



(51) International Patent Classification:

A23L 29/244 (2016.01)

Published:

— with international search report (Art. 21(3))

(21) International Application Number:

PCT/CN2023/095236

(22) International Filing Date:

19 May 2023 (19.05.2023)

(25) Filing Language:

English

(26) Publication Language:

English

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: FISH SUBSTITUTE

(57) Abstract: A fish substitute comprises a particulate flake mimetic and an emulsion matrix, wherein the flake mimetic comprises konjac, and the emulsion matrix comprises methylcellulose, water, and fat in an emulsion; wherein the flake mimetic is a thermally irreversible gel and at least a portion of the flake mimetic particles are contained in the emulsion matrix. The present disclosure also relates to a fried fish substitute product that comprises a fried coating and a fired portion of a fish substitute, in which the fish substitute comprises a particulate flake mimetic and an emulsion matrix. Further, a method for preparing a fish substitute product is described.



FISH SUBSTITUTE

FIELD OF INVENTION

[0001] This invention relates to the field of meat substitute products, in particular fish substitute food products.

BACKGROUND

[0002] Traditionally, seafood products have taken an important place in our diet. Seafood products are consumed in many different forms such as fillets and fish balls that are cooked, grilled, fried, smoked, or made as soup base.

[0003] There is a growing consumer trend for reducing or completely removing animal protein from their diets. Consumers switch towards plant-based seafood substitutes, such as fish substitutes, because of various reasons such as health concerns, environmental concerns, sustainability, and animal welfare.

[0004] To motivate a regular fish consumer to choose fish substitutes, the substitutes should mimic processed fish in terms of texture and organoleptic properties, like appearance, flavor, bite, succulence, mouthfeel, and overall acceptance.

SUMMARY

[0005] The present disclosure provides a fish substitute that comprises a particulate flake mimetic and an emulsion matrix. The flake mimetic is a thermally irreversible gel and comprises konjac, and the emulsion matrix comprises methylcellulose, water, and fat in an emulsion. At least a portion of the flake mimetic particles are contained in the emulsion matrix.

[0006] The present disclosure also provides a fried fish substitute product that comprises a fried portion of a fish substitute, which comprises a particulate flake mimetic, an emulsion matrix, and a fried coating. The flake mimetic is a thermally irreversible gel and comprises konjac. The emulsion matrix comprises methylcellulose, water, and fat in an emulsion. At least a portion of the flake mimetic particles are contained in the emulsion matrix. The fried coating is an external coating that covers at least part of the fried portion of the fish substitute.

[0007] The present disclosure further provides a method for preparing a fish substitute product, comprising a) combining a particulate flake mimetic and an emulsion matrix such that at least a

portion of the flake mimetic particles are contained in the emulsion matrix to obtain a composition; and b) forming the composition into individual fish portions of the fish substitute product. The flake mimetic is a thermally irreversible gel and comprises konjac. The emulsion matrix comprises methylcellulose, water, and fat in an emulsion.

BRIEF DESCRIPTION OF THE FIGURES

[0008] The drawings illustrate generally, by way of example, but not by way of limitation, various aspects discussed in the present document.

[0009] FIG. 1 shows a spider web diagram of the sensory evaluation in Example 3.

DETAILED DESCRIPTION

[0010] Reference will now be made in detail to certain aspects of the disclosed subject matter, examples of which are illustrated in part in the accompanying drawings. While the disclosed subject matter will be described in conjunction with the enumerated claims, it will be understood that the exemplified subject matter is not intended to limit the claims to the disclosed subject matter.

[0011] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one skilled in the art to which this invention belongs. As used herein, each of the following terms has the meaning associated with it as defined below. Unless expressly stated or context dictates otherwise, all percentages are on a weight basis.

[0012] The term “for example,” “for instance,” “such as,” or “including” as used herein is meant to introduce examples that further clarify more general subject matter. Unless otherwise specified, these examples are provided only as an aid for understanding the applications illustrated in the present disclosure and are not meant to be limiting in any fashion.

[0013] As used herein, “room temperature” or “RT” refer to a temperature between 20°C and 25°C.

Fish substitute

[0014] The present disclosure relates to a fish substitute suitable for making a fish substitute product. The fish substitute comprises a particulate flake mimetic and an emulsion matrix, in which at least a portion of the flake mimetic particles are contained in the emulsion matrix.

