Summary

[021] The disclosures described herein generally relate to processes for preparing hexoses from saccharides by enzymatic conversion. The disclosures also relate to hexoses prepared by any of the processes described herein.

[021a] In one aspect, the disclosure refers to a process for preparing allose from a saccharide, the process comprising: converting fructose 6-phosphate (F6P) to psicose 6-phosphate (P6P) catalyzed by a psicose 6-phosphate 3-epimerase (P6PE); converting the P6P to allose 6-phosphate (A6P) catalyzed by an allose 6-phosphate isomerase (A6PI); andconverting the A6P to allose catalyzed by an allose 6-phosphate phosphatase (A6PP), wherein the process steps are conducted in a single bioreactor.

[022] More specifically, the disclosure relates to processes for preparing a hexose, selected from allose, mannose, galactose, fructose, altrose, talose, sorbose, gulose and idose, from a saccharide, the process comprising: converting fructose 6-phosphate (F6P) to the hexose catalyzed by one or more enzymes selected from an isomerase, an epimerase, and a hexose-specific phosphatase and mixtures thereof.

[023] A process of the disclosure for the production of allose comprises converting the F6P to psicose 6-phosphate (P6P) catalyzed by psicose 6-phosphate 3-epimerase (P6PE); converting the P6P to allose 6-phosphate (A6P) catalyzed by allose 6-phosphate isomerase (A6PI); and converting the A6P to allose catalyzed by allose 6-phosphate phosphatase (A6PP).

[024] A process of the disclosure for the production of mannose comprises converting the F6P to mannose 6-phosphate (M6P) catalyzed by mannose 6-phosphate isomerase (M6PI) or

The claimed invention is:

1. A process for preparing allose from a saccharide, the process comprising:
converting fructose 6-phosphate (F6P) to psicose 6-phosphate (P6P) catalyzed by a psicose 6-phosphate 3-epimerase (P6PE);
converting the P6P to allose 6-phosphate (A6P) catalyzed by an allose 6-phosphate isomerase (A6PI); and
converting the A6P to allose catalyzed by an allose 6-phosphate phosphatase (A6PP),
wherein the process steps are conducted in a single bioreactor.

2. The process of any one of claims 1, further comprising a step of converting glucose 6-phosphate (G6P) to the F6P, wherein the step is catalyzed by a phosphoglucoisomerase (PGI).

3. The process of claim 2, further comprising the step of converting glucose 1-phosphate (G1P) to the G6P, wherein the step is catalyzed by a phosphoglucomutase (PGM).

4. The process of claim 3, further comprising the step of converting a saccharide to the G1P, wherein the step is catalyzed by at least one enzyme, wherein the saccharide is selected from the group consisting of a starch or derivative thereof, and sucrose.

5. The process of claim 4, wherein the at least one enzyme in the step of converting a saccharide to the G1P is selected from the group consisting of alpha-glucan phosphorylase (αGP), maltose phosphorylase, and sucrose phosphorylase, and mixtures thereof.

6. The process of claim 4 or 5, wherein the saccharide is starch or a derivative thereof selected from the group consisting of amylose, amylopectin, soluble starch, amylodextrin, maltodextrin, maltose, and glucose, and mixtures thereof.

7. The process of claim 6, further comprising the step of converting starch to a starch derivative wherein the starch derivative is prepared by enzymatic hydrolysis of starch or by acid hydrolysis of starch.

8. The process of claim 7 or 7, wherein a 4-glucan transferase (4GT) is added to the process.

9. The process of any one of claims 4-8, wherein the starch derivative is prepared by enzymatic hydrolysis of starch catalyzed by an isoamylase, a pullulanase, an alpha-amylase, or a combination thereof.

10. The process of claim 1, wherein the A6PI comprises an amino acid sequence having at least 55% sequence identity with SEQ ID Nos: 1 or 2, and wherein said A6PI catalyzes the conversion of P6P to A6P.

11. The process of claim 10, wherein the A6PI contains a Rossmanoid fold for catalysis, with a His C-terminal to the 1st β-strand of the Rossmanoid fold; an Arg C-terminal to the α-helix C-terminal to the 5th β-strand of the Rossmanoid fold; a His in the active site; a Cys; a Thr in the active site; a GTG-hydrophobic-G motif near the active site, and a Asn near the active site.

12. The process of any one of claims 1 and 10-11, wherein the A6PP comprises an amino acid sequence having at least 30% sequence identity with any one of SEQ ID Nos: 3-7, and wherein said A6PP catalyzes the conversion of A6P to allose.

13. The process of claim 12, wherein the A6PP contains a Rossmanoid fold domain for catalysis, a C1 capping domain, DxD signature in the 1st β-strand of the Rossmanoid fold, a Thr or Ser at the end of the 2nd β-strand of the Rossmanoid fold, a Lys at the N-terminus of the α-helix C-terminal to the 3rd β-strand of the Rossmanoid fold, and a ED signature at the end of the 4th β-strand of the Rossmanoid fold.

14. The process of any one of claims 1-13, wherein the process steps are conducted at a temperature ranging from 40˚C to 70˚C, at a pH ranging from 5.0 to 8.0, and/or for 8 hours to 48 hours.

15. The process of any one of claims 1-14, wherein the process steps are conducted ATP-free, NAD(P)(H)-free, at a phosphate concentration from 0.1 mM to 150 mM, the phosphate is recycled, and/or at least one step of the process involves an energetically favorable chemical reaction.