

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

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Date of mailing
(day/month/year)

16 OCT 2020

Applicant's or agent's file reference
146.0015-WO00

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US2020/042562

International filing date (day/month/year)

17 July 2020

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17 July 2019

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

IPC(8) - C12N 9/10; C12N 9/90; C12N 11/02; C12P 19/02 (2020.01)

CPC - C12N 11/14; C12N 11/18; C12P 19/02; C12Y 204/01001; C12Y 504/02002 (2020.08)

Applicant
BONUMOSE LLC

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☒ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

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Date of completion of this opinion

08 October 2020

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**WRITTEN OPINION OF THE
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Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:
 - ☒ the international application in the language in which it was filed.
 - ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).
2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).
3. ☒ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. ☒ forming part of the international application as filed:
 - ☒ in the form of an Annex C/ST.25 text file.
 - ☐ on paper or in the form of an image file.
 - b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
 - ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
 - ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).
4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:
SEQ ID NOs: 1-8 were searched.

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Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 10-22

because:

☐ the said international application, or the said claims Nos. _____ relate to the following subject matter which does not require an international search (*specify*):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 10-22 are so unclear that no meaningful opinion could be formed (*specify*):

Claims 10-22 are multiple dependent claims not drafted in accordance with the second and third sentences of Rule 6.4(a).

☐ the claims, or said claims Nos. _____ are so inadequately supported by the description that no meaningful opinion could be formed (*specify*):

☒ no international search report has been established for said claims Nos. 10-22

☐ a meaningful opinion could not be formed without the sequence listing; the applicant did not, within the prescribed time limit:

☐ furnish a sequence listing in the form of an Annex C/ST.25 text file, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

☐ furnish a sequence listing on paper or in the form of an image file complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

☐ pay the required late furnishing fee for the furnishing of a sequence listing in response to an invitation under Rule 13ter.1(a) or (b).

☐ See Supplemental Box for further details.

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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	2-9	YES
	Claims	1	NO
Inventive step (IS)	Claims	9	YES
	Claims	1-8	NO
Industrial applicability (IA)	Claims	1-9	YES
	Claims	None	NO

2. Citations and explanations:

Claim 1 lacks novelty under PCT Article 33(2) as being anticipated by BP Corporation North America Inc. (hereinafter BP Corporation).

Regarding Claim 1, BP Corporation discloses an immobilized enzyme composition (The invention provides detergent compositions comprising one or more polypeptides of the invention, e.g., enzymes as described in Table... 2... and methods of making and using these compositions, Para. [0821]; The invention provides immobilized polypeptides having enzyme... activity, wherein the polypeptide comprises a polypeptide of the invention... and a second domain. In one aspect, the polypeptide can be immobilized on... a resin,... a bead, Para. [0047]) comprising at least two, at least three, at least four, at least five, at least six carriers, at least seven, or at least eight of the following enzymes immobilized to at least one carrier or a mixture of carriers: a) a glucan phosphorylase (aGP), phosphoglucosyltransferase (PGT), and optionally 1,4-glucan transferase (4-GT) (Table 2 discloses Phosphoglucosyltransferase); and b) an enzyme from within a combination of enzymes selected from: (i) phosphoglucosyltransferase (PGT), fructose-6-phosphate epimerase (F6PE), and tagatose-6-phosphate phosphatase (T6PP) to prepare tagatose; (ii) phosphoglucosyltransferase (PGT), piscose-6-phosphate epimerase (P6PE), and piscose-6-phosphate phosphatase (P6PP) to prepare allulose; (iii) phosphoglucosyltransferase (PGT), P6PE, allose-6-phosphate isomerase (A6PI), and allose-6-phosphate phosphatase (A6PP) to prepare allose; (iv) phosphoglucosyltransferase (PGT), mannose-6-phosphate isomerase (M6PI) or phosphoglucose/phosphomannose isomerase (PGPMI), and mannose 6-phosphate phosphatase (M6PP) to prepare mannose; (v) phosphoglucosyltransferase (PGT), F6PE, galactose 6-phosphate isomerase (Gal6PI), and galactose 6-phosphate phosphatase (Gal6PP) to prepare galactose; (vi) PGI and fructose 6-phosphate phosphatase (F6PP) to prepare fructose; (vii) PGI, P6PE, altrose 6-phosphate isomerase (Alt6PI), and altrose 6-phosphate phosphatase (Alt6PP) to prepare altrose; (viii) PGI, F6PE, talose 6-phosphate isomerase (Tal6PI), and talose 6-phosphate phosphatase (Tal6PP) to prepare talose; (ix) PGI, F6PE, sorbose 6-phosphate epimerase (S6PE), and sorbose 6-phosphate phosphatase (S6PP) to prepare sorbose; (x) PGI, F6PE, S6PE, gulose 6-phosphate isomerase (Gul6PI), and gulose 6-phosphate phosphatase (Gul6PP) to prepare gulose; (xi) PGI, F6PE, S6PE, idose 6-phosphate isomerase (16P1), and idose 6-phosphate phosphatase (16PP) to prepare idose; and (xii) inositol 3-phosphate synthase (IPS) and inositol monophosphatase (IMP) to prepare inositol (Table 2 discloses Inositol-3-phosphate synthase, and Inositol-1(or 4)-monophosphatase). Further regarding the limitation relating to "for the preparation of a hexose," a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to distinguish the claimed invention from the prior art. If the prior art is capable of performing the intended use, it meets the limitation for the preparation of a hexose. Specifically, BP Corporation discloses a composition comprising a plurality of immobilized enzymes such as phosphoglucosyltransferase, Inositol-3-phosphate synthase, and Inositol-1(or 4)-monophosphatase capable of being used in biosynthetic mechanisms to generate a hexose such as inositol.