Flake mimetic

[0015] A flake mimetic of the present invention comprises konjac that can be present in different forms including, but not limited to, konjac gel, konjac gum, or any combinations thereof.

[0016] Konjac can form a thermally irreversible gel upon alkali treatment and/or combination with certain food texturizers (e.g., curdlan). As used herein, “thermally irreversible gel” refers to a gel that does not melt at a temperature less than 200°C. Thus, a thermally irreversible gel will not melt at 175°C, for example. The thermally irreversible gel can enhance the overall texture of the fish substitute and improve its freeze-thaw stability. Preferably, the flake mimetic has an elastic, tender, and flaky texture that is similar to a minced cod.

[0017] Preferably, the flake mimetic is a thermally irreversible gel and has a gel strength from 200 to 600 g/m³, preferably from 300 to 500 g/m³.

[0018] Preferably, in mimicking the texture and mouthfeel of a fish substitute, the flake mimetic may include, based on the total dry weight of the flake mimetic: konjac in an amount of from 1 to 8 wt%, preferably from 2 to 6 wt%; water in an amount of from 80 to 97 wt%, preferably from 85 to 95 wt%; and starch in an amount of from 1 to 8 wt%, preferably from 3 to 6 wt%. The konjac may be provided in the form of konjac powder or konjac gum. If konjac gum is used, the weight of konjac in the flake mimetic will be the weight of the konjac in the gum on a dry weight basis and the water in the gum will be part or all of the water in the mimetic. Konjac includes glucomannans. One can refer to the glucomannan content instead of konjac content in the flake mimetic. The glucomannan content in the flake mimetic is desirably from 0.5 to 8 wt% glucomannans, e.g., from 0.5 to 6 wt%, from 1 to 6 wt%, or from 1 to 4.5 wt% glucomannans.

[0019] To promote formation of a thermally irreversible gel, the flake mimetic desirably includes a gel promoter that may comprise an edible alkali, a food texturizer, or both. If an edible alkali is used, sufficient alkali is added to produce a gel with a pH of from 8 to 11, preferably from 9 to 10. Suitable edible alkalis include sodium carbonate and sodium hydroxide. Suitable food texturizers include modified starches, curdlan, soy protein, xanthan gum, Arabic gum, and carrageenan. In one implementation that includes both edible alkali and food texturizer, the flake mimetic includes, based on the total dry weight of the flake mimetic, sodium carbonate in an amount of from 0.1 to 0.8 wt%, preferably from 0.2 to 0.5 wt%.; curdlan in an amount of

from 0.5 to 2.5 wt%, preferably from 1 to 2 wt%; and modified starch in an amount of from 0.5 to 2.5 wt%, preferably from 1 to 2 wt%.

[0020] Suitable food texturizers for the flake mimetic can include native or modified starches. “Modified starch,” as used herein, is a starch that has been physically, enzymatically, or chemically treated to improve its functionality as a food texturizer, e.g., by increasing the starch’s water holding capacity, improving gel stability in storage or in freeze-thaw cycles. Preferred modified starches for use as a food texturizer in the flake mimetic are acetylated starches and hydroxypropylated starches.

[0021] The flake mimetic may include other ingredients, as well. For example, the flake mimetic may be made whiter and more opaque, to make it look more like cooked cod or other whitefish, by adding titanium dioxide. If titanium dioxide is used, the flake mimetic may include from 0.1 to 0.4 wt%, preferably from 0.1 to 0.2 wt%, titanium dioxide based on the total weight of the flake mimetic. One can also add flavors to the flake mimetic that deliver a desired taste or aroma.

[0022] One commercially satisfactory flake mimetic includes konjac powder, water, a starch, a modified starch (e.g., a hydroxypropylated starch), sodium carbonate, curdlan, and titanium dioxide.

[0023] The flake mimetic may be produced by a method that comprises the steps of: (i) mixing konjac, and desirably at least one of an edible alkali and a food texturizer; (ii) dispersing the mixture in water to form a homogenous dispersion; (iii) molding the dispersion with desirable shapes and sizes into a composition; (iv) treating the composition under alkali (e.g., in the presence of the edible alkali) and heat (e.g., at a temperature between 90 and 100°C) to form a gel; and (v) washing the gel to remove any residual ingredients to obtain the flake mimetic. If konjac gum is used, the dispersion is desirably allowed to settle for, say, 30 minutes to facilitate full dissolution before the molding step.

