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(71) Applicant: **CARGILL, INCORPORATED** [US/US]; 15407 McGinty Road West, Wayzata, Minnesota 55391 (US).

(72) Inventor: **SENARATNE-LENAGALA, Lasika Shyamalie**; 15407 McGinty Road West, Wayzata, Minnesota 55391 (US).

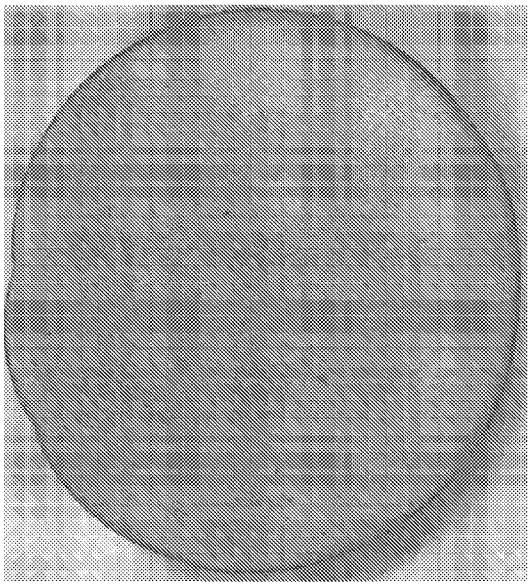
(74) Agent: **HOTCHKISS, Edward S.**; CARGILL, INCORPORATED, 15407 McGinty Road West, MS24, Wayzata, Minnesota 55391 (US).

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(54) **Title:** PLANT BASED DELI MEAT ANALOGUE PRODUCTS

FIG. 2



(57) **Abstract:** A plant-based deli meat analogue product is prepared by hydrating non-gluten plant protein, and then mixing plant-based oil and hydrocolloid, Vital Wheat Gluten and an edible acid to form a plant-based dough that is formed into a dough log and cooked to an internal temp of at least about 180°F to form a plant-based deli meat analogue product. By selection of specific ingredients in effective ratios, and mixing the ingredients in a specific order, a plant-based deli meat analogue product may be prepared having excellent appearance and texture.

[Continued on next page]

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PLANT BASED DELI MEAT ANALOGUE PRODUCTS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 63/505,279, filed May 31, 2023, which is incorporated by reference herein in its entirety.

FIELD

[0002] The present invention relates to plant-based deli meat analogue products.

BACKGROUND

[0003] Consumers increasingly desire protein choices that are alternatives to animal meat protein for a variety of reasons. At the same time, many consumers enjoy the flavors and textures that are uniquely provided by meats obtained from animals. For this reason, a number of companies have striven to provide plant-based meat substitutes that replicate the experience of cooking and eating meat.

[0004] Examples of plant-based meat substitute products include the Impossible Burger from Impossible Foods, The Beyond Burger from Beyond Meat, and Ultimate Beefless Burger from Gardein. These and other products are discussed, for example, at https://www.healthline.com/nutrition/vegan-meat-substitutes#section4, which states that the Beyond Burger is made from pea protein, canola oil, coconut oil, potato starch and other ingredients.

[0005] Likewise, extruded meat substitute compositions are described in WO 2017/046659 that comprise one or more sources of plant protein, one or more sources of lipid, one or more sources of carbohydrate, and water, wherein the one or more sources of carbohydrate may in some embodiments comprise fruit, fruit powder or chia seed extract, or any combination of any two or more thereof. In this composition, the sources of lipid may comprise a plant fat or oil; over 60 such oils are listed.

[0006] A meat substitute product made from wheat called "wheat meat" or "seitan" is known and can be used as a basis for vegetarian products. https://www.thespruceeats.com/what-is-seitan-3376819. Home recipes for making seitan are known, such as described at https://www.thespruceeats.com/how-to-make-seitan-3376639. Such recipes describe a simple process of combining ingredients such as vital wheat gluten flour, chickpea flour, nutritional yeast, ground ginger, and garlic powder in a bowl, mixing, kneading and cooking the product.

[0007] US Patent No. 7,070,827 to Cavallini describes a Vegetable protein meat analogue made by a process of sequentially blending methyl cellulose into a water/ice mix to form a cream, then blending in a modified gluten, a vegetable protein product having high solubility in water and capable of forming a gel with mild heat treatment, an oil to make an emulsion base, and a modified food starch and flavoring ingredients to form a flavored emulsion base.

[0008] US Patent Application Publication No. 2019/0191725 to Gladden describes a method of making seitan snack food products, wherein a spongy dough comprising a high amount of wheat gluten is formed into a loaf and subjected to a series of cooling and cooking steps including chilling, boiling, cooling, frying, and drying to produce imitation bacon snack food products with a low water activity of less than 0.85.

SUMMARY

[0009] Meat analogue products for purposes of the present discussion are food products that mimic meat but which contain no animal meat ingredients. Previous attempts at preparing meat analogue products often fall short of the desired organoleptic experience, because they lack one or more of the visual and textural characteristics of the animal meat it is intended to mimic. Moreover, it is particularly challenging to achieve the desired consistency and texture of the meat analogue product while using only non-animal-sourced components, without incorporating a number of additives that present a long ingredient list with names that sound artificial and undesirable to the average consumer.

[0010] It has been found that by selection of specific ingredients in effective ratios, and mixing the ingredients in a specific order, a plant-based deli meat analogue product may be prepared having excellent appearance and texture. In particular, a plant-based dough is formed by hydrating the non-gluten plant protein, incorporating other ingredients as desired, then incorporating Vital Wheat Gluten followed by mixing with an edible acid. When cooked, the plant-based dough exhibits excellent bite characteristics with a dense texture having a microfiber-like strands that mimics the texture of deli meats. By incorporation of appropriate flavorants and colorants, plant-based deli meat analogue products can be readily prepared that effectively mimic specific deli meat products, such as sliced chicken, turkey, ham or beef.

[0011] It has been found that addition of the edible acid to the intermediate mixture already containing the non-gluten plant protein and the Vital Wheat Gluten composition in an amount sufficient to provide a dough having a pH of from about 4.5 to about 7 provides a plant-based deli meat analogue product having excellent deli-meat like appearance and texture characteristics. In an aspect, it was found that addition of edible acid lightened the color of the final deli-meat product as compared to like compositions that did not contain the edible acid. In

an aspect, it was found that addition of edible acid as the last ingredient added before cooking provides excellent texture properties with a fibrous appearance when the meat analogue is torn apart, in contrast to like compositions wherein the edible acid introduced in an earlier stage of the process. Additionally, it was found that addition of edible acid as the last ingredient added before cooking provides excellent resilience properties when the meat analogue is physically manipulated (e.g., by folding a slice of the product), which is in contrast to like compositions wherein the edible acid introduced in an earlier stage of the process that easily break apart and are "brittle" when physically manipulated.

