What is claimed is:

1. An edible composition comprising an ~~An engineered~~ algae ~~having a genetic modification~~ preparation derived from Chlamydomonas sp., where in the ~~genetic modification results in an accumulation of~~ algae preparation comprises heme ~~in the algae as compared to an algae lacking the genetic modification~~ and imparts a red or red-like color to the edible composition.

2. The ~~engineered algae~~edible composition ~~of~~ of claim 1, wherein the ~~engineered~~ algae ~~has reduced or absence of chlorophyll production~~ preparation is an algal biomass.

3. The ~~engineered algae~~ edible composition of claim 1 ~~or claim 2~~, wherein the algae ~~has red or red-like color~~ preparation is a fractionated preparation derived from algae cells.

4. The ~~engineered algae according to any~~ edible composition of claim~~s~~ 1 ~~-3~~, wherein the algae preparation is a powder having a red or red-like color ~~is capable of growth on glucose as the sole carbon source~~.

5. The ~~engineered algae according to~~edible composition of ~~-~~any one of claims 1-4, wherein the *Chlamydomonas sp.* of the algae preparation comprises a genetic modification ~~comprises a genetic alteration to a chlorophyll synthesis pathway, protoporphyrinogen IX synthesis pathway or heme synthesis pathway~~ that results in enriched heme content of the algae.

6. The ~~engineered algae according to any~~edible composition of claim~~s 1-~~ 5, wherein the genetic modification ~~is associated with a deficiency in the expression of magnesium chelatase~~ comprises a genetic alteration to a chlorophyll synthesis pathway gene, a protoporphyrinogen IX synthesis pathway gene or a heme synthesis pathway gene.

7. The ~~engineered algae according to~~ edible composition of any one of claims 1-6, wherein the ~~genetic modification comprises an alteration in one or more of CHLD, CHLI1, CHLI2 or CHLH1~~algae preparation comprises a heme content that is greater than the chlorophyll content.

8. The ~~engineered algae~~ edible composition of any one of claim~~s 1–~~7, wherein the ~~*genetic modification comprises an alteration in an upstream regulatory region, a*~~

~~*downstream regulatory region, an exon, an intron or any combination thereof*~~*Chlamydomonas* sp. is *Chlamydomonas reinhardtii*.

9. The ~~engineered algae according to~~ edible composition of any one of claims ~~5~~1-8, wherein the ~~genetic modification comprises an insertion, a deletion, a point mutation, an inversion, a duplication, a frameshift or any combination thereof~~ algae preparation further comprises protoporphyrin IX.

10. ~~The engineered algae according to~~ A food product comprising the edible composition of any one of claims 1-9~~, wherein the engineered algae has a heme content greater than chlorophyll content~~.

11. The ~~engineered algae according to any~~ food product of claim~~s~~ 1-~~9~~0~~, wherein the engineered algae has a protoporphyrin IX content greater than chlorophyll content~~ selected from the group consisting of a beef-like product, a fish-like product, a chicken-like product, a pork-like product and a meat replica.

12. The ~~engineered algae according to any~~food product of claim~~s~~ 10 ~~-~~or claim 11, wherein the ~~engineered~~ algae ~~has reduced production of one or more fatty acids~~ preparation imparts a red color or a red-like color to an uncooked form of the food product.

13. The ~~engineered algae according to any~~ food product of claim~~s~~ 10 or~~-~~ claim ~~12~~11, wherein the ~~engineered~~ algae ~~further comprises a genetic modification that reduces or eliminates expression of light independent protochlorophyllide oxidoreductase~~ preparation imparts a red color or a red-like color to a cooked form of the food product.

14. The ~~engineered algae~~ edible composition of any one of claim~~s~~ ~~13~~1-9, wherein the ~~genetic modification comprises a mutation or deletion in one or more of ChlB, ChlL or ChlN~~ edible composition is an ingredient for a burger, a sausage, a kebab, a filet, a fish-alternative, a ground meat-like product or a meatball.

15. The ~~engineered algae according to~~ food product of any one of claims 10-1~~4~~3~~, wherein the engineered algae has upregulated expression of ferrocheletase~~ further comprising

one or more of: a protein source, a fat source, a carbohydrate, a starch, and a thickener.

16. The ~~engineered algae according to any~~ food product of claim ~~s 1-~~15, wherein the ~~engineered algae has upregulated expression of protoporphyrinogen IX oxidase~~protein source is selected from the group consisting of a wheat protein, a soy protein, a pea protein, a fungal protein, and an algal protein.

17. The ~~engineered algae according to~~ edible composition of any one of claims 1-~~9~~16, wherein the ~~engineered algae contains a recombinant or heterologous nucleic acid~~ edible composition is free of animal proteins.