[0024] Flake mimetic particles may take the form of an angular shape (e.g., a cubic shape, a rectangular shape), a round shape (e.g., a circular shape, an elliptical shape), or any combinations thereof. Preferably, the flake mimetic particles may take the form of an angular shape. Although flake mimetic particles may be uniform in size and shape, they desirably vary in size and shape to better simulate the appearance of minced fish.

[0025] Flake mimetic particles may have a median particle size of from 1 to 20 mm, preferably from 3 to 10 mm. For particles of angular shape, such as flake mimetic cubes, each cube may have a side with a minimum length of 1 mm, preferably 3 mm, and a maximum length of 20 mm, preferably 10 mm. For particles of round shape, such as flake mimetic pellets, each pellet may have a diameter between 1 and 20 mm, preferably between 3 and 10 mm. Preferably, the flake mimetic particles take the general form of rectangles, preferably cubes having a median particle size of from 3 to 10 mm. Such cubes need not be precisely cubic, with all corners at right angles and having precisely the same height, width, and length. In some instances, the flake mimetic particles may have a more irregular shape, with approximately equal height, width, and length.

[0026] Preferably, the flake mimetic particles are not intended to be as large as a whole flake of a whole cooked fish. An appearance more like minced fish is preferred.

Emulsion matrix

[0027] An emulsion matrix of the present invention comprises methylcellulose, water, and fat in an emulsion. The emulsion can hold flake mimetic particles relative to one another and thereby form an emulsion matrix that contains at least a portion of the flake mimetic particles. Preferably, all the flake mimetic particles are contained in the emulsion matrix, provided that flake mimetic particles at the outer surface of the emulsion matrix may be exposed or project from the emulsion matrix.

[0028] Methylcellulose is desirably fully hydrated to impart its full functionality to the emulsion. Preferably, methylcellulose is present in the emulsion at a ratio of, methylcellulose to water, from 1:5 to 1:30, preferably from 1:10 to 1:25.

[0029] Preferably, methylcellulose is present in the fish substitute in an amount of at least 1 wt%, preferably at least 1.5 wt%, based on the total weight of the fish substitute.

[0030] The fat in the emulsion may include one or more vegetable oils and/or one or more animal oils, preferably fish oil. Vegetable oils can provide nutrition to the fish substitute and preferably include a low saturated fat content. More preferably, vegetable oils present in the emulsion matrix may include no more than 11 % saturated fat content. Examples of vegetable oils having a low saturated fat content as a suitable ingredient for the emulsion matrix may include, but may not be limited to, sunflower oil, canola oil, rapeseed oil, avocado oil, flaxseed oil, walnut oil, sesame oil, grapeseed oil, safflower oil, olive oil, peanut oil, corn oil, soybean oil,

or any combinations thereof. Preferably, the vegetable oil with a low saturated fat content is sunflower oil or canola oil.

[0031] The fat in the emulsion preferably includes eicosapentaenoic acid (EPA) and/or docosahexaenoic acid (DHA) moieties. These omega-3 fatty acids can impart a fish-like texture and flavor to the fish substitute. Though algal oils can include EPA and DHA, fish oil is a preferred source of EPA and DHA. Preferably, the fat in the emulsion matrix includes at least 50 mg/g, EPA, DHA or both EPA and DHA.

[0032] The fat is present in the fish substitute in an amount of from 1 to 15 wt%, preferably from 3 to 10 wt%, based on the total weight of the fish substitute. Preferably, the fish oil present in the fish substitute is at most 3 wt% based on the total weight of the fish substitute.

[0033] Preferably, the emulsion matrix may include, based on the total weight of the fish substitute, methylcellulose in an amount of from 1 to 2.5 wt%, preferably from 1.2 to 2 wt%; water in an amount of from 5 to 35 wt%, preferably from 10 to 30 wt%; sunflower oil in an amount of from 1 to 10 wt%, preferably from 3 to 8 wt%; and fish oil in an amount of from 1 to 4 wt%, preferably 1.5 to 3.5 wt%.

[0034] Preferably, a weight ratio of flake mimetic to emulsion matrix in the fish substitute may be in a range of from 2:1 to 10:1, from 2:1 to 8:1, from 2:1 to 5:1, or from 2:1 to 3:1. More preferably, the ratio of flake mimetic to emulsion matrix is from 2:1 to 3:1.