[0012] In an aspect, a method of preparing a plant-based deli meat analogue product comprises

a) mixing non-gluten plant protein with water to form a hydrated non-gluten plant protein,

b) mixing the hydrated non-gluten plant protein with a plant-based oil and hydrocolloid to form a protein intermediate composition,

c) mixing the protein intermediate composition with Vital Wheat Gluten to form a protein/gluten mixture intermediate composition,

d) mixing the protein/gluten mixture intermediate composition with an edible acid to form a plant-based dough,

e) dispensing the plant-based dough into a casing to form a dough log,

f) cooking the dough log at humidity greater than about 80% at an oven temp of from about 170°F to about 220°F to an internal temp of from about 180°F to about 200°F to form a cooked dough log, and

g) chilling the cooked dough log to an internal temperature of from about 30F to about 45F. to provide a plant-based deli meat analogue product; wherein

the plant-based deli meat analogue product comprises

from about 5 wt% to about 20 wt% soy protein

from about 40 wt% to about 87 wt% water

from about 0.5 wt% to about 5 w% oil

from about 2 wt% to about 10 wt% Hydrocolloid

from about 5 wt% to about 20 wt% Vital Wheat Gluten and

edible acid in an amount sufficient to provide a dough having a pH of from about 4.5 to about 7.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The accompanying drawings, which are incorporated in and constitute a part of this application, illustrate several aspects of the invention and together with a description of the

embodiments serve to explain the principles of the invention. Where photographs are used, the photograph is provided in gray-scale. Counterpart color copies of such gray-scale photographs are provided as supplemental content in the present provisional application for reference as appropriate in various jurisdictions and for presentation in jurisdictions that permit submission of drawings in color.

[0014] A brief description of the drawings is as follows:

[0015] FIG. 1 is a photograph showing a Comparative plant-based deli meat analogue product where gluten and acid were added first in the mixing process.

[0016] FIG. 2 is a photograph showing a plant-based deli meat analogue product where gluten and acid were added last in the mixing process.

DETAILED DESCRIPTION

[0017] The aspects of the present invention described below are not intended to be exhaustive or to limit the invention to the precise forms disclosed in the following detailed description. Rather, a purpose of the aspects chosen and described is by way of illustration or example, to facilitate the appreciation and understanding by others skilled in the art of the general principles and practices of the present invention.

[0018] In the present method, non-gluten plant protein is mixed with water to form a hydrated non-gluten plant protein.

[0019] In an aspect, the non-gluten plant protein used in the present method is obtained from a plant protein source selected from the group consisting of alfalfa, algal, barley, bean, broad bean, chia, clover, chickpea, corn, cow pea, earth pea, sweet pea, pigeon pea, fava bean, kidney bean, mung bean, navy bean, soy, legume, lentil, lupin, mesquite, cocoa, carob, nut, peanut, pea, almond, potato, cereal, sorghum, fonio, quinoa, hemp, fungal, seaweed, or mixtures thereof. In an aspect, the non-gluten plant protein used in the present method is obtained from a plant protein source selected from the group consisting of bean, broad bean, corn, pea, chickpea, cow pea, earth pea, sweet pea, pigeon pea, fava bean, kidney bean, mung bean, navy bean, soy, legume, lentil, potato, and mixtures thereof.

[0020] In an aspect, the non-gluten plant protein used in the present method is obtained from a plant protein source selected from the group consisting of bean, corn, pea, fava bean, soy, potato, and mixtures thereof. In an aspect, the non-gluten plant protein used in the present process is obtained from a plant protein source selected from the group consisting of soy, pea or mixtures thereof. In an aspect, the non-gluten plant protein is pea protein.

[0021] Using textured soy protein, textured pea protein, or mixtures thereof has delivered very good results. In an aspect, the non-gluten plant protein is preferably textured pea protein.

[0022] In an aspect, the non-gluten plant protein present in the dough does not comprise a mechanically textured protein component (i.e., non-gluten plant protein that has been textured by a mechanical process such as extrusion, shear cell technology, and the like).

[0023] In an aspect, the non-gluten plant protein used in the present method is provided in a non-gluten plant protein composition, i.e. a composition comprising the plant protein and non-protein components from the plant protein source. In an aspect, the non-gluten plant protein composition may be a non-gluten plant protein concentrate composition, i.e., the source composition contains not less than 55% protein on a moisture-free basis. The non-gluten plant protein composition may be a non-gluten plant protein isolate composition, i.e., the source composition contains not less than 85% protein on a moisture-free basis.

[0024] In an aspect, the non-gluten plant protein used in the present method is a powdered non-gluten plant protein having a particle size range of from about 20 to about 150 μm or having a -100 US mesh particle size, i.e., the non-gluten plant protein passes through a US 100 Mesh Size screen, which has a nominal opening size of about 150 μm. In an aspect, the non-gluten plant protein used in the present method is a textured non-gluten plant protein having a particle size range of from about 0.2 to about 20 mm.

[0025] In an aspect, the non-gluten plant protein is provided in an amount effective to provide a plant-based deli meat analogue product comprising from about 3 wt% to about 20 wt% non-gluten plant protein. In an aspect, the non-gluten plant protein is provided in an amount effective to provide a plant-based deli meat analogue product comprising from about 4 wt% to about 10 w% non-gluten plant protein. To avoid confusion, it is noted that the identified amount of non-gluten plant protein is the protein content itself without regard to non-protein components that may additionally be present from the plant protein source. By way of example, adding 100 g of a soy protein isolate that is 80 wt% soy protein will contribute 80 g of non-gluten plant protein to the plant-based deli meat analogue.

[0026] The plant protein is hydrated by mixing with water in any appropriate vessel, such as a mixer or blender. In an aspect, water is mixed with the plant protein composition in a water:(plant protein) weight ratio of from about 2:1 to about 4:1. In an aspect, water is mixed with the plant protein composition in a water:(plant protein) weight ratio of from about 2.5:1 to about 3.5:1.