Claim 2 lacks an inventive step under PCT Article 33(3) as being obvious over BP Corporation North America Inc. (hereinafter BP Corporation).

Regarding Claim 2, BP Corporation discloses the immobilized enzyme composition of claim 1. BP Corporation fails to explicitly disclose wherein the weight of each enzyme relative to the total weight of the enzymes (w/w)% ranges from 0.1% to 40%. However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the composition of BP Corporation to include using a weight ranging from 0.1% to 40% for each enzyme, since the general conditions of the claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. The motivation for doing so would be to use an optimized concentration of each of a plurality of immobilized enzymes used in a composition for modifying substrates.

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Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claim 1 is objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because claim 1 is indefinite for the following reason(s):

With regards to claim 1, the claim recites, "comprising at least two... enzymes immobilized to at least one carrier or a mixture of carriers: a) a glucan phosphorylase (aGP), phosphoglucumutase (PGM), and optionally 1,4-glucan transferase (4-GT); and b) an enzyme from within a combination of enzymes selected from..." which is indefinite. It is unclear if the claim requires the presence of both aGP and PGM and at least a third enzyme selected from part b), or if at least one enzyme is selected from a) and at least one enzyme is selected from part b). For the purposes of this written opinion, the claim is interpreted to mean at least one enzyme of aGP and PGM from a), and at least one enzyme from b). Furthermore, claim 1 recites, "comprising at least two, at least three, at least four, at least five, at least six carriers, at least seven, or at least eight of the following enzymes" which is indefinite. For the purposes of this written opinion, the term "carriers" in this limitation is interpreted to be a typographical error and will not be considered. Claim 1 is amended to read as follows:

