

**CLAIMS:**

1. A whole muscle meat substitute comprising one or more layers of digitally printed protein-containing strands, wherein

each layer comprises a single convoluted strand or a plurality of strands such that segments between folds of the single strand or the plurality of strands are arranged in an essentially parallel along their longitudinal axis, the strand or strands comprising one or more bundles of axially aligned texturized protein fibers; and

wherein at least a portion of the texturized protein fibers comprises elongated fibers having a length above 5mm.

2. The whole muscle meat substitute of claim 1, wherein at least a portion of the segments between folds of the single strand or of the plurality of strands are interconnected one to its neighboring strand.

3. The whole muscle meat substitute of claim 1 or 2, wherein the axially aligned fibers within a segment of a strand have a nominal direction that is not more than  $\pm 45^\circ$  from the direction of the segment of the strand when the bundle of axially aligned fibers is viewed from a direction perpendicular to the segment's direction.

4. The whole muscle meat substitute of any one of claims 1 to 3, wherein the axially aligned fibers within a segment of a strand have a nominal direction that is not more than  $\pm 45^\circ$  from the direction of the segment of the strand when the bundle of axially aligned fibers is viewed from a direction perpendicular to a plane defined by the layer comprising the segment of the strand.

5. The whole muscle meat substitute of any one of claims 1 to 4, wherein said protein containing strands comprise said elongated fibers in an amount that constitutes at least 10%w/w out of the amount of protein in said protein-containing material.

6. The whole muscle meat substitute of claim 5, wherein said protein-containing strands comprise denatured protein.

7. The whole muscle meat substitute of any one of claims 1 to 6, wherein said protein containing strands comprise Texturized Vegetable Protein (TVP).

8. The whole muscle meat substitute of any one of claims 1 to 7, having a modified tensile strength above 0.02MPa when measured in a direction parallel to the strand nominal direction.
9. The whole muscle meat substitute of any one of claims 1 to 8, having a first modified tensile strength value measured in a P direction that is parallel to the strands nominal direction and a second modified tensile strength value measured in the XP direction that is perpendicular to the strands nominal direction and parallel to a layer's plane, wherein said first modified tensile strength value is at least 50% higher than the second modified tensile strength value.
10. The whole muscle meat substitute of any one of claims 1 to 9, having a modified shear resistance above 10N when measured in a XP direction that is parallel to the strands' nominal direction.
11. The whole muscle meat substitute of any one of claims 1 to 10, having a first modified shear resistance value that is measured in a direction parallel to the strands nominal direction and a second modified shear resistance value that is measured in a direction perpendicular to the strands nominal direction and parallel to a layer's plane, wherein said second modified shear resistance value is at least 100% greater than the first modified shear resistance value.
12. The whole muscle meat substitute of any one of claims 1 to 11, comprising two or more layers of said digitally printed strands.
13. The whole muscle meat substitute of claim 12, wherein two or more layers are in interconnected at one or more points along each layer.
14. The whole muscle meat substitute of any one of claims 1 to 13, comprising a fat-based component and a water-based component.
15. The whole muscle meat substitute of claim 14, wherein said fat-based component and/or water-based component are disposed or dispersed in between the digitally printed, protein containing strands.
16. The whole muscle meat substitute of claim 14 or 15, wherein at least a portion of the one or more layers comprise said fat-based component.

17. A method of producing a meat substitute the method comprising:
- introducing into a printer head of a digital printer protein-containing material; and
  - operating the digital printer to dispense onto a printer bed a single convoluted protein containing strand or a plurality of individual protein containing strands, the single strand being folded or the plurality of said strands being arranged such that segments between folds of the single strand or the plurality of strands are essentially parallel along their longitudinal axis;
- wherein the protein containing strand comprises texturized protein; and
- wherein at least a portion of the texturized protein comprises elongated fibers having a length above 5mm.
18. The method of claim 17, wherein said convoluted strand or the plurality of individual strands form a monolayer.
19. The method of claim 17 or 18, wherein said dispensing is operated to allow at least a portion of the segments between folds of the single strand or of the plurality of strands within a monolayer to be interconnected.
20. The method of any one of claims 17 to 19, wherein said strands comprise a bundle or bundles of axially aligned fibers.
21. The method of claim 20, wherein said bundle of axially aligned fibers within a segment of a strand has a nominal direction that is not more than  $\pm 45^\circ$  from the direction of the segment of the strand when the bundle of axially aligned fibers is viewed from a direction perpendicular to the segment's direction.
22. The method of claim 20, wherein the axially aligned fibers within a segment of a strand have a nominal direction that is not more than  $\pm 45^\circ$  from the direction of the segment of the strand when the bundle of axially aligned fibers is viewed from a direction perpendicular to a plane defined by a printed layer comprising the segment of the strand.
23. The method of any one of claims 17 to 22, wherein said protein containing material comprises denatured protein.

24. The method of any one of claims 17 to 22, wherein said texturized protein comprises TVP.
25. The method of any one of claims 17 to 24, wherein the amount of texturized protein in said protein containing material is at least 10%w/w out of the total weight of the protein containing material.
26. The method of any one of claims 17 to 25, wherein said operating of the digital printer comprises dispensing a single elongated strand of said protein containing material into a horizontal layer such that segments between folds of the single strand in the layer are arranged in an essentially parallel orientation along their longitudinal axis.
27. The method of any one of claims 17 to 26, wherein said operating of the digital printer comprises dispensing a plurality of axially aligned contiguous strands.
28. The method of any one of claims 17 to 27 comprising manipulating the dispensed strands or segments of the dispensed strands to interconnect.
29. The method of any one of claims 17 to 28, comprising allowing each layer of dispensed strands to rest prior to applying a subsequent layer thereon.
30. The method of any one of claims 17 to 29, comprising dispensing a plurality of layers of said protein containing strand.
31. The method of any one of claims 17 to 30, wherein said dispensing is through a printer head including a progressive cavity pump (PCP).
32. The method of any one of claims 17 to 31, wherein said dispensing is through a printer head including a piston.
33. The method of claim 32, comprising compacting the plurality of layers of said protein containing strands.
34. The method of claim 33, wherein said compacting comprises applying negative pressure onto the dispensed layers.
35. The method of any one of claims 17 to 34, wherein said dispensing causes change in shape and/or size of fibers within the protein containing material.