[0027] In an aspect, water is mixed with the plant protein composition at a water temperature of from about 40°F to about 90°F. In an aspect, water is mixed with the plant protein composition at a water temperature of from about 40°F to about 75°F. In an aspect, water is mixed with the plant protein composition at a water temperature of from about 60°F to about 75°F.

[0028] The resultant hydrated plant protein is mixed with a plant-based oil and hydrocolloid to form a protein intermediate composition.

[0029] In an aspect, the plant-based oil is selected from the group consisting of avocado, canola, coconut, cocoa, corn, cottonseed, flax, olive, palm, palm kernel, peanut, rapeseed, safflower, soya, and sunflower oils and mixtures thereof. Sunflower oil, coconut oil, and mixtures thereof have worked well. In an aspect, the plant-based oil is selected from unsaturated plant-based oils. In an aspect, the plant-based oil is selected from poly-unsaturated plant-based oils.

[0030] In an aspect, the plant-based oil is mixed with the hydrated non-gluten plant protein in an amount effective to provide a plant-based deli meat analogue product comprising from about 0.5 wt% to about 6 w% oil. In an aspect, the plant-based oil is mixed with the hydrated non-gluten plant protein in an amount effective to provide a plant-based deli meat analogue product comprising from about 2 wt% to about 4 w% oil.

[0031] In an aspect, the hydrocolloid incorporated in the plant-based deli meat analogue product is selected from the group consisting of hydrocolloid gums, hydrocolloid starches, hydrocolloid water soluble fibers, and mixtures thereof.

[0032] In an aspect, the hydrocolloid present in the plant-based deli meat analogue product comprises at least one hydrocolloid gum component, at least one hydrocolloid starch component, and at least one hydrocolloid water soluble fiber component.

[0033] In an aspect, the hydrocolloid gum component is selected from locust bean gum, carrageenan (seaweed extract), guar gum, xanthan gum, gellan gum, scleroglucan, agar, pectin, alginate, gum acacia, and mixtures thereof.

[0034] In an aspect, the hydrocolloid water soluble fiber component is selected from water soluble fibers or mixtures of soluble and insoluble fibers, such as konjac glucomannan and citrus fiber.

[0035] In an aspect, the hydrocolloid starch component is selected from starches derived from sources including but are not limited to fruits, seeds, and rhizomes or tubers of plants. In an aspect, sources of starch include but are not limited to rice, wheat, corn, potatoes, tapioca, arrowroot, buckwheat, banana, barley, cassava, kudzu, oca, sago, sorghum, sweet potatoes, taro and yams. In an aspect, the starch is selected from cassava starch, tapioca starch, and mixtures thereof.

[0036] In an aspect, the starch may be one or more modified starches, i.e. a starch that has been altered from its native state, resulting in modification of one or more of its chemical or physical properties. Starches may be modified, for example, by enzymes, oxidation or, substitution with various compounds. Starches can be modified to increase stability against heat, acids, or

freezing, improved texture, increase or decrease viscosity, increase or decrease gelatinization times, and increase or decrease solubility, among others. Modified starches may be partially or completely degraded into shorter chains or glucose molecules, or modified by substitution to have a different chemical composition. In an aspect, the starch many be a nOSA starch, i.e. a modified starch that has been partially substituted with n-octenyl succinic anhydride.

[0037] In an aspect, the plant-based oil and hydrocolloid may be mixed with the hydrated non-gluten plant protein at the same time, or either component may be mixed with the hydrated non-gluten plant protein before the other component.

[0038] In an aspect, the hydrocolloid is mixed with the hydrated non-gluten plant protein in an amount effective to provide a plant-based deli meat analogue product comprising from about 1.5 wt% to about 10 wt% hydrocolloid. In an aspect, the hydrocolloid is mixed with the hydrated non-gluten plant protein in an amount effective to provide a plant-based deli meat analogue product comprising from about 1.5 wt% to about 5 wt% hydrocolloid.

[0039] In an aspect, the hydrocolloid comprises:

from about 0.1 wt% to about 5 wt% carrageenan

from about 0.1 wt% to about 5 wt% konjac glucomannan

from about 0.1 wt% to about 5 wt% wt% citrus fiber

from about 0.1 wt% to about 5 wt% wt% tapioca starch, all amounts based on the total amount of plant-based deli meat analogue product.

[0040] For purposes of the present disclosure, "Vital Wheat Gluten" refers to a protein extract of wheat flour prepared by removing a significant portion of the starch, fibers, pentosans and water-soluble materials from wheat flour. Vital Wheat Gluten is commercially available, and may be obtained by any appropriate process such as, for example, as disclosed in US Patent No. 3,790,553. In an aspect, Vital Wheat Gluten has a protein content of 70% to 99% dry weight. In an aspect, Vital Wheat Gluten has a protein content of about 75% to about 80% dry weight. However, one skilled in the art will recognize that gluten is the protein found and/or derived from wheat, barley, rye, oats, and related species and/or hybrids of wheat, barley, rye, and oat. Consequently, in some embodiments, gluten refers to gluten protein from any available source and to mixtures of gluten protein from different sources.

[0041] In an aspect, the Vital Wheat Gluten is mixed with the protein intermediate composition in an amount effective to provide a plant-based deli meat analogue product comprising from about 10 wt% to about 20 wt% Vital Wheat Gluten. In an aspect, the Vital Wheat Gluten is mixed with the protein intermediate composition in an amount effective to provide a plant-based deli meat analogue product comprising from about 12 wt% to about 18 wt% Vital Wheat Gluten. To avoid confusion, it is noted that this identified amount of Vital Wheat Gluten is the gluten

protein content itself without regard to non-protein components that may additionally be present from the Vital Wheat Gluten source. By way of example, adding 100 g of a wheat protein concentrate that is 75 wt% gluten will contribute 75 g of Vital Wheat Gluten to the plant-based deli meat analogue.

[0042] For purposes of the present disclosure, an "edible acid" may be any acid suitable to be used in food. In an aspect, the acid is selected from the group consisting of citric acid, lactic acid, acetic acid, or mixtures thereof. In an aspect, the acetic acid is provided as vinegar.

