

CLAIMS

What is claimed is:

1. A chemoenzymatic process for the preparation of an oxidized glucose product comprising:

contacting D-glucose with an enzyme selected from the group consisting essentially of galactose oxidase (GAO), glucose oxidase (GOX), polysaccharide monooxygenase, catalase, animal peroxidase, periplasmic aldehyde oxidase (Pao), unspecific peroxygenase (UPO), lactoperoxidase (LPO), myeloperoxidase (MPO), eosinophil peroxidase (EPO), thyroid peroxidase (TPO), ovoperoxidase, salivary peroxidase, vanadium haloperoxidase, non-mammalian vertebrate peroxidase (POX), peroxidasin (Pxd), bacterial peroxicin (Pxc), invertebrate peroxinectin (Pxt), short peroxidockerin (PxDo), alpha-dioxygenase (aDox), dual oxidase (DuOx), prostaglandin H synthase (PGHS), cyclooxygenase (CyOx), linoleate diol synthase (LDS), variants thereof, and combinations thereof under conditions suitable for the formation of an oxidized intermediate; and
contacting the oxidized intermediate with a metal catalyst to form an oxidized glucose product.

2. The chemoenzymatic process of claim 1, wherein the galactose oxidase has SEQ ID NO.:1.

3. The chemoenzymatic process of claim 1, wherein the galactose oxidase has SEQ ID NO.:2.

4. The chemoenzymatic process of claim 1, wherein the galactose oxidase has any of SEQ ID NO.:6 to SEQ ID NO.:11.

5. The chemoenzymatic process of claim 1, wherein the glucose oxidase has SEQ ID NO.:3.

6. The chemoenzymatic process of claim 1, wherein the peroxidase is a lactoperoxidase.

7. The chemoenzymatic process of claim 6, wherein the lactoperoxidase has SEQ ID NO.:5.
8. The chemoenzymatic process of claim 1, wherein the polysaccharide monooxygenase has SEQ ID NO.:4.
9. The chemoenzymatic process of claim 1, carried out at a temperature of less than about 100 °C.
10. The chemoenzymatic process of claim 1, wherein the oxidized glucose product has a purity of greater than about 80%.
11. The chemoenzymatic process of claim 1, wherein the oxidized glucose product comprises guluronic acid.
12. The chemoenzymatic process of claim 1, wherein the oxidized glucose product comprises glucaric acid.
13. The chemoenzymatic process of claim 1, wherein the metal catalyst comprises a support comprising carbon, silica, alumina, titania (TiO₂), zirconia (ZrO₂), zeolite, or any combination thereof.
14. The chemoenzymatic process of claim 1, wherein the metal catalyst is homogeneous.
15. The chemoenzymatic process of claim 1, wherein the metal catalyst is heterogeneous.
16. A chemoenzymatic process for the production of glucaric acid comprising:
contacting glucose with a galactose oxidase having any of SEQ ID NO.:6 to SEQ ID NO.:11. under conditions suitable for formation of D-glucohexodialdose;

- contacting D-glucohexodialdose with a glucose oxidase having SEQ ID NO.:3 under conditions suitable for formation of L-guluronic acid- δ -2,6-lactone; and contacting L-guluronic acid- δ -2,6-lactone with a heterogeneous metal catalyst under conditions suitable for the formation of glucaric acid.
17. A chemoenzymatic process for the production of D-glucono- δ -1,5-lactone comprising:
contacting glucose with a galactose oxidase having any of SEQ ID NO.:6 to SEQ ID NO.:11. and a glucose oxidase having SEQ ID NO.:3 under conditions suitable for the formation of D-glucono- δ -1,5-lactone.
18. A chemoenzymatic process for the production of glucaric acid comprising:
acidifying D-glucono- δ -1,5-lactone to form L-gluconate;
contacting L-gluconate with a galactose oxidase having any of SEQ ID NO.:6 to SEQ ID NO.:11. and a glucose oxidase having SEQ ID NO.:3 under conditions suitable for the formation of L-gulonate; and
contacting L-gulonate with a heterogeneous metal catalyst to form glucaric acid.
19. A chemoenzymatic process for the production of glucaric acid comprising:
contacting a polysaccharide monooxygenase having SEQ ID NO.:4.
under conditions suitable for formation of saccharic acid lactone; and
hydrolyzing saccharic acid lactone at a pH of greater than about 7 to form glucaric acid.
20. A chemoenzymatic process for the production of glucaric acid comprising:
contacting glucose with an enzyme composition comprising a glucose oxidase having SEQ ID NO.:3, a peroxidase, halide ions, and a nitroxyl radical mediator, under conditions suitable for the formation to form an oxidized glucose intermediate; and contacting the oxidized glucose intermediate with a heterogeneous catalyst under conditions suitable for the formation of glucaric acid.

21. The chemoenzymatic process of claim 20, wherein the nitroxyl radical mediator comprises 2,2,6,6-tetramethylpiperidine *N*-oxyl (TEMPO) phthalimide *N*-oxyl or a combination thereof.
22. A manufacturing process comprising:
introducing to a reactor a feedstock comprising glucose and an enzyme selected from the group consisting essentially of galactose oxidase (GAO), glucose oxidase (GOX), polysaccharide monooxygenase, catalase, animal peroxidase, periplasmic aldehyde oxidase (Pao), unspecific peroxygenase (UPO), lactoperoxidase (LPO), myeloperoxidase (MPO), eosinophil peroxidase (EPO), thyroid peroxidase (TPO), ovoperoxidase, salivary peroxidase, vanadium haloperoxidase, non-mammalian vertebrate peroxidase (POX), peroxidasin (Pxd), bacterial peroxidin (Pxc), invertebrate peroxidectin (Pxt), short peroxidockerin (PxDo), short peroxidockerin (Pxt), alpha-dioxygenase (aDox), dual oxidase (DuOx), prostaglandin H synthase, cyclooxygenase (PGHS/CyOx), linoleate diol synthase (LDS), variants thereof and combinations thereof;
operating the reactor under conditions suitable for the formation of a feedstock comprising an oxidized glucose with an aldehyde moiety;

transferring the feedstock comprising an oxidized glucose with an aldehyde moiety to another reactor comprising a heterogeneous metal catalyst; and
operating the another reactor under conditions suitable for the oxidation of the feedstock.