Other ingredients

[0035] The fish substitute of the present invention can optionally comprise an external coating.

[0036] External coatings may include any kind of coatings known in the art, for instance, tempura coatings, breadcrumbs, panko (crushed or ground), breakfast cereals (e.g., cornflakes), and the like. Examples of ingredients for external coatings may include, but may not be limited to, wheat flour, starch, colorants, spices, or any combinations thereof.

[0037] The fish substitute of the present invention can optionally comprise an external batter coating. External batter coatings may include any kind of batter coatings known in the art with flour (e.g., wheat flour) and liquid (e.g., water) being the major ingredients.

[0038] The fish substitute of the present invention can optionally comprise one or more flavoring agents in an amount of from 2 to 5 wt%, preferably from 3 to 4.5 wt%, based on the total weight of the fish substitute. Flavoring agents may include, but may not be limited to, salt (e.g., any

standard food-grade kitchen salts such as sodium chloride), sugar (e.g., dextrose, trehalose, glucose, fructose, galactose, sucrose, lactose, maltose, palatinose, isomaltulose, cane sugar, beet sugar, rice syrup, invert sugar, honey, agave syrup, maple syrup, high fructose corn syrup, any combinations thereof, and the like), yeast extract, spices (e.g., pepper, white pepper, black pepper, mustard, cloves, nutmeg, turmeric, ginger, chili pepper, and the like), dried vegetables (e.g., shallots, garlic, onion, and the like), fish flavors (e.g., cod flavor, salmon flavor, and the like), herbs (e.g., oregano, basil, rosemary, sage, savory, thyme, bay leave, and the like), flavor enhancers (e.g., monosodium glutamate (MSG), disodium inosinate (I+G), and the like), mustard, or any combinations thereof. Preferably, the flavoring agents are in dry powder form.

[0039] Optional nutritional ingredients such as fibers and powdered proteins can also be included in the fish substitute to enhance the overall nutrition content. Fibers (e.g., oat fiber, wheat fiber) may improve hardness of the composition of the flake mimetic and the emulsion matrix, and provide additional nutrition to the fish substitute. Powdered proteins (e.g., egg white, isolated soy protein) may improve the protein content of the fish substitute.

[0040] Preferably, the fish substitute may comprise, based on the total weight of the fish substitute, the flake mimetic in an amount of from 50 to 80 wt%, preferably from 60 to 70 wt%; the emulsion matrix in an amount of from 10 to 45 wt%, preferably from 25 to 35 wt%; and optionally, one or more flavoring agents in an amount of from 2 to 5 wt%, preferably from 3 to 4.5 wt%. In another implementation, the fish substitute may comprise one or more external coating and/or external batter coating.

Fried fish substitute product

[0041] The present disclosure relates to a fried fish substitute product, including a fried coating and a fried portion of a fish substitute that comprises a particulate flake mimetic and an emulsion matrix. The flake mimetic is a thermally irreversible gel and comprises konjac. The emulsion matrix comprises methylcellulose, water, and fat in an emulsion. At least a portion of the flake mimetic particles are contained in the emulsion matrix. The fried coating is an external coating that covers at least part of, and preferably all of, a portion of the fish substitute. The fish substitute used to make the fried fish substitute product may be a fish substitute as described more fully above.

[0042] In one approach suitable for restaurant and food service use, the fish substitute is par-fried. The restaurant, food service company, or other user can further fry the par-fried fish substitute to create a fully fried fish substitute that is more acceptable for eating.

[0043] The flake mimetic and the emulsion matrix of the fried fish substitute product may be in a ratio of, flake mimetic to emulsion matrix, from 2:1 to 10:1, preferably from 2:1 to 3:1.

Method for preparing a fish substitute product

[0044] The present disclosure also provides a method for preparing a fish substitute product . The method comprises the steps of: (a). combining a particulate flake mimetic and an emulsion matrix such that at least a portion of the flake mimetic particles are contained in the emulsion matrix to obtain a composition; and (b). forming the composition into individual fish portions of the fish substitute product. The flake mimetic is a thermally irreversible gel and comprises konjac. The emulsion matrix comprises methylcellulose, water, and fat in an emulsion. The fish substitute used to make the fish substitute product may be a fish substitute as described more fully above.

[0045] Preferably, each individual fish portion is a fish ball having a weight between 10 and 20g.