[0043] In an aspect, the edible acid is incorporated in an amount sufficient to provide a dough having a pH of from about 4.5 to about 7. In an aspect, the edible acid is incorporated in an amount sufficient to provide a dough having a pH of from about 5.5 to about 6.5. In an aspect, the edible acid is incorporated in an amount sufficient to provide a dough having a pH of from about 5.5 to about 6. In an aspect, the edible acid is incorporated in an amount sufficient to provide a dough having a pH of from about 6 to about 6.5. In an aspect, an acid is additionally incorporated during mixing of the dough in an amount sufficient to provide a dough having a pH of from about 4.5 to about 5.5.

[0044] In an aspect the plant-based deli meat analogue product is a sausage mimic, which characteristically has a pH in the range of from about 4.5 to 5.5.

[0045] In an aspect, the plant-based deli meat analogue product comprises edible acid in an amount of from about 0.5 wt% to about 5 wt%.

[0046] In an aspect, the plant-based deli meat analogue product may include an additional ingredient or ingredients to meet desired product characteristics. In an aspect, the additional ingredient(s) is selected from flavors, colorants, preservatives (i.e., an ingredient to prevent or retard microbiological growth and/or spoilage), stabilizers, vitamins, and minerals and mixtures thereof.

[0047] In an aspect, the plant-based deli meat analogue product comprises seasonings selected from paprika, garlic, cayenne, chili pepper, black pepper, nutmeg, allspice, celery seed, coriander, and myrtle berries.

[0048] In an aspect, the plant-based deli meat analogue product comprises sugar and/or salt.

[0049] In an aspect, the plant-based deli meat analogue product is formulated with flavor ingredients selected to mimic the flavor of a meat-based dough product. In an aspect, the plant-based deli meat analogue product is formulated with flavor ingredients selected to mimic the flavor of beef. In an aspect, the plant-based deli meat analogue product is formulated with flavor ingredients selected to mimic the flavor of pork. In an aspect, the plant-based deli meat analogue product is formulated with flavor ingredients selected to mimic the flavor of chicken.

In an aspect, the plant-based deli meat analogue product is formulated with flavor ingredients selected to mimic the flavor of turkey.

[0050] In an aspect, the plant-based deli meat analogue product is formulated with flavor ingredients selected to provide a flavor profile that is not a meat flavor.

[0051] In an aspect, the plant-based deli meat analogue product comprises colorant ingredients, which may be natural colorant ingredients. In an aspect, the plant-based deli meat analogue product comprises fruit or vegetable juices as a natural colorant, such as beet, radish, or pomegranate juice.

[0052] In an aspect, one or more of the additional ingredients may be introduced to the plant-based deli meat analogue product before or at the same time as introduction of the oil and hydrocolloid, or before or at the same time as introduction of the Vital Wheat Gluten, or before or at the same time as introduction of the edible acid, or after introduction of the edible acid and before dispensing of the plant-based dough into a casing.

[0053] In an aspect, the additional ingredients that are oil soluble flavors/colors may be added to the oil prior mixing with other ingredients. In an aspect, the additional ingredients that are liquid water-soluble flavors/colors may be added to the water prior to mixing with other ingredients.

[0054] In an aspect, the additional ingredients comprise a calcium salt, such as calcium lactate, calcium citrate, or calcium chloride. It has been found that plant-based deli meat analogue products as described herein comprising a calcium salt exhibits an enhanced structural profile that affords a perceivable organoleptic improvement in appearance and bite characteristics of the final plant-based deli meat analogue product as compared to like products that do not contain calcium salt as described herein.

[0055] In an aspect, the calcium salt is present in an amount effective to provide a plant-based deli meat analogue product comprising from about 0.05 wt% to about 1 wt% calcium salt. In an aspect, the calcium salt is present in an amount effective to provide a plant-based deli meat analogue product comprising from about 0.1 wt% to about 0.5 wt% calcium salt.

[0056] Any suitable mixing device may be used carry out the above discussed mixing steps to prepare the plant-based deli meat analogue product. Examples of suitable equipment include blenders or mixing devices that use an impeller such as a paddle blender. In an aspect, the mixer is configured and operated in a manner such that the mixer does not impart excess pressure to the mixture. It has been found that application of excess pressure results in production of an overly dense product that does not meet texture expectations. In an aspect, the mixing is not carried out in an extruder exerting 1.5 MPa or more of pressure.

[0057] The protein/gluten mixture intermediate composition is mixed with the edible acid. It has been found that when the analogue dough is mixed with Vital Wheat Gluten under pH neutral conditions, the dough becomes very stiff and unsuitable for use in forming a sausage, and additionally does not absorb water well. In contrast, when the analogue dough is mixed with Vital Wheat Gluten together with the edible acid, gluten strands are developed to provide elastic strands that do not unduly increase the viscosity of the dough. It has been found that mixing of the protein/gluten mixture intermediate composition with the edible acid under these conditions imparts an elastic structure to the plant-based dough, providing an enhanced meat-like texture in the final plant-based deli meat analogue product. Additionally, when the analogue dough is mixed with Vital Wheat Gluten together with the edible acid, the resulting composition does absorb water well, providing a dough that absorbs water during mixing, and is easily manipulated for mixing with additional ingredients and dispensing into a casing for cooking.

[0058] In an aspect, the protein/gluten mixture intermediate composition is mixed with the edible acid under gluten strand development shear conditions, (i.e. under sufficient shear to provide a dough that stretches when physically pulled apart, and wherein all water is absorbed in the dough when water is present as 50% of the dough formulation.

[0059] In an aspect, the mixing under gluten strand development shear conditions is carried out using a high shear mixer. In an aspect, the mixing apparatus is a food chopper, bowl chopper, or food processor.

[0060] For purposes of the present description, a food chopper is a food cutter having a surface for receiving food to be cut, and one or more vertically movable cutting blades configured to chop the plant-sourced composition into pieces.

[0061] In an aspect, the mixing apparatus is a bowl chopper. For purposes of the present description, a bowl chopper is a food cutter having a rotary bowl for receiving food to be cut, and one or more vertically oriented blades (also described as "knives" in the art) attached to a horizontally oriented rotary knife shaft. The rotary bowl rotates around a vertical axis, and the blades cut by rotation of the horizontally oriented rotary knife shaft. The blades are aligned relative to the internal wall or walls of the bowl such that they may chop and mix the food within the bowl. While the lateral position of the rotary knife shaft is substantially stationary, the bowl and the contents therein rotate relative to the blades whereby the contents are continuously moved against the blades as the bowl is rotating. In an aspect, the blades may be run in only a forward direction, or in an aspect run in both a forward direction and a reverse direction. Bowl choppers are commercially available, and are described, for example, in US Patent No. 5,996,917, the disclosure of which is incorporated herein by reference. The use of a bowl

chopper in the present process is particularly advantageous, because it efficiently performs a cutting function as it mixes the material.

