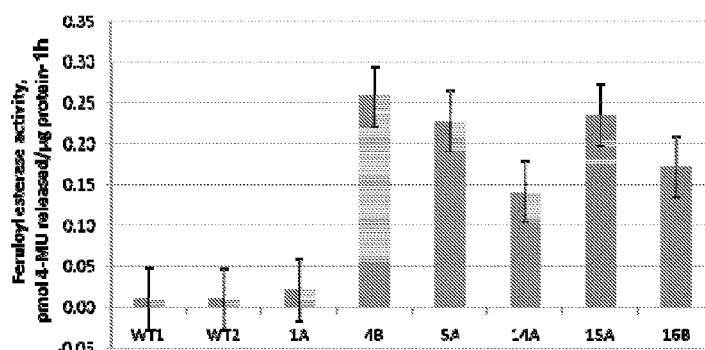


Figure 28

(57) Abstract: Improved systems and methods for reducing costs and increasing yields of cellulosic ethanol including compositions of matter comprising plant biomass and cell wall-modifying enzyme polypeptides and transgenic plants expression cell wall-modifying enzyme polypeptides.

INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER

ADD. C12N15/82 A01H5/00 C12N9/00 C07K16/00 C12Q1/68

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 A01H C12Q

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

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

EPO-Internal, BIOSIS, Sequence Search, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BUANAFINA MARCIA M DE O ET AL: "Expression of a fungal ferulic acid esterase increases cell wall digestibility of tall fescue (Festuca arundinacea)." PLANT BIOTECHNOLOGY JOURNAL APR 2008 LNKD- PUBMED:18086237, vol. 6, no. 3, 18 December 2007 (2007-12-18), pages 264-280, XP002589609 ISSN: 1467-7652	1,2,4,5, 7-20
Y	epublication 18-12-2007; the whole document	1-5,7-21
X	WO 02/068666 A1 (GENENCOR INT [US]; DUNN-COLEMAN NIGEL [US]; LANGDON TIMOTHY [GB]; PHIL) 6 September 2002 (2002-09-06) the whole document ----- -/--	1,2,4,5, 7-19



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 document 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 another 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

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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2005/096804 A2 (SYNGENTA PARTICIPATIONS AG [CH]; LANAHAN MICHAEL B [US]; BASU SHIB S []) 20 October 2005 (2005-10-20) example 52 example 53	1,2,4,5, 7-16
Y	----- DATABASE UniProt [Online] 1 June 2002 (2002-06-01), "SubName: Full=Putative alpha-dextrin endo-1, 6-alpha-glucosidase; EC=3.2.1 .41"; XP002589610 retrieved from EBI accession no. UNIPROT:Q8U1U7 Database accession no. Q8U1U7 * abstract 100% identity in 404 amino acids to SEQID1	1-5,7-20
X	----- WO 03/106654 A2 (DIVERSA CORP [US]; STEER BRIAN [US]; CALLEN WALTER [US]; HEALEY SHAUN) 24 December 2003 (2003-12-24) page 33	1,2,4,7, 9-19
Y	----- VRSANSKA MARIA ET AL: "Mode of action of glycoside hydrolase family 5 glucuronoxylan xylanohydrolase from Erwinia chrysanthemi" FEBS JOURNAL, vol. 274, no. 7, April 2007 (2007-04), pages 1666-1677, XP002601179 the whole document	1-4, 7-11, 13-21
Y	----- DATABASE UniProt [Online] 1 November 1996 (1996-11-01), "SubName: Full=Xylanase;" XP002601180 retrieved from EBI accession no. UNIPROT:Q46961 Database accession no. Q46961 compound 100% identity in 413 a.a. to SEQID78 & DATABASE EMBL [Online] 27 December 1995 (1995-12-27), "Erwinia chrysanthemi xylanase gene, complete cds." retrieved from EBI accession no. EMBL:U41750 Database accession no. U41750 compound -/--	1-4, 7-11, 13-21

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2009/045883

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	& KEEN N T ET AL: "Cloning and characterization of a xylanase gene from corn strains of Erwinia chrysanthemi" 1996, MOLECULAR PLANT-MICROBE INTERACTIONS, VOL. 9, NR. 7, PAGE(S) 651-657 ISSN: 0894-0282 ----- HURLBERT JASON C ET AL: "Functional characterization of a novel xylanase from a corn strain of Erwinia chrysanthemi" JOURNAL OF BACTERIOLOGY, vol. 183, no. 6, March 2001 (2001-03), pages 2093-2100, XP002601181 ISSN: 0021-9193 the whole document	1-4, 7-11, 13-21
A	IKEDA M ET AL: "MOLECULAR CLONING OF EXTREMELY THERMOSTABLE ESTERASE GENE FROM HYPERTHERMOPHILIC ARCHAEON PYROCOCCLUS FURIOSUS IN ESCHERICHIA COLI" BIOTECHNOLOGY AND BIOENGINEERING, WILEY & SONS, HOBOKEN, NJ, US LNKD-DOI:10.1002/(SICI)1097-0290(19980305)57:5<624::AID-BIT15>3.0.CO;2-B, vol. 57, no. 5, 5 March 1998 (1998-03-05), pages 624-629, XP001179442 ISSN: 0006-3592 the whole document	1
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INTERNATIONAL SEARCH REPORT