[0046] The flake mimetic may be formed by mixing konjac, water, and at least one of a starch, an edible alkali, and food texturizer, and optionally including titanium dioxide to form a thermally irreversible gel having a gel strength from 200 to 600 g/m³, preferably from 300 to 500 g/m³; and breaking the gel into flake mimetic particles having angular shapes and a median particle size of from 1 to 20 mm, preferably from 3 to 10 mm.

[0047] The emulsion may be formed by mixing the methylcellulose with one of the water and the fat; and adding the other of the water and the fat while mixing to form the emulsion matrix.

[0048] The step of combining the particulate flake mimetic and the emulsion matrix may include mixing the flake mimetic particles into the emulsion matrix.

[0049] The method may include a step of coating the fish portion, preferably with an external coating, to provide a coated fish portion; more preferably, the method may further include a step of frying the coated fish portion to provide a fried fish substitute product.

[0050] The method may optionally include a step of forming the composition into a fish patty of the fish substitute product. Preferably, the fish patty is weighed between 50 and 120g.

Examples

[0051] The invention is further described in detail by reference to the following experimental examples. These examples are provided for purposes of illustration only and are not intended to be limiting unless otherwise specified. Thus, the invention should in no way be construed as being limited to the following examples.

Example 1 – Formulation of the fish substitute

[0052] Formulation for making fish substitute product is shown in Table 1. Ingredient concentrations are measured in wt% of the total weight of the formulation.

Table 1

Ingredient	wt%
Flake mimetic	
Konjac gel (see below)	66.38
Emulsion matrix	
Benecel methylcellulose (Ashland, Inc.)	1.65
Water	20.01
Sunflower oil (Cargill)	5.82
Fish oil (Novosana)	2.49
Flavoring agents	
Sugar (sucrose) (Sourced from local supermarket)	1.00
Salt (Sourced from local supermarket)	0.90
White pepper powder (Sourced from local supermarket)	0.20
Yeast extract (Springer)	0.90
Garlic powder (Sourced from local supermarket)	0.15
Cod flavor (IFF)	0.20
Salmon flavor (Givaudan)	0.30

[0053] Formulation for making the konjac gel is shown in Table 2. Ingredient concentrations are measured in wt% of the total weight of the konjac gel.

Table 2

Ingredient	wt%
Water	85 to 95
Starch	3 to 6
Refined konjac powder (BLG)	2 to 6
Dextrose	1 to 3
Sodium carbonate	0.2 to 0.5
Curdlan	1 to 2
Hydroxypropyl starch (Cargill)	1 to 2
Titanium dioxide	0.1 to 0.2

Example 2 – Process for preparing a fish substitute product

[0054] The following steps were taken to prepare fish substitute product using the formulations shown in Tables 1 and 2.

[0055] (1). Konjac powder, starch, dextrose, sodium carbonate, curdlan, hydroxypropyl starch, and titanium dioxide were mixed to form a mixture.

[0056] (2). The mixture was dispersed in water to form a homogenous dispersion.

[0057] (3). The dispersion was molded into a composition.

[0058] (4). The composition was heated at a temperature between 90 and 100°C under an alkali condition to form a konjac gel.

[0059] (5). The konjac gel was washed to remove any residual ingredients.

[0060] (6). The konjac gel was cut into small konjac pieces with a median particle size of from 3 to 10 mm.

[0061] (7). Methylcellulose was mixed with water in a bowl chopper for 1 to 2 minutes.

[0062] (8). Sunflower oil and fish oil were slowly added to the mixture until an emulsion was formed.

[0063] (9). The konjac pieces were mixed with the flavoring agents in a blender for 1 minute.

[0064] (10). The emulsion was added to the blender and mixed with the mixture of konjac pieces and flavoring agents for 3 minutes to obtain a composition.

[0065] (11). The composition was formed into plant-based cod fish balls (i.e., fish substitute product).

[0066] (12). The plant-based cod fish balls were coated with an external coating to obtain coated plant-based cod fish balls as follows: (12a). pre-dust was applied to the plant-based cod fish balls; (12b). the plant-based cod fish balls were coated with batter, and; (12c). the battered fish balls were breaded with crumbs to form the coated plant-based cod fish balls.

[0067] (13). Pan-frying the coated plant-based cod fish balls at around 200°C for about 30 seconds to obtain fried plant-based cod fish balls.