[0062] In an aspect, the mixing apparatus is a food processor. For purposes of the present description, a food processor is a food mixer having a food container for receiving food to be mixed that is fitted with a hub configured to be coupled to a drive shaft of the food processor. One or more blades are rotatably coupled to the hub. If so desired, the blades may have an edge that is suitable to cut the food in the food container. In the case of the food processor, the blades are horizontally oriented, and the hub and drive shaft are generally vertically oriented. In an aspect, the blades may be run in only a forward direction, or in an aspect run in both a forward direction and a reverse direction. Such food processors are commercially available. In an aspect, the food processor is a Robo coupe type food processor.

[0063] In an aspect, a vacuum is applied to the plant-based dough or other intermediate at any appropriate stage of the preparation method to degas the dough or intermediate in an amount sufficient to remove or substantially reduce undesired air pockets or bubbles. Air pockets and bubbles can adversely impact the visual appeal and texture of the deli meat analogue. Any suitable vacuum system may be used to "degas" the dough or intermediate to remove air pockets.

[0064] In an aspect, after being mixed, but prior to being dispensed into a casing, the dough has a shiny and elastic consistency indicating that it is ready to be dispensed into a casing.

[0065] In an aspect, additional food particles such as cheese, vegetable or fruit pieces are incorporated in the dough, preferably after mixing the dough but prior to being dispensed into a casing. If so desired, though, such food particles may be added earlier in the process. Examples of vegetable pieces that may be incorporated include pepper, dried tomato, pickle, and pimento pieces.

[0066] The plant-based dough then dispensed into a casing to form a dough log.

[0067] In an aspect, the casing is an artificial casing. In an aspect, the casing is an artificial casing manufactured from natural materials. In an aspect, the casing is an artificial casing made of natural materials selected from cellulosic casings and collagen casings. In an aspect, the casing is an artificial casing made of natural materials that is permeable to gases, smoke and water vapor. In an aspect, the artificial casings made of natural materials are edible, and therefore do not need to be removed from the encased plant-based deli meat analogue product when being eaten by a consumer.

[0068] In an aspect, the casing is an artificial casing manufactured from synthetic substances. In an aspect, the casing is an artificial casing manufactured from thermoplastic materials

("synthetic casings"). In an aspect, the synthetic casings are mechanically strong, relatively heat resistant, impermeable to smoke, gases and water vapor.

[0069] In an aspect, the casing is prepared from a material selected from polyamide (PA), polyethylene (PE), polypropylene (PP), polyvinylidenchloride (PVDC) and polyester (PET). The above-mentioned categorization of casings is disclosed in the FAO (Food and Agriculture Organization of the United Nations) Corporate Document Repository under the Title "Meat processing technology for small and medium-scale producers" under the keyword "Casings".

[0070] In an aspect, the casing made of a mono- or multilayered film of which at least one layer comprises a film-forming synthetic polymer.

[0071] In an aspect, the casing made of a mono- or multilayered film of which at least one layer comprises a film-forming synthetic polymer. Such casings for processed meat products are well known in the art. In an aspect, the casings, such as sausage casings, are typically made of 1 - 5 layered films. In an aspect, the film-forming polymer of at least one film layer is a thermoplastic synthetic polymer. In an aspect, the thermoplastic synthetic polymer is a polyamide, polyethylene, polypropylene, polyvinylidene chloride or polyester. In an aspect, the film layer can contain adjuvants, such as plasticizers, colorants or other known additives, but they should not substantially affect the film-forming properties of the synthetic polymer and other properties that are provided by the synthetic polymer to the casing, such as its known impermeability to smoke, water vapor or other gases. In an aspect, the water vapor impermeable casings have water vapor permeability of not more than 10 g/m2·d, or not more than 9 g/m2·d, measured according to DIN 53122 at 38 °C and 100% relative humidity. A wide variety of water vapor impermeable casings are disclosed in the art, e.g., in European Patent Application Nos. EP 0 603 676 and EP 1 817 962 and in International Patent Application Nos. WO 2005/113236 and WO 2017/192445; the disclosures of which are incorporated herein by reference with respect to the discussions regarding the preparation, identity and use of casings provided therein.

[0072] In an aspect, the casing is permeable to water vapor.

[0073] In an aspect, when the casing is filled, the casing generally has about cylindrical shape, but other cross-sections may also be suitable.

[0074] In an aspect, the thus-prepared encased uncooked dough log is then cooked to an internal temperature of at least about 180°F, e.g., at least about 190°F or at least about 195°F, to form an encased cooked dough log. In an aspect, the thus-prepared encased uncooked dough log is then cooked to an internal temperature of from about 180°F to about 220°F, e.g., from about 185°F to about 210°F or from about 190°F to about 210°F, to form an encased cooked dough log.

[0075] In an aspect, the casing is permeable to water vapor. It has been found that cooking of an encased uncooked dough log having a water vapor permeable casing in a steam oven is

particularly effective in achieving the desired texture properties of the final cooked product. While not being bound by theory, it is believed that cooking of the described encased uncooked dough log in the presence of steam facilitates a desired degree of gelling of the protein and additional ingredients in the dough log, thereby affording a final plant-based deli meat analogue product exhibiting excellent texture and other organoleptic properties. In an aspect, the encased uncooked dough log may be then cooked in a steam oven at humidity greater than 80% at an oven temp of from about 180°F to about 220°F.

[0076] The thus-prepared encased cooked dough log may be chilled to an internal temperature of from about 30°F to about 45°F. for storage purposes as appropriate.

[0077] It has additionally been found that chilling the dough log facilitates removal of the casing from the cooked dough log. While not being bound by theory, it is believed that chilling enhances the textural difference and/or reduces the adhesion of the cooked dough log and the casing so that removal of the casing can be carried out without damage to the surface of the cooked dough log. In an aspect, encased cooked dough log is chilled to an internal temperature of from about 30°F to about 40°F. In an aspect, encased cooked dough log is chilled to an internal temperature of from about 30°F to about 36°F.

[0078] In an aspect, after the chilling of the encased cooked dough log, the casing may be removed by a suitable process to provide a non-encased plant-based dough log product.