International application No

PCT/US2009/045883

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2007/100897 A2 (EDENSPACE SYSTEM CORP [US]; BLAYLOCK MICHAEL J [US]; FERGUSON BRUCE W) 7 September 2007 (2007-09-07) paragraph [0008] paragraph [0074] - paragraph [0083] paragraph [0089] - paragraph [0094] page 62 - page 63 -----	1
A	RECORD E ET AL: "Overproduction of the Aspergillus niger feruloyl esterase for pulp bleaching application." APPLIED MICROBIOLOGY AND BIOTECHNOLOGY, vol. 62, no. 4, September 2003 (2003-09), pages 349-355, XP002589611 ISSN: 0175-7598 page 351, left-hand column -----	1
A	BAE ET AL: "Production of a recombinant xylanase in plants and its potential for pulp biobleaching applications" BIORESOURCE TECHNOLOGY, ELSEVIER BV, GB LNKD- DOI:10.1016/J.BIORTECH.2007.07.064, vol. 99, no. 9, 22 February 2008 (2008-02-22), pages 3513-3519, XP022494945 ISSN: 0960-8524 page 3517, right-hand column; figure 3 -----	1
A	PAUL S S ET AL: "Effect of administration of an anaerobic gut fungus isolated from wild blue bull (Boselaphus tragocamelus) to buffaloes (Bubalus bubalis) on in vivo ruminal fermentation and digestion of nutrients" ANIMAL FEED SCIENCE AND TECHNOLOGY, vol. 115, no. 1-2, 1 July 2004 (2004-07-01), pages 143-157, XP002589612 ISSN: 0377-8401 the whole document paragraph 2.3.1 and 3.1.1 -----	1
A	DAI ZIYU ET AL: "Expression of Trichoderma reesei exo-cellobiohydrolase I in transgenic tobacco leaves and calli" APPLIED BIOCHEMISTRY AND BIOTECHNOLOGY, THE HUMANA PRESS, INC, US LNKD- DOI:10.1385/ABAB:79:1-3:689, vol. 77-79, 1 April 1999 (1999-04-01), pages 689-699, XP002473456 ISSN: 0273-2289 the whole document ----- -/--	1

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2009/045883

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2004/009804 A2 (BIOCATALYSTS LTD [GB]; UNIV NOTTINGHAM [GB]; INST OF FOOD RES [GB]; WE) 29 January 2004 (2004-01-29) the whole document -----	1

INTERNATIONAL SEARCH REPORT

International application No.
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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.:
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:
3. ☐ Claims Nos.:
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:

see additional sheet

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 fees, this Authority did not invite payment of additional fees.
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.:
1-21
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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-21(partially)

Composition of matter comprising plant biomass and at least one enzyme polypeptide having at least 85% amino acid identity to SEQID1; wherein the enzyme is encoded by the nucleotide sequence of SEQID87; wherein said enzyme is involved in post-harvest processing and the plant biomass is from a monocot or dicot plant; said composition further comprising another enzyme.

2. claims: 1-21(partially)

as invention 1, but limited to the respective SEQIDs 2 and corresponding nucleotide sequence of claim 3.

3-10. claims: 1, 4-21(all partially)

Composition of matter comprising plant biomass and at least one enzyme polypeptide having at least 85% amino acid identity to respective SEQIDs 3-10; wherein said enzyme is involved in post-harvest processing and the plant biomass is from a monocot or dicot plant; said composition further comprising another enzyme.

11. claims: 1-21(partially)

as invention 1, but limited to the respective SEQID 11 and corresponding nucleotide sequence of claim 3.

12-39. claims: 1, 4-21(all partially)

as invention 3, but limited to the respective SEQIDs 12-39.

40. claims: 1-21(partially)

as invention 1, but limited to the respective SEQID 40 and corresponding nucleotide sequence of claim 3.

41-77. claims: 1, 4-21(all partially)

as invention 3, but limited to the respective SEQIDs 41-77.

78. claims: 1-21(partially)

as invention 1, but limited to the respective SEQID 78 and

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

corresponding nucleotide sequence of claim 3.

79. claims: 1, 4-21(all partially)

as invention 3, but limited to the respective SEQID 79.

80. claims: 1-21(partially)

as invention 1, but limited to the respective SEQIDs 80 and
corresponding nucleotide sequence of claim 3.

81-84. claims: 1, 4-21(all partially)

as invention 3, but limited to the respective SEQIDs 81-84.

85-168. claims: 22-53(partially)

Transgenic plant comprising stably integrated into its
genome a recombinant polynucleotide encoding the polypeptide
as characterized by SEQIDs 1-84, respectively; an expression
vector and host cell comprising said sequence.

169-252. claim: 54(partially)

Method for pretreating a plant under conditions to promote
accessibility of the plant's celluloses within the
lignocellulosic biomass wherein said plant is transformed
with a recombinant vector comprising the polynucleotide
encoding the polypeptide of SEQIDs 1-84.

253. claims: 55, 56(completely); 59, 60(partially)

Isolated antibody that specifically binds to the feruloyl
esterase as characterized by SEQID2.

254. claims: 57, 58(completely); 59, 60(partially)

Isolated antibody that specifically binds to the
exoglucanase as characterized by SEQID40.

255-338. claims: 61-65(partially)

Array comprising a solid substrate, the substrate having a
surface and a plurality of genetic probes; the genetic probe
is immobilized and comprises an oligonucleotide comprising
at least 10 consecutive nucleotides from a nucleotide
sequence encoding a polypeptide as characterized by SEQIDs

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1-84.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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WO 02068666	A1	06-09-2002	AT 429501 T 15-05-2009
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