THEREFORE WHAT IS CLAIMED IS:

1. A process for producing fibrous meat analogs, comprising:

a) preparing an ingestible biopolymer gel, solution, or dispersion comprised of one or more ingestible proteins and/or hydrocolloids, and water;

b) subjecting the biopolymer gel, solution, or dispersion to directional freezing inducing formation of aligned elongated ice crystals to form a directionally frozen biopolymer gel, solution, or dispersion with aligned elongated channels in which the aligned elongated ice crystals are located;

c) replacing the aligned elongated ice crystals with ingestible proteins and/or hydrocolloids to produce an infused gel; and

d) subjecting the infused gel to a suitable condition to gel at least some of the ingestible proteins and/or hydrocolloids to create gelled proteins and/or hydrocolloids within the aligned channels to form a fibrous food product;

wherein the ingestible proteins and/or hydrocolloids of steps a) and c) are the same or different.

2. The process according to claim 1, wherein the ingestible biopolymer gel, solution, or dispersion is:

(i) a hydrocolloid gel, solution or dispersion, preferably a hydrocolloid gel, comprising one or more different ingestible hydrocolloids and water;

(ii) a composite gel, solution or dispersion comprising one or more different ingestible hydrocolloids and one or more different ingestible proteins, and water; or.

(iii) a protein gel, solution or dispersion comprising one or more different ingestible proteins and water.

3. The process according to any of preceding claims, wherein the ingestible hydrocolloids comprises one or more of agar, gellan gum, alginate, regular and/or recombinant gelatin, curdlan, kappa-carrageenan, kappa 2-carrageenan and iota-carrageenan, furcelleran, starch, modified starch, seaweed extract, dextrins, konjac glucomannan, methylcellulose, pectin, xanthan gum, guar gum, locust bean gum, gum Arabic, tara gum, or a polysaccharide;

preferably the hydrocolloid is:

a kappa-carrageenan hydrogel having a modulus in a range from about 100 to about 5000 Pascals; or

an agar hydrogel having an agar concentration in a range from about 0.1% to about 15 wt %.

4. The process according to any of preceding claims, wherein the ingestible proteins comprise gellable proteins, non-gellable proteins, or combinations thereof, wherein the ingestible proteins comprise cultured proteins; animal proteins, such as recombinant proteins; plant proteins; bacterial proteins; fungal proteins, such as yeast protein; algae proteins; or combinations thereof;

preferably wherein the ingestible proteins are any one, or any combination, of potato protein, soy protein, pea protein, mammalian whey proteins, caseins or caseinates; rubisco protein, lemna protein, rice protein, almond protein, egg protein, oat protein, flax seed protein, euglena protein, schizochytrium protein, mung bean protein, recombinant mammalian whey, cultured mammalian whey, recombinant egg albumin, cultured egg albumin, recombinant gelatin or collagen, cultured gelatin or collagen, canola protein, lupin protein, fava protein, wheat protein, lentil protein, amaranth protein, peanut protein, moringa seed protein, pumpkin seed protein, chickpea protein, sunflower seed protein, safflower seed protein, mustard seed protein, chlorella protein and spirulina protein.

5. The process of any of preceding claims, wherein step c) comprise thawing the directionally frozen biopolymer gel, solution, or dispersion; and optionally the process comprise multiple cycles of directionally freezing and thawing.

6. The process according to any of preceding claims, wherein step c) comprise:

(i) thawing the directionally frozen biopolymer gel, solution, or dispersion by immersion in a solvent, preferably a solvent containing the ingestible proteins and/or hydrocolloids of step c), having a temperature suitable to melt the ice crystals;
(ii) subjecting one end of the infused gel under vacuum to extract the ice crystals and to pull the ingestible proteins and/or hydrocolloids of step c) into the aligned elongated channels from another end of the infused gel;
(iii) freeze drying the directionally frozen biopolymer gel, solution, or dispersion to remove substantially all the water and then immersing the dried gel into a solution containing the ingestible proteins and/or hydrocolloids of step c); or
(iv) evaporating the ice crystals and then immersing the dried gel into a solution containing the ingestible proteins and/or hydrocolloids of step c).

7. The process according to any of preceding claims, further comprising controlling the diameter of the aligned elongated channels by controlling the temperature gradient across the material in order to alter the speed of the directional freezing process, and wherein a diameter of gelled proteins in the aligned elongated channels is proportional to the diameter of the aligned elongated channels;

preferably wherein the diameter of the aligned elongated channels are controlled to give elongated gelled proteins having a diameter in a range from about 20 to about 500 microns.

8. The process according to any of preceding claims, wherein the biopolymer gel, solution, or dispersion is a solution or dispersion, and the process comprises:

(i) gelling the solution or dispersion prior to step c) by further subjecting the directionally frozen solution or dispersion to the suitable condition;

(ii) inducing the gelation of the solution or dispersion by immersing in a suitable solution, prior to step c); or

(iii) gelling the solution or dispersion at the same time as directional freezing.