[0079] In an aspect, the plant-based deli meat analogue product is provided in overwrapped trays. This package type features air permeable overwrap with plant-based deli meat analogue product placed on an absorbent pad in a foam or plastic tray. In an aspect, the product is provided in a case ready tray, wherein the plant-based deli meat analogue product is packaged and sealed at the plant in a plastic-lidded package. In an aspect, the product is provided in chubs, wherein the plant-based deli meat analogue product is packaged for slicing at the point of purchase (e.g. at a deli counter) or point of use (e.g. at a restaurant or by the home user). In an aspect, the plant-based deli meat analogue product is packaged in any such format in sizes of 0.25 lb, 0.5 lb, 1 lb., 2 lb., 3 lb., 5 lb. and 10 lb.

[0080] In an aspect, the plant-based deli meat analogue product does not contain animal-sourced materials of any kind.

[0081] In an aspect, the process of preparing the plant-based deli meat analogue product does not include an extrusion step that exceeds a pressure of 1.5 MPa. In an aspect, the process of preparing the plant-based deli meat analogue product does not include an extrusion step.

[0082] In an aspect, the plant-based deli meat analogue product contains no more than 1wt% of methylcellulose. In an aspect, the plant-based deli meat analogue product does not contain methylcellulose.

EXAMPLES

[0083] Example 1 - Comparative Plant-Based Deli Meat Analogue Product – Acid and Gluten added first

[0084] Ingredients as shown in Table 1 were obtained and a plant-based deli meat analogue product was prepared using Process Methodology 1 described below.

Table 1 Ingredients

Type	Ingredient Information		Formulation	
	Ingredient Description	Supplier	WT	100% formula
Liquid	Water		59.0500	59.050%
Liquid	Woeber's Distilled White Vinegar - 200 Grain	Woeber	0.7500	0.750%
Dry	Wheat Gluten (Gluvital 21020)	Cargill	19.0000	19.000%
Dry	Carrageenan Aubey gel 1014 (100003010)	Cargill	2.0000	2.000%
Dry	Citri-Fi 100	Fiber Star	0.7000	0.700%
Dry	RBWD MID OELIC SUNFLOWER OIL (110033124)	PDM/cargill	3.0000	3.000%
Dry	Supro EX-45 (110033488)	Solae	7.5000	7.500%
Dry	Salt (100012525)	Cargill	0.8000	0.800%
Dry	Flake select KCL (B5179)	Cargill	0.4000	0.400%
Dry	Calcium lactate	Purac	0.3000	0.300%
Dry	Cane Sugar (B5300)	US Sugars Corp.	1.0000	1.000%
Dry	TURKEY TYPE DELI SEASONING REDUCED COLOR No smk 1201840	Cargill	4.0000	4.000%
Dry	CreamGel 70001(100001311)	Cargill	1.5000	1.500%
	TOTALS		**100.00**	**100.00%**

[0085] Process Methodology 1.

Processing Steps:

a) Mixing blend (Fatosa Mixer):

1. Add water and vinegar into the mixer and mix (2 min).
2. Add VWG, carrageenan, Citri-Fi to mixer and mix until it forms a uniform blend (5 min).
3. Add oil and mix well (5 min).
4. Add Supra EX-45 while running the blender and let it mix well.
5. Add salt, KCI, Calcium lactate and sugar in to the blender while running it and let it mix well.
6. Add flavors in to the blender while running the blender.
7. Add Tapioca starch in to the blender and mix well.

b) Robot Coupe & Vacuum tumbler:

1. Divide the whole blend in to 4 equal parts (12.5 lbs).
2. Add one part in to the Robot Coupe, close the lid, latch it, and run until it develops an elastic consistency.
3. Repeat step 2 for other 3 remaining parts.
4. Combine all 4 parts in a white tub.
5. Put the white tub in the vacuum tumbler and pull vacuum slowly for 10 min. (to pull all the air trapped as much as possible).
6. Take composition to the stuffer.

c) Stuffing:

1. Add the vacuum pulled blend into the stuffer (Use smallest stuffing horn).
2. Stuff into the Viscofan plastic casing high barrier smoke casing M20-07422-500062197 BTC 150.0 000 00 53, 500 000000 089 00 (P20-0224).
3. Shape - round. Size- about 8 lb per log.
4. Hold overnight in the cooler before cooking.

Cooking:

1. Cook logs in the pilot plant oven according to the cook cycle below.
   - 1st step: 140F at 100% humidity for 30 min
   - 2nd Step: 180F at 100% humidity for 30 min.
   - 3rd Step: 200F at 100% humidity for until 180F internal temp
   - 4th Step: 200F at 100% humidity for 90 min.
   - 5th Step: Cold shower for 30 min.
2. Chill according to USDA chilling requirement.

Slicing And Packaging:

1. Slice on Webber Slicer. (Slice thickness 1.5 mm; Shingle stack- 1 lb)
2. Vacuum package in Multivac 4-up.

[0086] Example 2 – Plant-Based Deli Meat Analogue Product - Acid and Gluten added Last

[0087] Ingredients as shown in Tables 2 and 3 were obtained and a plant-based deli meat analogue product was prepared using Process Methodology 2.

[0088] Table 2- Blend A

Type	Ingredient Information		Formulation	
	Ingredient Description	**Supplier**	**WT**	**100% formula**
Liq.	Water		59.0500	59.496%
Dry	Supro EX-45 (110033488)	Solae	7.5000	7.557%
Liq.	RBWD MID OELIC SUNFLOWER OIL (110033124)	PDM/cargill	3.0000	3.023%
Dry	TURKEY TYPE DELI SEASONING REDUCED COLOR No smk 120184	Griffith	4.0000	4.030%
Dry	Carrageenan Aubey gel 1014 (100003010)	Cargill	2.0000	2.015%
Dry	Citri-Fi 100	Fiber Star	0.7000	0.705%
Dry	Salt (100012525)	Cargill	0.8000	0.806%
Dry	Flake select KCL (B5179)	Cargill	0.4000	0.403%
Dry	Calcium lactate	Purac	0.3000	0.302%
Dry	Cane Sugar (B5300)	US Sugars Corp.	1.0000	1.008%
Dry	CreamGel 70001(100001311)	Cargill	1.5000	1.511%
Dry	Wheat Gluten (Gluvital 21020)	Cargill	19.0000	19.144%
	TOTALS		**99.250**	**100.00%**

[0089] Table 3, final mixture

	Type	Ingredient Information		Formulation	
		Ingredient Description	Supplier	WT	100% Formula
	Dry	Blend A		99.2500	99.250%

	Liq.	Woeber's Distilled White Vinegar - 200 Grain	Woeber	0.7500	0.750%
			TOTALS	**100.00**	**100.00%**

[0090] Process Methodology 2.

