CLAIMS

We Claim:

1. A process for purifying succinic acid from a fermentation broth, the process comprises: filtering a fermentation broth; adjusting pH to yield a succinate-containing filtrate having a pH value less than or equal to about 3.0; running said acidified filtrate through a chromatographic column having a non-functionalized resin selectively at an operational temperature in a range from about 20°C to about 100°C, such that at least two distinct fractions are achieved, at least one of which contains succinic acid or succinate salt.

2. The process according to claim 1, wherein said operational temperature is either a) greater than 50°C to produce a free succinic acid or b) less than 50°C to produce a salt of succinic acid.

3. The process according to claim 2, wherein said operational temperature for free succinic acid is between about 50°C to about 90°C.

4. The process according to claim 2, wherein said operational temperature for free succinic acid is between about 55°C to about 85°C.

5. The process according to claim 2, wherein said operational temperature for salt of succinic acid is between about 20°C to about 50°C.

6. The process according to claim 2, wherein said operational temperature for salt of succinic acid is between about 22°C to about 45°C.

7. The process according to claim 1, further comprising crystallizing a free succinic acid.

8. The process according to claim 7, wherein said free succinic acid is ≥ 90% purity after a single crystallization.

9. The process according to any one of the preceding claims, wherein a distinct peak of said succinic acid appears within 3 bed volumes.

10. The process according to any one of the preceding claims, wherein a distinct peak of succinic acid appears between about 1.0 and about 2.75 bed volumes.

11. The process according to claim 1, wherein said filtrate has a pH in the range of about 1.0 to about 3.0

12. The process according to claim 11, wherein said filtrate has a pH in the range from about 1.5 to about 2.8.

13. The process according to claim 2, wherein a free succinic acid-producing operation is an isocratic elution of deionized water.

14. The process according to claim 2, wherein a salt-producing operation is a binary elution of deionized water and aqueous strong base.

15. The process according to claim 14, wherein said salt-producing operation is a binary elution of deionized water and an organic solvent.

16. The process according to claim 15, wherein said organic solvent is selected from the group consisting of methanol, ethanol, and acetone.

17. The process according to claim 1, wherein said non-functionalized resin is a hydrophobic polystyrene-di-vinylbenzene (PS-DVB).

18. The process according to claim 1, wherein said chromatographic column is part of a continuous separation apparatus.

19. The process according to claim 18, wherein said continuous separation apparatus is a simulated-moving bed (SMB) system.

20. The process according to claim 1, wherein said resin exhibits a greater affinity for succinic acid than the other impurities found in the fermentation broth.

21. The process according to claim 1, wherein said succinic acid is separated from other organic acids, salts, and sugars present in said filtrate.

22. A method for producing a succinate salt, the method comprises: filtering a fermentation broth to yield succinate-containing filtrate, said filtrate having a pH of less than 3.0; processing said filtrate through a liquid chromatographic column over a non-functionalized resin at a temperature up to 70°C, eluting with a strong base or organic solvent to form succinic salts.

23. The method according to claim 22, wherein said strong base is an inorganic base.

24. The method according to claim 23, wherein said inorganic base is NH_3, and said succinic salt is diammonium succinate.

25. The method according to claim 22, wherein said temperature is between about 20°C and about 45°C.

26. The method according to claim 22, wherein a distinct peak of free succinic acid or succinate salt appears within 3 bed volumes.

27. The method according to claim 22, wherein said resin exhibits a greater affinity for succinic acid than the other impurities found in the fermentation broth.

28. The method according to claim 22, wherein said chromatographic column is part of a continuous chromatographic apparatus.

29. A method of purifying succinic acid from a fermentation broth, the method comprising: filtering a fermentation broth to yield a clarified broth; providing or acidifying said clarified broth to a pH value of less than 3.0; introducing said clarified filtrate into a continuous chromatographic apparatus having a non-functionalized resin at an operating temperature predetermined for a particular resin employed to separate free succinic acid; and crystallizing said succinic acid.

30. The method according to claim 29, wherein said succinic acid is separated from other organic acids, sugars and salts in said clarified broth.