9. The process according to claim 7, wherein the biopolymer solution or dispersion comprise first and second hydrocolloids, preferably an agar-alginate solution, and wherein the process comprises:

a) gelling the first hydrocolloid, preferably agar,

b) subjecting the biopolymer to directional freezing,

c) thawing the biopolymer and gelling the second hydrocolloid in a gelling agent, preferably wherein the second hydrocolloid is alginate and preferably wherein the gelling agent is a calcium ion solution, and

d) infusing with ingestible proteins.

10. The process according to any one of preceding claims, wherein the suitable condition comprises:

(i) heat treating the infused gel, preferably at a temperature in a range from about 40° C to about 150° C, and wherein the ingestible proteins comprise at least a heat gellable protein;

(ii) infiltrating a solution containing a crosslinking agent into the infused gel, the crosslinking agent selected to induce gelation of said at least some of the ingestible proteins and/or hydrocolloids; preferably wherein the crosslinking agent is a chemical cross-linking agent comprising glutaraldehyde, tannins, genipin, liquid smoke, or a combination thereof; or preferably wherein the crosslinking agent is an enzyme-based crosslinking agent, comprising transglutaminase (EC 2.3.2.13), sortase A (EC 3.4.22.70), tyrosinase (EC 1.14.18.1), Laccase (EC 1.10.3.2), peroxidase (EC 1.11.1.x), lysyl oxidase (EC 1.4.3.13), amine oxidase (EC 1.4.3.6), or a combination thereof;

(iii) adjusting a pH of the infused gel to a value suitable to cause gelation of said at least some of the ingestible proteins and/or hydrocolloids; preferably wherein adjusting the pH of the infused gel comprises adding a food safe pH modifier comprising acetic acid, hydrochloric acid, ascorbic acid, malic acid, formic acid, lactic acid, tartaric acid, citric acid, gluconic acid, glucono-delta lactone, sodium hydroxide, potassium hydroxide, calcium hydroxide, or combinations thereof;

(iv) infiltrating a salt or ions into the infused gel, the salt selected to induce gelation of said at least some of the ingestible proteins and/or hydrocolloids; preferably wherein infiltrating the salt comprises contacting the infused gel with a sufficient concentration of salt solution to allow gelation of said at least some of the ingestible proteins and/or hydrocolloids; and more preferably wherein the salt is any one of sulfate, citrate, chloride, carbonate, ascorbate, acetate, sorbate, lactate, tartrate, gluconate and phosphate salts of sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg), and any combination thereof;

(v) pressure treating of the infused gel to induce gelation of said at least some of the ingestible proteins and/or hydrocolloids; and/or

(vi) irradiating the infused gel with radiation of suitable wavelength and intensity to induce crosslinking of the protein thereby inducing gelling of said at least some of the ingestible proteins.

11. The process according to any of preceding claims, wherein the ingestible biopolymer gel, solution, or dispersion has multiple layers, optionally, alternating layers are made with same or different biopolymer or biopolymer blends; and

preferably the process comprise producing a layer mimicking a skin layer of meat or fish by producing a mixture of an agar and alginate solution with an alginate-oil emulsion and gelling the mixture to produce a skin layer.

12. The process according to any of preceding claims, further comprising producing a plurality of protein infused biopolymer gels each having a preselected thicknesses, and preparing an interstitial layer made of materials selected to emulate connective tissue of meats and/or fish; wherein the plurality of protein infused biopolymer gels are stacked and adhered to the interstitial layer; and preferably wherein the interstitial layer comprise materials selected to emulate connective tissue of meats and/or fish comprises any one or a combination of protein, hydrocolloid, oil-in-water emulsion, solid particles, fats and oleogel; more preferably, the solid particles comprise any one or combination of titanium dioxide, protein, calcium carbonate, starch, solid fat crystals and algae.

13. The process according to claim 8, further comprising:

i) replacing the aligned elongated ice crystals with a mixture comprising A) the second ingestible proteins and/or hydrocolloids, and B) the colorant or a tastent;

wherein the colourant comprises carotenoids, beta-carotene, astaxanthin, lycopene, bixin, anthocyanins, betalain, hemoglobin, myoglobin, beet juice extract, safflor yellow, lutein, curcumin, capsanthin, capsorubin, norbixin, anthocyanins, curcuminoids, turmeric, phycocyanins, melanoidins, or combinations thereof; or

ii) adding a colorant during preparation of the biopolymer gel, solution, or dispersion.