Processing Steps:

a) Mixing blend (Fatosa Mixer):

1. Add water to the mixer.
2. Add SPI in to the mixer.
3. Mix well to hydrate all the SPI property (3 min).
4. Add Oil and mix well (2.5 min).
5. Add all the flavors & dried tomato and mix well (2.5 min).
6. Add all hydrocolloids (Citri-fi + carrageenan) and mix well (2.5 min).
7. Add salts, sugar, calcium lactate, and tapioca starch and mix well (3 min).
8. Add vital wheat gluten and mix for 2 min.
9. Transfer the paste in to the robot Coupe/bowl chopper.

b) Emulsification (Robot Coupe/Bowl chopper)

1. Add vinegar in to the blend.
2. Run the bowl chopper at speed 3 (800 RPM) & 4 (1600 RPM) alternatively until it forms an elastic stringy texture.
3. Pull vacuum partially on chamber vac.

c) Stuffing (658 Handtmann Stuffer):

1. Set up the stuffer – use alternative veins only.
2. Add the vacuum pulled blend into the stuffer (Use smallest 1" stuffing horn).
3. Stuff into the Viscofan plastic/High barrier smoke casing M20-07422-500062197 BTC 150.0 000 00 53, 500 000000 089 00 (P20-0224).
3. Shape – round.
4. Cook & chill.

Cooking:

1. Cook logs in the pilot plant oven according to the cook cycle below.
   - 1st step: 160F at 100% humidity for 30 min
   - 2nd Step: 180F at 100% humidity for 60 min.
   - 3rd Step: 200F at 100% humidity for until 180F internal temp
   - 4th Step: 200F at 100% humidity for 90 min (>196F).
   - 5th Step: 30 min Cold shower with 100% fan
2. Chill according to USDA chilling requirement.

Slicing And Packaging:

1. Slice thickness 1.6 mm; Straight stack – 0.5 lb, 15 slices/stack).
2. Vacuum package in Multivac 4-up (Regular film – top film – P20-0356)

Boxing and Storage:

1. Box and store in the freezer

[0091] Example 3 Product comparison

[0092] FIG. 1 is a photograph showing the product of Comparative Example 1 where gluten and acid were added first, and FIG. 2 is a photograph showing the product of Example 2 that is plant-based deli meat analogue product where gluten and acid were added last. As can be seen in the photos, the product of Comparative Example 1 has little to no observable texture, and has an overall dense appearance with a surface that appears to be uniform and without voids or apparent fiber structure.

[0093] In contrast, the product of Example 2 wherein gluten and acid were added last has a surface comprising visually observable voids so that the product comprises visible physical discontinuities.

[0094] It was additionally noted that when the product of Example 2 was torn apart, the edges had a ragged edges with visible microfiber-like strands, giving the general appearance of a sliced deli meat product having a fibrous texture. In contrast, when the product of Comparative Example 2 was torn apart, the edges had the appearance of a clean-cut edge with no visible microfiber-like strands, giving the general appearance of a solid gel product.

[0095] Example 4 Sensory Panel Outcomes

[0096] Products in accordance with Comparative Example 1 and Example 2 were prepared at separate times and were evaluated separately on informal in-house sensory evaluations using panels of 4-5 individuals experienced in evaluating meat and meat mimicking products. Results of the evaluation are reported in Table 3.

Table 3

Sensory properties	**Adding Acid and Vital Wheat Gluten 1st in the mix**	**Adding Vital Wheat Gluten and Acid last in the mix:**
Flavor	Smoked Turkey deli-type flavors.	Smoked Turkey deli-type flavors.
After taste	Lingering smoke flavor.	Lingering smoke flavor.
Juiciness	Slightly drier, not too bad.	Slightly dryer, not bad.
Texture	No fibrous texture felt, glossy, somewhat doughy. Uniform gel-like bite.	Good texture (somewhat closer to highly processed animal protein deli bite), No doughy texture and firmer bite, felt somewhat fibrous visually.

[0097] As used herein, the terms "about" or "approximately" mean within an acceptable range for the particular parameter specified as determined by one of ordinary skill in the art, which will depend in part on how the value is measured or determined, e.g., the limitations of the sample preparation and measurement system. Examples of such limitations include preparing the sample in a wet versus a dry environment, different instruments, variations in sample height, and differing requirements in signal-to-noise ratios.

[0098] All patents, patent applications (including provisional applications), and publications cited herein are incorporated by reference as if individually incorporated for all purposes. Unless otherwise indicated, all parts and percentages are by weight and all molecular weights are weight average molecular weights. The foregoing detailed description has been given for clarity of understanding only. No unnecessary limitations are to be understood therefrom. The invention is not limited to the exact details shown and described, for variations obvious to one skilled in the art will be included within the invention defined by the claims.

CLAIMS:

1. A method of preparing a plant-based deli meat analogue product comprising

a) mixing non-gluten plant protein with water to form a hydrated non-gluten plant protein,

b) mixing the hydrated non-gluten plant protein with a plant-based oil and hydrocolloid to form a protein intermediate composition,

c) mixing the protein intermediate composition with Vital Wheat Gluten to form a protein/gluten mixture intermediate composition,

d) mixing the protein/gluten mixture intermediate composition with an edible acid to form a plant-based dough,

e) dispensing the plant-based dough into a casing to form a dough log,

f) cooking the dough log to an internal temp of at least about 180°F to form a cooked dough log, and

g) chilling the cooked dough log to an internal temperature of from about 30°F to about 45°F to provide a plant-based deli meat analogue product; wherein

the plant-based dough comprises

from about 5 wt% to about 20 wt% non-gluten plant protein

from about 40 wt% to about 87 wt% water

from about 0.5 wt% to about 6 w% oil

from about 2 wt% to about 10 wt% Hydrocolloid

from about 5 wt% to about 20 wt% Vital Wheat Gluten and

edible acid in an amount sufficient to provide a dough having a pH of from about 4.5 to about 7.

2. The method of claim 1, wherein the plant-based deli meat analogue product has a pH of from about 5.5 to about 6.5.

3. The method of claim 1, wherein the plant-based deli meat analogue product comprises edible acid in an amount of from about 0.5 wt% to about 5 wt%.