1. An immobilized enzyme composition for the preparation of a hexose comprising at least two, at least three, at least four, at least five, at least six, at least seven, or at least eight of the following enzymes immobilized to at least one carrier or a mixture of carriers: a) a glucan phosphorylase (aGP), phosphoglucumutase (PGM), and optionally 1,4-glucan transferase (4-GT); and b) an enzyme from within a combination of enzymes selected from: (i) phosphoglucosomerase (PGI), fructose-6-phosphate epimerase (F6PE), and tagatose-6-phosphate phosphatase (T6PP) to prepare tagatose; (ii) phosphoglucosomerase (PGI), piscose-6-phosphate epimerase (P6PE), and piscose-6-phosphate phosphatase (P6PP) to prepare allulose; (iii) phosphoglucosomerase (PGI), P6PE, allose-6-phosphate isomerase (A6PI), and allose-6-phosphate phosphatase (A6PP) to prepare allose; (iv) phosphoglucosomerase (PGI), mannose-6-phosphate isomerase (M6PI) or phosphoglucose/phosphomannose isomerase (PGPMI), and mannose 6-phosphate phosphatase (M6PP) to prepare mannose; (v) phosphoglucosomerase (PGI), F6PE, galactose 6-phosphate isomerase (Gal6PI), and galactose 6-phosphate phosphatase (Gal6PP) to prepare galactose; (vi) PGI and fructose 6-phosphate phosphatase (F6PP) to prepare fructose; (vii) PGI, P6PE, altrose 6-phosphate isomerase (Alt6PI), and altrose 6-phosphate phosphatase (Alt6PP) to prepare altrose; (viii) PGI, F6PE, talose 6-phosphate isomerase (Tal6PI), and talose 6-phosphate phosphatase (Tal6PP) to prepare talose; (ix) PGI, F6PE, sorbose 6-phosphate epimerase (S6PE), and sorbose 6-phosphate phosphatase (S6PP) to prepare sorbose; (x) PGI, F6PE, S6PE, gulose 6-phosphate isomerase (Gul6PI), and gulose 6-phosphate phosphatase (Gul6PP) to prepare gulose; (xi) PGI, F6PE, S6PE, idose 6-phosphate isomerase (16P1), and idose 6-phosphate phosphatase (16PP) to prepare idose; and (xii) inositol 3-phosphate synthase (IPS) and inositol monophosphatase (IMP) to prepare inositol.

Claims 2-9 depend from claim 1, and are objected to for at least the same reason(s) as claim 1.

With regards to claim 18, the claim recites dependency from itself (claim 18) which is improper. Herein, claim 18 is best interpreted to be dependent on claim 17.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of:

Claims 1, 3-5, 7, and 8 lack an inventive step under PCT Article 33(3) as being obvious over Bonumose LLC (hereinafter Bonumose) in view of Enginzyme AB (hereinafter Enginzyme).

Regarding Claim 1, Bonumose discloses an enzyme composition for the preparation of a hexose (The invention relates to preparation of hexose monosaccharides, Para. [002]; A 0.20 mL reaction mixture, Para. [0404]) comprising at least two, at least three, at least four, at least five, at least six, at least seven, or at least eight of the following enzymes: a) a glucan phosphorylase (aGP), phosphoglucosyltransferase (PGM), and optionally 1,4-glucan transferase (4-GT) (containing... 0.01 U of aGP, 0.01 U PGM, Para. [0404]); and b) an enzyme from within a combination of enzymes selected from: (i) phosphoglucosyltransferase (PGI), fructose-6-phosphate epimerase (F6PE), and tagatose-6-phosphate phosphatase (T6PP) to prepare tagatose; (ii) phosphoglucosyltransferase (PGI), psicose-6-phosphate epimerase (P6PE), and psicose-6-phosphate phosphatase (P6PP) to prepare allulose; (iii) phosphoglucosyltransferase (PGI), P6PE, allose-6-phosphate isomerase (A6PI), and allose-6-phosphate phosphatase (A6PP) to prepare allose; (iv) phosphoglucosyltransferase (PGI), mannose-6-phosphate isomerase (M6PI) or phosphoglucose/phosphomannose isomerase (PGPMI), and mannose 6-phosphate phosphatase (M6PP) to prepare mannose; (v) phosphoglucosyltransferase (PGI), F6PE, galactose 6-phosphate isomerase (Gal6PI), and galactose 6-phosphate phosphatase (Gal6PP) to prepare galactose; (vi) PGI and fructose 6-phosphate phosphatase (F6PP) to prepare fructose; (vii) PGI, P6PE, altrose 6-phosphate isomerase (Alt6PI), and altrose 6-phosphate phosphatase (Alt6PP) to prepare altrose; (viii) PGI, F6PE, talose 6-phosphate isomerase (Tal6PI), and talose 6-phosphate phosphatase (Tal6PP) to prepare talose; (ix) PGI, F6PE, sorbose 6-phosphate epimerase (S6PE), and sorbose 6-phosphate phosphatase (S6PP) to prepare sorbose; (x) PGI, F6PE, S6PE, gulose 6-phosphate isomerase (Gul6PI), and gulose 6-phosphate phosphatase (Gul6PP) to prepare gulose; (xi) PGI, F6PE, S6PE, idose 6-phosphate isomerase (I6PI), and idose 6-phosphate phosphatase (I6PP) to prepare idose; and (xii) inositol 3-phosphate synthase (IPS) and inositol monophosphatase (IMP) to prepare inositol (containing... 0.01 U PGI, Para. [0404]).

