CLAIMS

1. A composition for promoting and/or sustaining ketosis in a mammal, comprising:

a beta-hydroxybutyrate mixed salt in solid or powder form, the beta-hydroxybutyrate mixed salt being formed from at least four different cations and comprising:

10-70% by weight of sodium beta-hydroxybutyrate;

10-70% by weight of potassium beta-hydroxybutyrate;

10-70% by weight of calcium beta-hydroxybutyrate; and

10-70% by weight of magnesium beta-hydroxybutyrate.

2. The composition of claim 1, wherein the beta-hydroxybutyrate mixed salt comprises 10% to 30%, or 12% to 25%, or 14% to 22%, or 16% to 20%, or 18%, by weight, of sodium beta-hydroxybutyrate.

3. The composition of claim 1 or 2, wherein the beta-hydroxybutyrate mixed salt comprises 10% to 30%, or 12% to 25%, or 14% to 22%, or 16% to 20%, or 18%, by weight, of potassium beta-hydroxybutyrate.

4. The composition of any one of claims 1 to 3, wherein the beta-hydroxybutyrate mixed salt comprises 10% to 40%, or 12% to 35%, or 15% to 30%, or 18% to 25%, or 20% to 23%, by weight, of calcium beta-hydroxybutyrate.

5. The composition of any one of claims 1 to 4, wherein the beta-hydroxybutyrate mixed salt comprises 10% to 40%, or 12% to 35%, or 15% to 30%, or 18% to 25%, or 20% to 23%, by weight, of magnesium beta-hydroxybutyrate.

6. The composition of any one of claims 1 to 5, further comprising vitamin D_3.

7. The composition of claim 6, wherein the composition comprises 5 µg to 200 µg, or 10 µg to 100 µg, or 15 µg to 75 µg of vitamin D_3.

8. The composition of claim 6 or 7, wherein the composition comprises 200 IU to 8000 IU, or 400 IU to 4000 IU, or 600 IU to 3000 IU of vitamin D_3.

9. The composition of any one of claims 1 to 8, wherein the beta-hydroxybutyrate mixed salt further comprises at least one transition metal beta-hydroxybutyrate.

10. The composition of claim 9, wherein the beta-hydroxybutyrate mixed salt comprises 2% to 40%, or 3% to 30%, or 4% to 20%, or 5% to 15%, or 7% to 13%, by weight, of zinc beta-hydroxybutyrate.

11. The composition of claim 9 or 10, wherein the beta-hydroxybutyrate mixed salt comprises 2% to 40%, or 3% to 30%, or 4% to 20%, or 5% to 15%, or 7% to 13%, by weight, of iron beta-hydroxybutyrate.

12. The composition of any one of claims 1 to 11, wherein the sodium beta-hydroxybutyrate is included in an amount by weight no greater than the amount by weight of the potassium beta-hydroxybutyrate.

13. The composition of any one of claims 1 to 12, wherein the calcium beta-hydroxybutyrate and the magnesium beta-hydroxybutyrate are included in amounts so that the molar ratio of calcium ions to magnesium ions is no greater than 1.

14. The composition of any one of claims 1 to 13, further comprising at least one medium chain fatty acid, or a mono-, di- or triglyceride of the at least one medium chain fatty acid.

15. The composition of claim 14, wherein the at least one medium chain fatty acid has from 6 to 12 carbons, or from 8 to 10 carbons.

16. The composition of any one of claims 1 to 15, further comprising at least one beta hydroxybutyrate-amino acid salt.

17. The composition of claim 16, wherein the at least one beta hydroxybutyrate-amino acid salt includes at least one cationic amino acid or amino acid metabolite.

18. The composition of claim 17, wherein the at least one cationic amino acid or amino acid metabolite is selected arginine, lysine, leucine, iso-leucine, histidine, ornithine, citrulline, glutamine, or creatine.