31. The method according to claim 29, wherein said crystallization yields succinic acid having at least 90% purity after a single crystallization.

32. The method according to claim 29, wherein said separation of free succinic acid manifests at least two distinct chromatographic peaks within 3 bed volumes.

33. The method according to claim 29, wherein said separation of free succinic acid manifests a succinic acid peak between about 1.0 and 2.75 bed volumes.

34. The method according to claim 29, wherein said separation is an isocratic elution.

35. The method according to claim 29, wherein said operational temperature is between about 20°C and 100°C.

CLAIMS

We claim:

1. A process for obtaining a succinate product from a fermentation broth comprising:

filtering the fermentation broth to obtain a succinate-containing filtrate;

ensuring that the succinate-containing filtrate has a pH of about 3.0 or less;

running said succinate-containing filtrate through a chromatographic column having a non-functionalized resin at an operational temperature in a range of about 20°C to about 100°C,

wherein said operational temperature is selected to produce a column eluent that is selectively either enriched in free succinic acid relative to a salt of succinic acid, or enriched in a salt of succinic acid relative to free succinic acid.

2. The process according to claim 1, wherein said operational temperature is either a) greater than 50°C to produce said eluent enriched in free succinic acid, or b) less than 50°C to produce said eluent enriched in said salt of succinic acid.

3. The process according to claim 2, wherein said operational temperature for producing said eluent enriched in free succinic acid is between about 50°C to about 90°C.

4. The process according to claim 2, wherein said operational temperature for producing said eluent enriched in said salt of succinic acid is between about 20°C to about 45°C.

5. The process according to claim 1, further comprising crystallizing succinic acid from said eluent enriched in free succinic acid.

6. The process according to claim 5, wherein said crystallized succinic acid exhibits ≥ 90% purity after a single crystallization.

7. The process according to claim 1, wherein said eluent enriched in free succinic acid manifests as a distinct chromatographic peak within 3 bed volumes of elution of said column.

8. The process according to claim 1, wherein said succinate-containing filtrate has a pH of about 1.0 to about 3.0.

9. The process according to claim 1, wherein producing said eluent enriched in free succinic acid involves an isocratic elution of said column with deionized water.

10. The process according to claim 1, wherein producing said eluent enriched in said salt of succinic acid involves a binary elution of said column with either a) deionized water and aqueous strong base, or b) deionized water and an organic solvent.

11. The process according to claim 1, wherein said non-functionalized resin is a hydrophobic polystyrene-di-vinylbenzene (PS-DVB).

12. The process according to claim 1, wherein said chromatographic column is configured in a simulated-moving bed (SMB) chromatographic system.

13. A method for producing a succinate salt comprising: filtering a fermentation broth to yield a succinate-containing filtrate; ensuring that said filtrate has a pH of 3.0 or less; processing said filtrate through a liquid chromatographic column over a non-functionalized resin at a temperature of up to 70°C, and eluting said chromatographic column with a strong base or organic solvent to obtain an eluent enriched with a succinic salt.

14. The process according to claim 13, wherein said temperature is between about 20°C and about 45°C.

15. A method of purifying succinic acid from a fermentation broth comprising: filtering a fermentation broth to yield a clarified broth filtrate; ensuring said clarified broth filtrate has a pH of about 3.0 or less; introducing said clarified broth filtrate into a continuous simulated moving bed chromatographic apparatus configured with column comprising a non-functionalized resin, at an operational temperature selected to produce a column eluent that is

selectively enriched in free succinic acid relative to a salt of succinic acid; and crystallizing said free succinic acid from said column eluent.

16. The method according to claim 15, wherein said crystalized free succinic acid has at least 90% purity after a single crystallization.

17. The method according to claim 15, wherein said column eluent of free succinic acid manifests as a distinct chromatographic peak within 3 bed volumes of elution of said column.

18. The method according to claim 17, wherein said column eluent of free succinic acid manifests as a distinct peak between about 1.0 and 2.75 bed volumes of elution of said column.

19. The method according to claim 15, wherein said column is eluted by an isocratic elution.

20. The method according to claim 15, wherein said operational temperature is between about 50°C and 100°C.