4. The method of claim 1, wherein the edible acid is selected from the group consisting of citric acid, lactic acid, acetic acid, or mixtures thereof.

5. The method of claim 1, wherein the non-gluten plant protein is selected from the group consisting of soy protein, pea protein, and mixtures thereof.

6. The method of claim 1, wherein the hydrocolloid comprises at least one hydrocolloid gum component, at least one hydrocolloid starch component, and at least one hydrocolloid water soluble fiber component.

7. The method of claim 1, wherein the hydrocolloid comprises a starch selected from the group consisting of Cassava starch, tapioca starch, and mixtures thereof.

8. The method of claim 1, wherein the hydrocolloid comprises:

from about 0.1 wt% to about 5 wt% carrageenan,
from about 0.1 wt% to about 5 wt% konjac glucomannan,
from about 0.1 wt% to about 5 wt% citrus fiber, and
from about 0.1 wt% to about 5 wt% tapioca starch, all amounts based on the total amount of plant-based deli meat analogue product.

9. The method of claim 1, wherein the plant-based deli meat analogue product includes one or more additional ingredients that are introduced to the plant-based dough before or at the same time as introduction of the oil and hydrocolloid, or are introduced to the plant-based dough before or at the same time as introduction of the Vital Wheat Gluten, or are introduced to the plant-based dough before or at the same time as introduction of the edible acid, or are introduced to the plant-based dough after introduction of the edible acid and before dispensing of the plant-based dough into a casing.

10. The method of claim 9, wherein the one or more additional ingredients comprises flavors selected to mimic the flavor of a meat product selected from the group consisting of ham, beef, turkey and chicken.

11. The method of claim 1, wherein the plant-based deli meat analogue product comprises Vital Wheat Gluten in an amount of from about 5 wt% to about 20 wt%.

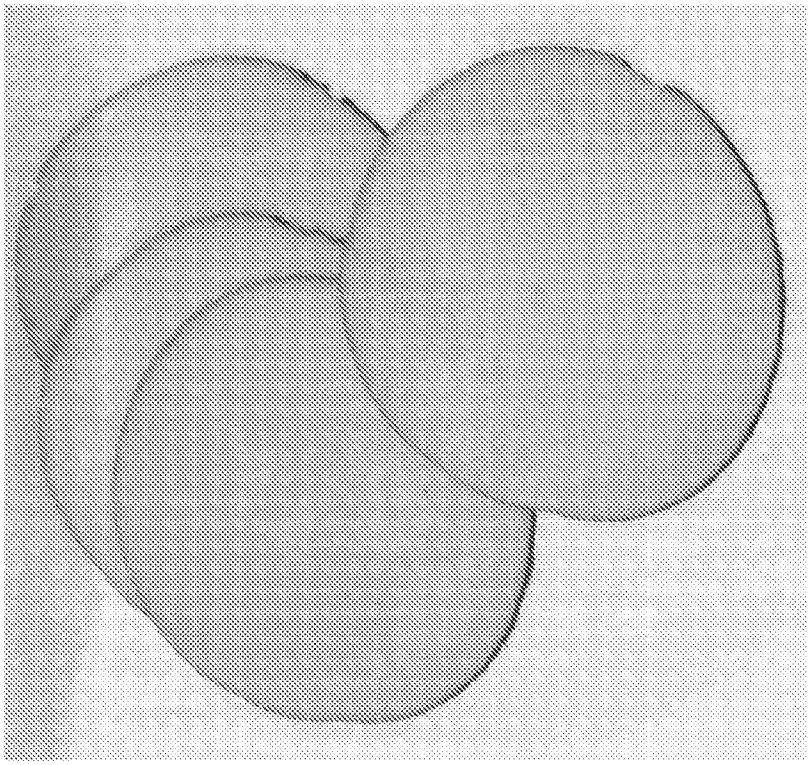
12. The method of claim 1, wherein the plant-based deli meat analogue product comprises Vital Wheat Gluten in an amount of from about 12 wt% to about 18 wt%.

13. The method of claim 1, wherein the plant-based deli meat analogue product additionally comprises calcium salt in an amount effective to provide a plant-based deli meat analogue product comprising from about 0.05 wt% to about 1 wt% calcium salt.

14. The method of claim 1, wherein the casing is an artificial casing manufactured from natural materials.

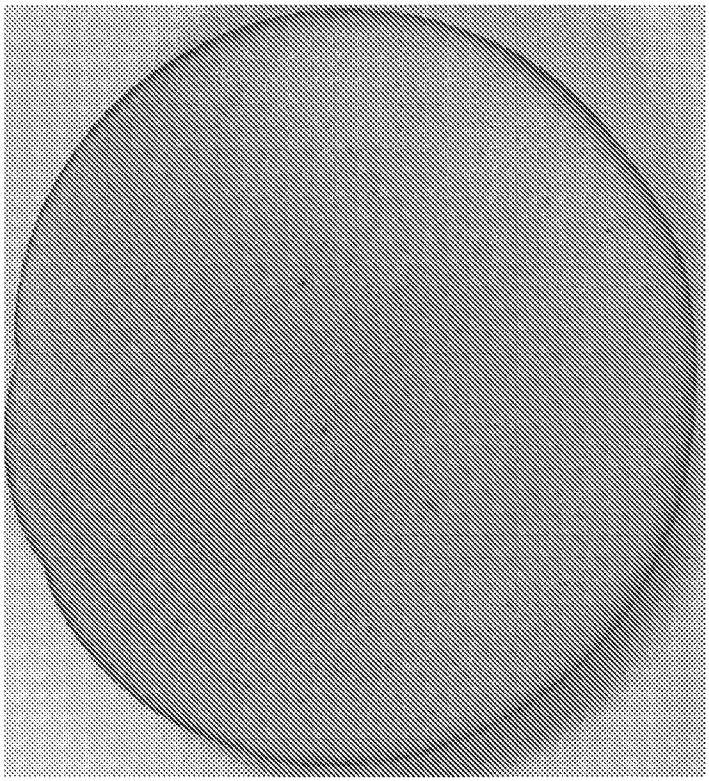
15. A plant-based deli meat analogue product made by the process of claim 1.

FIG. 1



Comparative product

FIG. 2



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2024/026376

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23J3/18 A23J3/22
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A23J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, FSTA, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 July 2024	23/07/2024

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Diller, Reinhard

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

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