Bonumose fails to explicitly disclose said enzymes of the compositions are immobilized to at least one carrier or a mixture of carriers.

Enginzyme teaches immobilizing enzymes to carriers (The invention also relates to the use of an immobilized enzyme material as a heterogeneous biocatalyst in chemical synthesis, Para. [0001]; In a first aspect, the invention relates to an immobilized protein material comprising a carrier and at least one protein immobilized on the carrier, Para. [0015]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bonumose with the teaching of Enginzyme for the purpose of providing a cell-free compositions capable of generating hexoses using enzymes immobilized to carriers so that said enzymes may be removed from the composition to purify said hexose.

Regarding Claim 3, modified Bonumose discloses the immobilized enzyme composition of claim 1. Bonumose fails to explicitly disclose comprising 10-30% (aGP); 0-10% (4GT); 10-30% (PGM); and when present 0.1-10% (PGI).

However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the composition of Bonumose to include using a weight of 10-30% aGP, 0-10% 4GT, 10-30% PGM, and 0.1-10% PGI, since the general conditions of the claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. The motivation for doing so would be to use an optimized concentration of each of a plurality of immobilized enzymes for generating a particularly desired hexose using the aforementioned enzymes.

Regarding Claim 4, modified Bonumose discloses the immobilized enzyme composition of claim 3. Bonumose further discloses further comprising PGI, F6PE, and T6PP to prepare tagatose (The processes of hexose production according to the invention can involve a step of converting glucose 6-phosphate (G6P) to the F6P, wherein the step is catalyzed by phosphoglucose isomerase (PGI), Para. [032]; According to the invention, a hexose can also be produced from fructose. For example, the process involves generating F6P from fructose and polyphosphate catalyzed by polyphosphate fructokinase (PPFK); converting F6P to T6P catalyzed by F6PE; and converting T6P to tagatose catalyzed by T6PP, Para. [072]).

Regarding Claim 5, modified Bonumose discloses the immobilized enzyme composition of claim 4. Bonumose fails to explicitly disclose wherein the weight of each enzyme relative to the total weight of the enzymes (w/w)% is: 10-30% (aGP); 0-10% (4GT); 10-30% (PGM); 0.1-10% (PGI); 15-35% (F6PE); and T6PP (25-45%), wherein the total weight of enzymes in the composition total 100 w/w% relative to the total weight of the enzymes.

However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the composition of Bonumose to include using a weight of 10-30% aGP, 0-10% 4GT, 10-30% PGM, 0.1-10% PGI, 15-35% F6PE, and 25-45% T6PP, since where the general conditions of the claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. The motivation for doing so would be to use an optimized concentration of each of a plurality of immobilized enzymes for generating a particularly desired hexose using the aforementioned enzymes.

Regarding Claim 7, modified Bonumose discloses the immobilized enzyme composition of claim 3. Bonumose further discloses further comprising PGI, P6PE, and P6PP to prepare allulose (The processes of hexose production according to the invention can involve a step of converting glucose 6-phosphate (G6P) to the F6P, wherein the step is catalyzed by phosphoglucose isomerase (PGI), Para. [032]; Processes for making psicose include converting fructose 6-phosphate (F6P) to psicose 6-phosphate (P6P) catalyzed by an epimerase (e.g., psicose 6-phosphate 3-epimerase, P6PE) and converting the P6P produced to psicose catalyzed by a phosphatase (e.g., psicose 6-phosphate phosphatase, P6PP), Para. [0362]).

Regarding Claim 8, modified Bonumose discloses the immobilized enzyme composition of claim 7. Bonumose fails to explicitly disclose wherein the weight of each enzyme relative to the total weight of the enzymes (w/w)% is: 10-30% (aGP); 0-10% (4GT); 10-30% (PGM); 0.1-10% (PGI); 0.1-10% (P6PE); and (45-65%) P6PP, wherein the total weight of enzymes in the composition total 100 w/w% relative to the total weight of the enzymes.