18. The ~~engineered algae according to~~ edible composition of any one of claims 1-~~9~~17, wherein the ~~engineered~~ algae ~~is a *Chlamydomonas* sp~~ preparation provides omega-3 fatty acids to the edible composition.~~.~~

19. ~~The engineered algae of claim 18, wherein the~~ A method for the production of an algal preparation comprising: (a) culturing an engineered algae, wherein the engineered algae is of a *Chlamydomonas* sp.~~, is *Chlamydomonas reinhardtii*~~ under conditions wherein the algae accumulates heme and exhibits a red or red-like color; and (b) collecting the cultured engineered algae to produce an algae preparation.~~.~~

20. ~~An edible composition comprising an algae preparation~~The method of claim 19, wherein the ~~algae~~ algal preparation ~~comprises an engineered algae of any of claims 1-19 or a portion thereof~~ is an algal biomass.

21. The ~~edible composition~~method of claim 19 or claim 20, ~~wherein the edible composition~~further comprise~~s~~ing ~~heme derived from the engineered algae~~ drying the algal preparation to produce a red or red-like powder.

22. The ~~edible composition~~ method of any one of claim~~s~~ ~~20~~19-21, ~~wherein~~ further comprising (c) combining the algae preparation ~~comprises algae cells~~ with at least one edible ingredient to produce an edible composition.

23. The ~~edible composition~~method of any one of claim~~s~~ ~~20~~19-22, wherein the engineered algae ~~preparation is a fractionated algae preparation~~ comprises engineering by one or

more of UV mutagenesis, chemical mutagenesis, recombinant genetic engineering, gene editing, or gene silencing.

~~24. The edible composition according to any of claims 20-23, wherein the algae preparation is red or red-like in color.~~

~~25. The edible composition according to any of claims 20-24, wherein the edible composition has a red or red-like color derived from the algae preparation.~~

~~26. The edible composition according to any of claims 20-25, wherein the algae preparation confers a meat or meat-like flavor to the edible composition.~~

~~27. The edible composition according to any of claims 20-26, wherein the edible composition has a meat or meat-like texture derived from the algae preparation.~~

~~28. The edible composition according to claim 27, wherein the meat or meat-like texture is a beef or beef-like texture, a fish or fish-like texture, a chicken or chicken-like texture, a pork or pork-like texture or a texture of a meat replica.~~

~~29. The edible composition according to any of claims 20-28, wherein the edible composition is a finished product selected from the group consisting of a beef-like food product, a fish-like product, a chicken-like product, a pork-like product and a meat replica.~~

~~30. The edible composition according to any of claims 20-29, wherein the edible composition is vegan, vegetarian or gluten-free.~~

~~31. The edible composition according to any of claims 20-30, wherein the edible composition has an appearance of blood derived from the algae preparation.~~

~~32. The edible composition according to any of claims 20-31, wherein the algae preparation has a heme content greater than chlorophyll content.~~

~~33. The edible composition according to any of claims 20-32, wherein the algae preparation has a protoporphyrin IX content greater than chlorophyll content.~~

~~34. The edible composition according to any of claims 20-33, wherein the algae preparation provides at least 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%,~~

~~55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 99% or 100% of the total protein content to the edible composition.~~

~~35. The edible composition according to any of claims 20-34, wherein the algae preparation provides vitamin A, beta carotene or a combination thereof to the composition.~~

~~36. The edible composition of claim 35, wherein the vitamin A, the beta carotene or the combination thereof is at least about 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 99% or 100% of the daily recommended requirement.~~

~~37. The edible composition according to any of claims 20-36, wherein the algae preparation provides less than about 0.01%, 0.05%, 0.1%, 0.2%, 0.3%, 0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9%, 1.0%, 1.2%, 1.5%, 2%, 5% or 10% of total saturated fat present in the edible composition.~~

~~38. The edible composition according to any of claims 20-37, wherein the algae preparation provides less than about 0.01%, 0.05%, 0.1%, 0.2%, 0.3%, 0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9%, 1.0%, 1.2%, 1.5%, 2%, 5% or 10% of total saturated fat present in a finished product comprising the edible composition.~~

~~39. The edible composition according to any of claims 20-38, wherein the algae preparation provides at least about 5 mg, 10 mg, 15 mg, 20 mg, 25 mg, 30 mg, 35 mg, 40 mg, 45 mg, 50 mg, 55 mg, 60 mg, 65 mg, 70 mg, 75 mg, 80 mg, 85 mg, 90 mg, 95 mg, 100 mg, 125 mg, 150 mg, 175 mg, 200 mg, 250 mg, 300 mg, 350 mg, 400 mg, 450 mg or 500 mg of omega-3 fatty acids to the edible composition.~~

~~40. The edible composition according to any of claims 20-39, wherein the algae preparation has reduced fatty acid content.~~

~~41. The edible composition according to any of claims 20-40, wherein the edible product is combined with a protein source, a fat source, a carbohydrate, a starch, a thickener, a vitamin, a mineral, or any combination thereof.~~

42. The edible composition of claim 41, wherein the protein source is selected from the group consisting of textured wheat protein, textured soy protein and textured pea protein, fungal protein or algal protein.

43. The edible composition of claim 41, wherein the fat source comprises at least one of refined coconut oil or sunflower oil.

44. The edible composition of any of claims 41-43, further comprising at least one of potato starch, methylcellulose, water, and a flavor, wherein the flavor is selected from the group consisting of yeast extract, garlic powder, onion powder, salt, and any combination thereof.