14. The process according to claim 1, comprising:

subjecting the ingestible biopolymer gel to directional freezing inducing formation of aligned elongated ice crystals to form a directionally frozen biopolymer gel with aligned channels in which the aligned elongated ice crystals are located;

thawing the directionally frozen biopolymer gel with the aligned channels by immersing the frozen biopolymer in a solution containing at least one ingestible soluble heat gelling protein, preferably said solution containing at least one ingestible soluble heat gelling protein has a temperature of about 1° C. to about 60° C, thereby melting and replacing the aligned elongated ice crystals with the at least one ingestible soluble heat gelling protein at a temperature below the gelling temperature of the soluble heat gelling protein, to produce a protein infused biopolymer gel; optionally varying the immersion time of the frozen biopolymer or varying a volume ratio of the ingestible biopolymer gel and the solution containing the at least one ingestible soluble heat gelling protein, to control protein loading; and

heating the protein infused biopolymer gel at a temperature above the gelling temperature of the at least one ingestible soluble heat gelling protein to create protein fibers to form a fibrous meat analog food product, preferably the ingestible biopolymer gel has a melting temperature greater than the gelling temperature of the ingestible soluble heat gelling protein.

15. The process according to claim 14, wherein the ingestible biopolymer gel is:

a) a hydrocolloid gel comprising one or more different ingestible hydrocolloids and water;
b) a composite gel comprising i) at least two different ingestible hydrocolloids, ii) at least two different ingestible proteins, or iii) one or more different ingestible hydrocolloids and one or more different ingestible proteins; and water; or
c) a protein gel comprising one or more different ingestible proteins and water.

16. The process according to any one of claims 5, 6, 14, and 15, wherein thawing the directionally frozen hydrocolloid gel includes adjusting the temperature of the solvent containing the ingestible gellable proteins to be in a range from the melting point of the solvent within the hydrocolloid gel to the melting point of the hydrocolloid gel, and wherein replacing the aligned elongated ice crystals with the ingestible proteins includes adjusting the temperature of the solvent containing the ingestible proteins to be in a range from the freezing point of the solvent containing the protein solution to a gelation onset denaturation temperature of said at least some of the ingestible proteins;

preferably thawing the directionally frozen hydrocolloid gel is conducted between about 0^{o}C to about 85^{o}C, more preferably between about 0^{o}C to about 45^{o}C.

17. The process of any one of claims 9 and 14-16, wherein the solution containing at least one ingestible soluble heat gelling protein further comprises an ingestible non-heat gelling protein, and a heat induced trigger agent to trigger gelling of the ingestible non-heat gelling protein as the temperature is raised, preferably the heat induced trigger agent comprises a salt, enzyme, pH modifier, or combination thereof, more preferably the enzyme is an enzyme microencapsulated within a meltable coating.

18. The process of any of preceding claims, wherein the step of directional freezing is conducted by placing the biopolymer gel, solution, or dispersion in contact with a pre-cooled substrate to give directional freezing in one direction, or placing the ingestible biopolymer gel

between two pre-cooled substrates, wherein the directional freezing proceeds from opposite directions, preferably at a temperature of about minus 2° C. to about minus 196° C.

19. The process of any one of claims 14-18, wherein the solution containing at least one ingestible soluble heat gelling protein further comprise flavors, tastants, emulsifiers, preservatives, colors, pH modifiers, texture modifiers, ingestible supplements or a combination thereof;

preferably the solution containing at least one ingestible soluble heat gelling protein further comprise ingestible supplements that diffuse into the aligned channels, wherein the ingestible supplements comprise: water-soluble vitamins, including ascorbic acid (vitamin C), thiamin, riboflavin, niacin, vitamin B_6 (pyridoxine, pyridoxal, and pyridoxamine), folacin, vitamin B_{12}, biotin, pantothenic acid, and combinations thereof; or emulsions of esters of omega-3, omega-6, omega-9 fatty acids or a combination thereof; ingestible minerals; and/or anti-oxidants.

20. The process of any preceding claims, further exposing the infused gel to an agent that acts to prevent leakage of protein from the infused gel, wherein said agent comprises any one or combination of a pH modifier, salt, heat treatment, chemical crosslinking agents, enzymatic crosslinking agents, infusion of a gelling hydrocolloid, and applying a hydrocolloid coating to said protein infused hydrocolloid gel.

21. A fibrous analog food product produced by the process of any of preceding claims, preferably wherein the food product is a fibrous mammalian meat, poultry or seafood analog foo d product;

more preferably:

wherein the ingestible proteins are present in a range from about 2 wt.% to about 50 wt.%, preferably from about 5 wt.% to about 50 wt.%, preferably from about 5 wt.% to about 35 wt.%, preferably from about 10 wt.% to about 30 wt.%, preferably from about 15 wt.% to about 25 wt.%, preferably from about 10 wt.% to about 20 wt.% in the food product; and

wherein the hydrocolloid is present in a range from about 0.2 wt.% to about 10 wt.%, preferably about 0.5 wt.% to about 8 wt.%, preferably about 0.5 wt.% to about 5 wt.% in the food product.

22. The food product according to claim 21, wherein a maximum amount of protein present is 25 wt.%, then a minimum amount of ingestible heat gellable protein in the mixture is 2 wt.%, preferably 8 wt.%, more preferably 10 wt.%, and a maximum amount of non-heat gellable protein is 23 wt. %, preferably 17 wt. %, more preferably 15 wt. %.