However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the composition of Bonumose to include using a weight of 10-30% aGP, 0-10% 4GT, 10-30% PGM, 0.1-10% PGI, 0.1-10% P6PE, and 45-65% P6PP, since where the general conditions of the claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. The motivation for doing so would be to use an optimized concentration of each of a plurality of immobilized enzymes for generating a particularly desired hexose using the aforementioned enzymes.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of:

Claim 6 lacks an inventive step under PCT Article 33(3) as being obvious over Bonumose LLC (hereinafter Bonumose) in view of Enginzyme AB (hereinafter Enginzyme), CJ Cheiljedang Corporation (hereinafter CJ Cheiljedang), Callen et al. (hereinafter Callen), US 2011/0252501 A1 to Abad et al. (hereinafter Abad), and Monsanto Technology LLC (hereinafter Monsanto).

Regarding Claim 6, modified Bonumose discloses the immobilized enzyme composition of claim 5. Bonumose further discloses wherein the T6PP comprises the amino acid sequence, or fragment thereof, of SEQ ID NO:5 (Examples of A6PPs include, but are not limited to the following proteins:... D1C7G9, with the amino acid sequence set forth in SEQ ID NO:7, Para. [0101]; SEQ ID NO: 7 of Bonumose comprises 100% sequence identity to instant SEQ ID NO: 5).

Bonumose fails to explicitly disclose wherein the aGP comprises the amino acid sequence, or fragment thereof, of SEQ ID NO:1; the 4-GT comprises the amino acid sequence, or fragment thereof, of SEQ ID NO:6; the PGM comprises the amino acid sequence, or fragment thereof, of SEQ ID NO:2; the PGI comprises the amino acid sequence, or fragment thereof, of SEQ ID NO:3 the F6PE comprises the amino acid sequence, or fragment thereof, of SEQ ID NO:4.

CJ Cheiljedang teaches enzymes comprising fragments 100% identical to fragments of instant SEQ ID NOs: 1 and 4 (The phosphorylase of the present application consists of or consists of the amino acid sequence of SEQ ID NO: 21, Pg. 5, seventh full paragraph; SEQ ID NO: 21 of CJ Cheiljedang is 36.5% identical to instant SEQ ID NO: 1 and comprises multiple fragments 100% identical to fragments found within instant SEQ ID NO: 1; Gene sequences registered in the Genbank of Sumeon Aerobics decensis, a thermophilic microorganism, were used to discover additional novel heat-resistant fructose-6-phosphate-4-epimerase. To select the gene sequence expected by the enzyme, and based on the amino acid sequence (SEQ ID NO: 9), Pg. 8, fourth paragraph of Example 3-1; SEQ ID NO: 9 of CJ Cheiljedang comprises 100% identity to instant SEQ ID NO: 4).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bonumose with the teaching of CJ Cheiljedang for the purpose of using enzymes or fragments thereof capable of acting as aGPs and F6PEs.

Callen teaches an amino acid sequence comprising 71.6% identity to instant SEQ ID NO: 6 (Exemplary nucleic acids of the invention also include isolated or recombinant nucleic acids encoding a polypeptide of the invention, e.g., an exemplary polypeptide having a sequence as set forth in... SEQ ID NO:439, Para. [0019]; SEQ ID NO:439 of Callen is 71.6% identical to instant SEQ ID NO: 6 and comprises multiple fragments comprising 100% identity to multiple fragments found within instant SEQ ID NO: 6).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bonumose with the teaching of Callen for the purpose of using enzymes or fragments thereof capable of acting as a 4-GT enzyme.

Abad teaches an amino acid sequence comprising 50.2% identity to instant SEQ ID NO: 2 (Homologs from a large number of distinct organisms were identified and are reported by amino acid sequences of SEQ ID NO: 717 through SEQ ID NO: 30327, Para. [0096]; SEQ ID NO: 7986 of Abad comprises 50.3% identity to instant SEQ ID NO: 2 and comprises multiple fragments comprising 100% identity to multiple fragments found within instant SEQ ID NO: 2).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bonumose with the teaching of Abad for the purpose of using enzymes or fragments thereof capable of acting as a PGM enzyme.