19. The composition of any one of claims 1 to 18, wherein the beta-hydroxybutyrate mixed salt comprises a racemic mixture of DL-beta hydroxybutyrate.

20. The composition of any one of claims 1 to 18, wherein the beta-hydroxybutyrate mixed salt comprises isolated D-beta hydroxybutyrate or is enriched with D-beta hydroxybutyrate relative to L-beta hydroxybutyrate.

21. A composition for promoting or sustaining ketosis in a mammal, the composition comprising a plurality of salts formulated from at least four different cations and a single anion, wherein the at least four different cations are selected from the group consisting of sodium, potassium, calcium, magnesium, and amino acids, wherein the single anion is beta-hydroxybutyrate, and wherein other anions are omitted from the plurality of salts, the composition being provided in solid or powder form.

22. The composition of claim 21, wherein the at least four different cations comprise sodium, potassium, calcium, and magnesium, and wherein the molar ratio of sodium ions to potassium ions is no greater than 1, and wherein the molar ratio of calcium ions to magnesium ions is no greater than 1.

23. The composition of claim 21 or 22, further comprising one or more additional ingredients mixed with the plurality of salts and configured to lower the hygroscopicity of the composition.

24. A composition for promoting or sustaining ketosis in a mammal, the composition comprising:

a potassium beta-hydroxybutyrate salt;

a sodium beta-hydroxybutyrate salt included in an amount, by weight, that is no greater than an amount, by weight, of the potassium beta-hydroxybutyrate salt;

a magnesium beta-hydroxybutyrate salt; and

a calcium beta-hydroxybutyrate salt included in an amount, by weight, that is no greater than an amount, by weight, of the magnesium beta-hydroxybutyrate salt.

25. The composition of claim 24, further comprising at least transition metal beta-hydroxybutyrate, such as zinc beta-hydroxybutyrate and/or iron beta-hydroxybutyrate.

26. The composition of claim 24 or 25, further comprising at least one BHB-amino acid salt, such as a BHB-amino acid salt that includes BHB and at least one of arginine, lysine, leucine, iso-leucine, histidine, ornithine, citrulline, glutamine, or creatine.

27. The composition of any one of claims 1 to 26 for use in therapy.

28. The composition of any one of claims 1 to 26 for use as a medicament.

29. The composition of any one of claims 1 to 26 for use in the treatment of high blood glucose, treatment of type II diabetes, preventative against metabolic dysfunction,

preventative against mitochondrial defect, preventative against insulin resistance, or improved metabolic health.

30. A composition for increasing blood ketone level in a subject, comprising:

at least three beta-hydroxybutyrate salts selected from:

sodium beta-hydroxybutyrate;

potassium beta-hydroxybutyrate;

calcium beta-hydroxybutyrate; and

magnesium beta-hydroxybutyrate;

wherein the composition is in solid and/or powder form,

wherein the composition is free of medium chain fatty acids having 6 to 12 carbons and glycerides or other esters thereof.

31. The composition of claim 30, wherein the beta-hydroxybutyrate salts comprise:

sodium beta-hydroxybutyrate;

potassium beta-hydroxybutyrate;

calcium beta-hydroxybutyrate; and

magnesium beta-hydroxybutyrate.

32. The composition of claim 31, wherein the composition provides a greater quantity of calcium than each of sodium, potassium, or magnesium.

33. The composition of claim 30, wherein the beta-hydroxybutyrate salts comprise up to 70% by weight of sodium beta-hydroxybutyrate.

34. The composition of claim 30, wherein the beta-hydroxybutyrate salts comprise up to 70% by weight of potassium beta-hydroxybutyrate.

35. The composition of claim 30, wherein the beta-hydroxybutyrate salts comprise up to 70% by weight of magnesium beta-hydroxybutyrate.

36. The composition of claim 30, wherein the beta-hydroxybutyrate salts comprise up to 70% by weight of calcium beta-hydroxybutyrate.