[0068] Formulation for the pre-dust, the batter, and the breading crumbs are shown in Table 3. Ingredient concentrations are measured in wt% of the total weight of the corresponding item.

Table 3

Ingredient	wt%
Pre-dust	
Wheat flour (Sourced from local supermarket)	60.1
Starch (Cargill)	30.0
Acetylated distarch adipate (Cargill)	7.0
Starch Acetate (Cargill)	1.5
Disodium dihydrogen pyrophosphate (ICL)	0.2
Sodium hydrogen carbonate (Sourced from local supermarket)	0.2
Spice (Sourced from local supermarket)	0.2
Salt (Sourced from local supermarket)	0.8
Batter	
Wheat flour (Sourced from local supermarket)	76.9
Starch (Cargill)	18.0
Sodium hydrogen carbonate (Sourced from local supermarket)	0.7
Disodium dihydrogen pyrophosphate (ICL)	0.8
Food flavors	0.6

(Sourced from local supermarket)	
Salt (Sourced from local supermarket)	1.0
Breading crumbs	
Wheat Flour (Sourced from local supermarket)	at least 70
Yeast (Springer)	1 to 5
Disodium dihydrogen pyrophosphate (ICL)	1.5
Sodium hydrogen carbonate (Sourced from local supermarket)	at most 2
Salt (Sourced from local supermarket)	at most 2
Soybean oil (Sourced from local supermarket)	at most 2
Spices (Sourced from local supermarket)	at most 2

Example 3 – Sensory evaluation

[0069] A sensory evaluation was conducted to evaluate the fried fish substitute product in accordance with the quantitative descriptive analysis (QDA) method. Samples of fried fish substitute product (e.g., plant-based cod fish balls) were tasted independently by a trained panel of eight panelists on different attributes (e.g., mouthfeel, taste, and flavor), who then assigned a score from 1 to 15 to each aspect, with a higher score representing a stronger intensity. A spider web diagram showing the scores of the different sensory attributes of the samples was shown in Fig. 1.

[0070] Other observations from the panel are summarized in Table 4.

Table 4

Attribute	Remarks
Visual	A golden appearance but slightly not even
Mouthfeel	- Very crispy outside with a little oily mouthfeel - A sea food flavor perceived
Texture	Elastic and firm texture and juiciness mouthfeel, associating with authentic cod fish taste and mouthfeel

CLAIMS

What is claimed is:

1. A fish substitute, comprising a particulate flake mimetic and an emulsion matrix, wherein
 - i. the flake mimetic comprises konjac; and
 - ii. the emulsion matrix comprises methylcellulose, water, and fat in an emulsion;
wherein the flake mimetic is a thermally irreversible gel and at least a portion of the flake mimetic particles are contained in the emulsion matrix.
2. The fish substitute of claim 1, further comprising an external coating.
3. The fish substitute of any of the preceding claims, wherein the flake mimetic has a gel strength of from 200 to 600 g/m³, preferably from 300 to 500 g/m³.
4. The fish substitute of any of the preceding claims, wherein the flake mimetic particles have a median particle size of from 1 to 20 mm, preferably from 3 to 10 mm.
5. The fish substitute of any of the preceding claims, wherein the flake mimetic has a texture similar to that of minced cod.
6. The fish substitute of any of the preceding claims, wherein the fat in the emulsion matrix comprises an oil having no more than 11 wt% saturated fat; an oil comprising at least 50 mg/g of EPA, DHA, or both EPA and DHA; and/or fish oil.
7. The fish substitute of any of the preceding claims, wherein a ratio of the flake mimetic to the emulsion matrix is from 2:1 to 10:1, preferably from 2:1 to 3:1.
8. The fish substitute of any of the preceding claims, wherein the emulsion matrix comprises, based on the total weight of the fish substitute,
 - i. methylcellulose in an amount of from 1 to 10 wt%, preferably from 4 to 6 wt%;
 - ii. sunflower oil in an amount of from 1 to 2.5 wt%, preferably from 1.5 to 1.8 wt%;
 - iii. fish oil in an amount of from 1 to 4 wt%, preferably from 2 to 3 wt%; and
 - iv. water in an amount of from 5 to 35 wt%, preferably from 15 to 25 wt%.
9. The fish substitute of any of the preceding claims, comprising, based on the total weight of the fish substitute,
 - i. the flake mimetic in an amount of from 50 to 80 wt%, preferably from 60 to 70 wt%;
and

