In a thirteenth embodiment, the poly alpha-1,3-glucan ester compound produced in the reaction is poly alpha-1,3-glucan triacetate. The method in this embodiment further comprises: isolating the poly alpha-1,3-glucan triacetate; contacting the poly alpha-1,3-glucan triacetate with acetic acid and water to form a preparation; and applying steam pressure of 3-10 kg/cm^2 to the preparation to raise its temperature up to 260 °C, wherein poly alpha-1,3-glucan acetate is produced having a degree of substitution of 0.05 to 2.70. Poly alpha-1,3-glucan acetate produced by this method can optionally be isolated.

DETAILED DESCRIPTION OF INVENTION

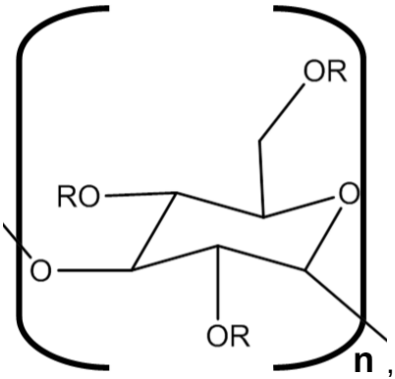
The disclosures of all patent and non-patent literature cited herein are incorporated herein by reference in their entirety.

As used herein, the term “invention” or “disclosed invention” is not meant to be limiting, but applies generally to any of the inventions defined in the claims or described herein. These terms are used interchangeably herein.The terms “poly alpha-1,3-glucan”, “alpha-1,3-glucan polymer” and “glucan polymer” are used interchangeably herein. Poly alpha-1,3-glucan is a polymer comprising glucose monomeric units linked together by glycosidic linkages, wherein at least 50% of the glycosidic linkages are alpha-1,3-glycosidic linkages. Poly alpha-1,3-glucan is a type of polysaccharide. The structure of poly alpha-1,3-glucan can be illustrated as follows:

CLAIMS

What is claimed is:

1. A composition comprising a poly alpha-1,3-glucan ester compound represented by the structure:



wherein

(i) n is at least 6;

(ii) each R is independently an H or acyl group; and

(iii) the compound has a degree of substitution of 0.05 to 3.0; wherein the compound contains two or more types of said acyl group.

2. The composition of Claim 1, wherein the two or more types of said acyl group are selected from the group consisting of acetyl, propionyl, butyryl, pentanoyl, hexanoyl, heptanoyl, and octanoyl.

3. The composition of Claim 2, wherein at least one acyl group is an acetyl group.

4. The composition of Claim 3, wherein the degree of substitution with said acetyl group is 0.05 to 2.6.

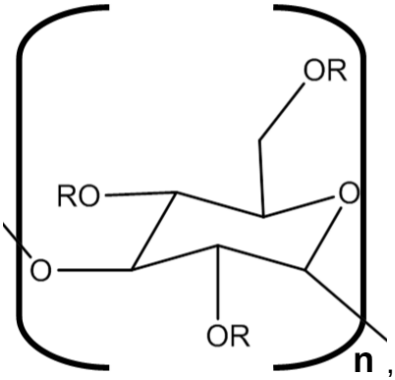
5. The composition of any one of Claims 2 to 4, wherein the two or more types of said acyl group are:

(i) acetyl and propionyl; or

(ii) acetyl and butyryl.

6. A method of producing a poly alpha-1,3-glucan ester compound, the method comprising:

(a) contacting poly alpha-1,3-glucan in a reaction that is substantially anhydrous with at least one acid catalyst, at least one acid anhydride, and at least one organic acid, wherein two or more types of acyl group are esterified to the poly alpha-1,3-glucan thereby producing a poly alpha-1,3-glucan ester compound represented by the structure:



wherein

(i) n is at least 6;

(ii) each R is independently an H or acyl group; and

(iii) the compound has a degree of substitution of 0.05 to 3.0 wherein the compound contains two or more types of acyl group; and

(b) optionally, isolating the poly alpha-1,3-glucan ester compound produced in step (a).

7. The method of Claim 6, wherein the poly alpha-1,3-glucan is acid-exchanged with an organic acid before contacting step (a) to remove water from the poly alpha-1,3-glucan.

8. The method of Claim 6 or Claim 7, wherein the acid catalyst is an inorganic acid.

9. The method of Claim 8, wherein the inorganic acid is sulfuric acid or perchloric acid.

10. The method of any one of Claims 6 to 9, wherein:
the acid anhydride is one or more of acetic anhydride, propionic anhydride, or butyric anhydride; and
the organic acid is one or more of acetic acid, propionic acid, or butyric acid.

11. The method of Claim 10, wherein:
(i) the acid anhydrides are propionic anhydride and acetic anhydride, and the organic acids are propionic acid and optionally acetic acid, wherein the poly alpha-1,3-glucan ester compound produced in the reaction is a poly alpha-1,3-glucan acetate propionate;
(ii) the acid anhydride is propionic anhydride, and the organic acids are propionic acid and acetic acid, wherein the poly alpha-1,3-glucan ester compound produced in the reaction is a poly alpha-1,3-glucan acetate propionate;
(iii) the acid anhydrides are butyric anhydride and acetic anhydride, and the organic acids are butyric acid and optionally acetic acid, wherein the poly alpha-1,3-glucan ester compound produced in the reaction is a poly alpha-1,3-glucan acetate butyrate; or
(iv) the acid anhydride is butyric anhydride, and the organic acids are butyric acid and acetic acid, wherein the poly alpha-1,3-glucan ester compound produced in the reaction is a poly alpha-1,3-glucan acetate butyrate.

12. The method of any one of Claims 6 to 11, wherein the poly alpha-1,3-glucan is further contacted with an organic solvent in step (a).

13. The method of any one of Claims 6 to 12, wherein step (a) comprises:

(i) cooling the reaction;

(ii) cooling a mixture containing the poly alpha-1,3-glucan, acid catalyst and organic acid, and then adding the acid anhydride to the mixture;

(iii) cooling a mixture containing the acid anhydride and organic acid, and then adding the poly alpha-1,3-glucan and acid catalyst to the mixture; or

(iv) cooling a mixture containing the acid catalyst and organic acid, and then adding the poly alpha-1,3-glucan and acid anhydride to the mixture.

14. The method of any one of Claims 6 to 13, wherein at least two acid anhydrides are contacted with poly alpha-1,3-glucan in step (a).