Monsanto teaches SEQ ID NO: 3 (In more specific embodiments of the invention the protein expressed in plant cells is a protein selected from the group of proteins identified in Table 2 and their homologs identified in Table 8, Para. [0005]; Table 8 discloses SEQ ID NO: 25119; SEQ ID NO: 25119 of Monsanto comprises 100% identity to instant SEQ ID NO: 3).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bonumose with the teaching of Monsanto for the purpose of using an enzyme sequence capable of acting as a PGI.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of:

Claim 9 meets the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest:

Regarding claim 9, the prior art of record, individually or in combination, does not teach or fairly suggest the immobilized enzyme composition of claim 8, wherein: the aGP comprises the amino acid sequence, or fragment thereof, of SEQ ID NO:1; the 4-GT comprises the amino acid sequence of SEQ ID NO:6; the PGM comprises the amino acid sequence of SEQ ID NO:2; the PGI comprises the amino acid sequence of SEQ ID NO:3 the P6PE comprises the amino acid sequence of SEQ ID NO:7; and the P6PP comprises the amino acid sequence of SEQ ID NO:8.

The following prior art is made of record to support and further define the reasons claim 9 meets the criteria set out in PCT Article 33 (2)-(3):

(i) US 2018/0245095 A1 to Monsanto Technology, LLC (hereafter Monsanto) teaches SEQ ID NO: 3 (In more specific embodiments of the invention the protein expressed in plant cells is a protein selected from the group of proteins identified in Table 2 and their homologs identified in Table 8, Para. [0005]; Table 8 discloses SEQ ID NO:25119; SEQ ID NO:25119 of Monsanto comprises 100% identity to instant SEQ ID NO:3).

(ii) WO 2018/182344 A1 to CJ Cheiljedang Corporation (hereafter CJ Cheiljedang) teaches an amino acid sequence comprising 36.5% sequence identity to instant SEQ ID NO: 1 (The phosphorylase of the present application consists of the amino acid sequence of SEQ ID NO:21, Pg. 5, seventh full paragraph; SEQ ID NO: 21 of CJ Cheiljedang is 36.5% identical to instant SEQ ID NO:1).

(iii) US 2011/0252501 A1 to Abad et al. (hereafter Abad) teaches an amino acid sequence comprising 50.2% identity to instant SEQ ID NO: 2 (Homologs from a large number of distinct organisms were identified and are reported by amino acid sequences of SEQ ID NO: 717 through SEQ ID NO:30327, Para. [0096]; SEQ ID NO:7986 of Abad comprises 50.3% identity to instant SEQ ID NO:2).

(iv) US 2007/0157329 A1 to Callen et al. (hereafter Callen) teaches an amino acid sequence comprising 71.6% identity to instant SEQ ID NO:6 (Exemplary nucleic acids of the invention also include isolated or recombinant nucleic acids encoding a polypeptide of the invention, e.g., an exemplary polypeptide having a sequence as set forth in... SEQ ID NO:439, Para. [0019]; SEQ ID NO:439 of Callen is 71.6% identical to instant SEQ ID NO:6).

(v) WO2018/112139 A1 to Bonumose LLC (hereafter Bonumose_139) teaches an amino acid sequence comprising 60.4% identity to instant SEQ ID NO:7 (In some aspects of the invention, epimerases suitable for use in the processes to convert F6P to A6P comprise an amino acid sequence that has a degree of identity to the amino acid sequence of SEQ ID NOs:3 or 6, Para. [23]; SEQ ID NO:3 of Bonumose_139 is 60.4% identical to instant SEQ ID NO:7).

(vi) US 2008/0148432 A1 to Abad et al. (hereafter Abad_432) teaches an amino acid comprising 86.5% identity to instant SEQ ID NO: 8 (Homologs from a large number of distinct organisms were identified and are reported by amino acid sequences of SEQ ID NO: 1483 through SEQ ID NO: 52767, Para. [0082]; SEQ ID NO: 23686 of Abad_432 is 86.5% identical to instant SEQ ID NO: 8).

None of the prior art taken alone or in combination fairly teach or suggest an amino acid sequence comprising 100% sequence identity to instant SEQ ID NOs: 1, 2, 6, 7, or 8 as recited above.

Claims 1-9 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.