- ii. the emulsion matrix in an amount of from 10 to 45 wt%, preferably from 25 to 35 wt%.
10. A fried fish substitute product comprising a fried coating and a fried portion of a fish substitute that comprises a particulate flake mimetic and an emulsion matrix, wherein
- i. the flake mimetic is a thermally irreversible gel and comprises konjac;
 - ii. the emulsion matrix comprises methylcellulose, water, and fat in an emulsion;
 - iii. at least a portion of the flake mimetic particles are contained in the emulsion matrix; and
 - iv. the fried coating is an external coating that covers at least part of the fried portion of the fish substitute.
11. The fried fish substitute product of claim 10, wherein the fish substitute is par-fried.
12. The fried fish substitute product of any of claims 10 to 11, wherein a ratio of the flake mimetic and the emulsion matrix is from 2:1 to 10:1, preferably from 2:1 to 3:1.
13. A method for preparing a fish substitute product, comprising a) combining a particulate flake mimetic and an emulsion matrix such that at least a portion of the flake mimetic particles are contained in the emulsion matrix to obtain a composition, and b) forming the composition into individual fish portions of the fish substitute product, wherein:
- i. the flake mimetic is a thermally irreversible gel and comprises konjac; and
 - ii. the emulsion matrix comprises methylcellulose, water, and fat in an emulsion.
14. The method of claim 13, wherein the flake mimetic is formed by mixing the konjac, water, and at least one of a starch, an edible alkali, and a food texturizer, and optionally titanium dioxide to form a thermally irreversible gel having a gel strength from 200 to 600 g/m³, preferably from 300 to 500 g/m³; and breaking the gel into particles having an angular shape and a median particle size of from 1 to 20 mm, preferably from 3 to 10 mm.
15. The method of any of claims 13 to 14, wherein the emulsion matrix is formed by mixing the methylcellulose with one of the water and the fat; and adding the other of the water and the fat while mixing to form the emulsion matrix.
16. The method of any of claims 13 to 15, wherein combining the particulate flake mimetic and the emulsion matrix comprises mixing the flake mimetic particles into the emulsion matrix.
17. The method of any of claims 13 to 16, further comprising coating the fish portion.

18. The method of any of claims 13 to 17, further comprising coating the fish portion and frying the coated fish portion to provide a fried fish substitute product.