45. The edible composition of any of claims 41-44, wherein the edible product is an ingredient for a burger, a sausage, a kebab, a filet, a fish-alternative, a ground meat-like product or a meatball.

46. The edible composition of claim 45, wherein the burger comprises about 5% of the algae preparation, about 20% textured soy protein and about 20% refined coconut oil.

47. The edible composition of claim 46, further comprising about 3% sunflower oil, about 2% potato starch, about 1% methylcellulose, about 45% water and about 4-9% flavors.

48. The edible composition of claim 46, further comprising about 0.5% Kojac gum, about 0.5% Xanthan gum, about 45% water and about 4-9% flavors.

49. The edible composition of claim 45, wherein the fish-alternative comprises 20% textured soy protein, about 5 % of algae preparation, about 65% water and about 10% flavors.

50. The edible composition according to any of claims 20-49, wherein the edible composition is free of animal proteins.

51. The edible composition according to any of claims 20-50, wherein the algae preparation comprises an algae having an increase in protoporphyrinogen IX synthesis or accumulation.

52. The edible composition according to any of claims 20-51, wherein the algae preparation comprises an algae that exhibits a red or red-like color when grown in the dark conditions.

53. The edible composition according to any of claims 20-52, wherein the algae in the algae preparation are recombinant or genetically modified algae.

54. The edible composition according to any of claims 20-53, wherein the algae preparation comprises a *Chlamydomonas* sp.

55. The edible composition of claim 54, wherein the *Chlamydomonas* sp. is *Chlamydomonas reinhardtii*.

56. A method for the production of an edible composition comprising:

(a) culturing an engineered algae according to any of claims 1-19 in a condition where the engineered algae exhibits a red or red-like color and wherein the engineered algae produces heme;

(b) collecting the cultured engineered algae to produce an algae preparation; and

(c) combining the algae preparation with at least one edible ingredient to produce an edible composition.

57. The method of claim 56, wherein the condition comprises a fermentation condition.

58. The method according to any of claims 56-57, wherein the condition comprises acetate as a reduced carbon source for growth of the engineered algae.

59. The method according to any of claims 56-58, wherein the condition comprises sugar as a reduced carbon source for growth of the engineered algae.

60. The method according to any of claims 56-59, wherein the condition comprises dark or limited light conditions.

61. The method according to any of claims 56-60, wherein the method further comprises fractionating the cultured algae to produce the algae preparation.

62. The method according to any of claims 56-61, wherein the algae preparation has a heme content that is greater than chlorophyll content.

63. The method according to any of claims 56-62, wherein the algae preparation has a protoporphyrin IX content that is greater than chlorophyll content.

64. The method according to any of claims 56-63, wherein the condition further comprises iron supplements.

65. The method according to any of claims 56-64, wherein the engineered algae is a *Chlamydomonas* sp.

66. The method of claim 65, wherein the engineered algae is a *Chlamydomonas reinhardtii*.

67. The method according to any of claims 56-66, wherein the edible composition has at least one feature selected from the group consisting of a meat or meat-like flavor, a meat or meat-like texture, a blood-like appearance and a meat or meat-like color, wherein the at least one feature is derived from the algae preparation.

68. The method according to any of claims 56-67, wherein the method further comprises producing a finished product comprising the edible composition and wherein the finished product is a beef-like food product, a fish-like product, a chicken-like product, a pork-like product or a meat replica.

69. The method according to any of claims 56-68, wherein the edible composition is free of animal proteins.

70. The method according to any of claims 56-69, wherein the algae preparation is fractionated to remove one or more of starch, protein, PPIX, fatty acids and chlorophyll.

71. A method of making an engineered algae enriched in heme content, comprising:

(a) subjecting an algae strain to a process that produces genetic modification to create a first algae population; and

(b) from the first algae population, selecting a second algae population that is enriched in heme content, and optionally, PPIX content.

~~72. The method according to claim 71, wherein the process comprises at least one of a random UV mutagenesis, a random chemical mutagenesis, a recombinant genetic engineering, a gene editing, or a gene silencing.~~

~~73. The method according to claim 71 or claim 72, further comprising culturing the first algae population in a fermentation condition.~~

~~74. The method according to claim 73, wherein the fermentation condition comprises a media having sugar as a sole carbon source.~~

~~75. The method according to claim 74, wherein the sugar is selected from the group consisting of glucose, dextrose, fructose, maltose, galactose, sucrose, and ribose.~~

~~76. The method according to any of claims 73-75, wherein the fermentation condition comprises a brightness of less than 500 lux.~~

~~77. The method of any of claims 73-76, wherein the step of selecting the second algae population comprises sorting or identifying algae cells having a red or red-like color.~~

~~78. The method of any of claims 73-77, wherein the selecting is performed by FACS.~~

~~79. The method according to any of claims 73-78, wherein the second algae population is selected with its capability to grow in the fermentation condition.~~

~~80. The edible composition according to any of claims 20-59, wherein the algae preparation comprises an algae having an increase in protoporphyrinogen IX synthesis or accumulation.~~

~~81. The edible composition according to any of claims 20-59, wherein the algae preparation comprises an algae that exhibits a red or red-like color when grown in dark conditions.~~