37. The composition of claim 30, wherein the molar ratio of sodium ions to potassium ions in the beta-hydroxybutyrate salts is no greater than 1.

38. The composition of claim 30, wherein the amount of sodium in the beta-hydroxybutyrate salts, by weight, is no greater than the amount of potassium in the beta-hydroxybutyrate salts, by weight.

39. The composition of claim 30, further comprising at least one of anticaking agent, flow agent, moisture absorber, aluminosilicate, ferrocyanide, carbonate salt, bicarbonate salt, silicate, phosphate, talcum, or powdered cellulose.

40. The composition of claim 21, further comprising at least one of acetoacetate, vitamin, lithium, chromium, manganese, cobalt, copper, zinc, iron, molybdenum, selenium, amino acid, flavoring agent, essential oil, natural sweetener, artificial sweetener, or other supplement.

41. A composition for increasing ketone level in a subject, comprising:

at least three beta-hydroxybutyrate salts selected from:

sodium beta-hydroxybutyrate;

potassium beta-hydroxybutyrate;

calcium beta-hydroxybutyrate; and

magnesium beta-hydroxybutyrate;

wherein the composition is provided as or in a tablet, capsule, powder, food product, food additive, drink product, drink additive, vitamin fortified food or drink, or mouth spray,

wherein the composition is free of medium chain fatty acids having 6 to 12 carbons and glycerides or other esters thereof.

42. The composition of claim 41, wherein the beta-hydroxybutyrate salts comprise:

sodium beta-hydroxybutyrate;

potassium beta-hydroxybutyrate;

calcium beta-hydroxybutyrate; and

magnesium beta-hydroxybutyrate.

43. The composition of claim 41, further comprising at least one of acetoacetate, vitamin, lithium, chromium, manganese, cobalt, copper, zinc, iron, molybdenum, selenium, amino acid, flavoring agent, essential oil, natural sweetener, artificial sweetener, or other supplement.

44. A composition for increasing ketone level in a subject, comprising:

a dietetically or pharmaceutically acceptable carrier selected from the group consisting of tablet, capsule, powder, food product, food additive, drink product, drink additive, ethanol, glycerin, propylene glycol, 1,3-propanediolvitamin fortified food or drink, and flavored mouth spray; and

at least three beta-hydroxybutyrate salts selected from:

sodium beta-hydroxybutyrate;

potassium beta-hydroxybutyrate;

calcium beta-hydroxybutyrate; or

magnesium beta-hydroxybutyrate,

wherein the composition is free of medium chain fatty acids having 6 to 12 carbons and glycerides or other esters thereof.

45. The composition of claim 44, wherein the beta-hydroxybutyrate salts comprise:

sodium beta-hydroxybutyrate;

potassium beta-hydroxybutyrate;

calcium beta-hydroxybutyrate; or

magnesium beta-hydroxybutyrate.

46. The composition of claim 30, wherein the composition is in a form that provides about 1 g to about 50 g of total beta-hydroxybutyrate salts.

47. The composition of claim 46, wherein the composition is in a form that provides about 5 g to about 30 g of total beta-hydroxybutyrate salts.

48. The composition of claim 46, wherein the composition is in a form that provides about 10 g to about 20 g of total beta-hydroxybutyrate salts.

49. The composition of claim 31, wherein the composition includes a combined amount of the calcium beta-hydroxybutyrate and the magnesium beta-hydroxybutyrate that exceeds a combined amount of the sodium beta-hydroxybutyrate and the potassium beta-hydroxybutyrate.

50. The composition of claim 41, further comprising a ketone ester

51. The composition of claim 44, further comprising a ketone ester.

52. The composition of any one of claims 30 to 51 for use in therapy.

53. The composition of any one of claims 30 to 51 for use as a medicament.

54. The composition of any one of claims 30 to 51 for use in the treatment of high blood glucose, treatment of type II diabetes, preventative against metabolic dysfunction, preventative against mitochondrial defect, preventative against insulin resistance, or improved metabolic health.