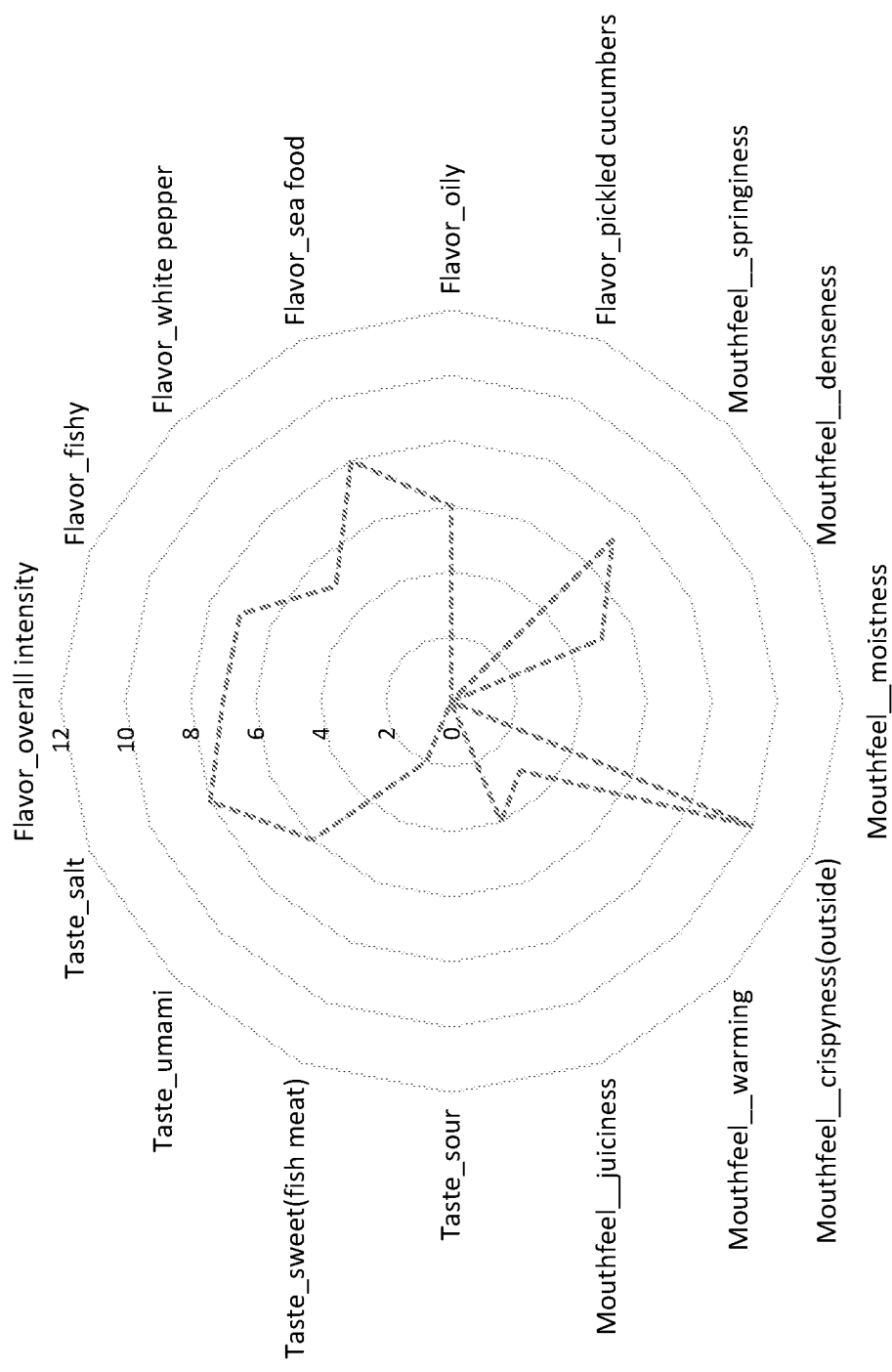


FIG. 1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2023/095236

A. CLASSIFICATION OF SUBJECT MATTER A23L 29/244(2016.01)i 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) IPC: A23L 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) CNTXT,CJFD,CNKI,DWPI,VEN,ENTXT,WPABS,WPABSC,ENTXTC: konjac, gel, fish, oil, fat, methylcellulose, emulsion, fry																				
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>Y</td> <td>TW 202236972 A (FUJI OIL HOLDINGS INC et al) 01 October 2022 (2022-10-01) description paragraph 8-16</td> <td>1-18</td> </tr> <tr> <td>Y</td> <td>WO 2021170856 A1 (ALGAMA et al) 02 September 2021 (2021-09-02) claims 1-12</td> <td>1-18</td> </tr> <tr> <td>A</td> <td>US 2003017246 A1 (ALAMIAN S et al) 23 January 2003 (2003-01-23) claims 1-58</td> <td>1-18</td> </tr> <tr> <td>A</td> <td>CN 112056566 A (UNIV NORTHEAST AGRIC) 11 December 2020 (2020-12-11) claims 1-4</td> <td>1-18</td> </tr> <tr> <td>A</td> <td>CN 112970934 A (UNIV JIANGNAN) 18 June 2021 (2021-06-18) claims 1-10</td> <td>1-18</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	Y	TW 202236972 A (FUJI OIL HOLDINGS INC et al) 01 October 2022 (2022-10-01) description paragraph 8-16	1-18	Y	WO 2021170856 A1 (ALGAMA et al) 02 September 2021 (2021-09-02) claims 1-12	1-18	A	US 2003017246 A1 (ALAMIAN S et al) 23 January 2003 (2003-01-23) claims 1-58	1-18	A	CN 112056566 A (UNIV NORTHEAST AGRIC) 11 December 2020 (2020-12-11) claims 1-4	1-18	A	CN 112970934 A (UNIV JIANGNAN) 18 June 2021 (2021-06-18) claims 1-10	1-18
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Date of the actual completion of the international search 15 January 2024		Date of mailing of the international search report 27 January 2024																		
Name and mailing address of the ISA/CN CHINA NATIONAL INTELLECTUAL PROPERTY ADMINISTRATION 6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088, China		Authorized officer SHI,Jun Telephone No. (+86) 010-62411178																		

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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				FR	3107432	A1	27 August 2021
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CN	112056566	A	11 December 2020	None			
CN	112970934	A	18 June 2021	None			