(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) **World Intellectual Property Organization**
International Bureau

(43) **International Publication Date**
24 October 2024 (24.10.2024)

WIPO | PCT

(10) **International Publication Number**
WO 2024/218349 A1

(51) **International Patent Classification:**
A23B 4/06 (2006.01) *A23P 20/10* (2016.01)
A23L 3/36 (2006.01) *A23L 3/365* (2006.01)
A23L 5/30 (2016.01) *A23L 5/10* (2016.01)
A23L 13/00 (2016.01) *A23L 29/206* (2016.01)

(21) **International Application Number:** PCT/EP2024/060814

(22) **International Filing Date:** 19 April 2024 (19.04.2024)

(25) **Filing Language:** English

(26) **Publication Language:** English

(30) **Priority Data:**
63/460,968 21 April 2023 (21.04.2023) US
23197414.8 14 September 2023 (14.09.2023) EP

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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).

Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:
— *with international search report (Art. 21(3))*

(54) **Title:** A PROCESS AND COMPOSITION FOR PREPARING A CRISPY BREADED FOOD PRODUCT

(57) **Abstract:** Disclosed are coated food products which products may be reheated in microwave ovens. Specifically, the present invention relates to a process and composition for preparing a breaded frozen food product. More specifically the process of the present invention provides a frozen food product that upon reheating in a microwave oven has a crispy coating, more specifically the crispy coating is crispy breading. Furthermore, the invention relates to crumb coated food products, wherein a meat, fish, poultry, vegetable, plant-based meat analogue, fruit, fungus materials or dairy product substrate is coated with particulate materials for example with crumbs or flakes.

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A PROCESS AND COMPOSITION FOR PREPARING A CRISPY BREADED FOOD PRODUCT

The invention is in the field of coated food products which products may be reheated in microwave ovens. Specifically, the present invention relates to a process and composition for preparing a breaded frozen food product. More specifically the process of the present invention provides a frozen food product that upon reheating in a microwave oven has a crispy coating, more specifically the crispy coating is crispy breading. Furthermore, the invention relates to crumb coated food products, wherein a meat, fish, poultry, vegetable, plant-based meat analogue, fruit, fungus materials or dairy product substrate is coated with particulate materials for example with crumbs or flakes.

There is a constant demand for frozen food products that can be conveniently reheated in a microwave oven. Unfortunately, heating of a frozen food product by a microwave oven has some drawbacks. This is especially true for breaded frozen food products, which upon reheating in a microwave oven do not become crispy. However, a crispy product would be highly desirable by consumers.

The use of a microwave oven for cooking or reheating coated products is problematic because the core tends to absorb microwaves better than the coating, leading to an unsuitable temperature gradient from inside out. As a result, moisture also tends to move from the core to the coating, making the latter soggy. Another common problem is that the product heats up unevenly and this leads to a heated product that on one side is soggy, while another part may be overly dry and hard to chew.

There have been several attempts to overcome the above problems. These either focused on providing a specific barrier layer between the water containing inner portion and the crisp outer surface see for example WO 2017/042296. Alternatively, there were approaches to have multiple layers of breaded surfaces see for example WO 1997/003572. Both approaches are similar in that they try to keep water away from the surface of the breaded food product. The fundamental problem with these types of approaches is that upon reheating steam escapes from the wet inner core. This results in that the escaped steam condenses on the still cold outer surface so that this surface becomes wet and soggy. Another common issue is moisture movement during the time of frozen storage. Products that have been stored for several months usually have visible frost on the surface. During microwaving, this ice will melt on the breading and thereby add to the sogginess.

Another approach suggested so far for providing crispiness is the use of a susceptor sleeve or plate to provide strong surface heat to a food object, thereby causing browning and crisping. However, there are several drawbacks with this approach also. The susceptors are expensive, they are difficult to recycle and represent an additional packaging element. Furthermore, they are only effective, where the food has good contact with the susceptor. The patent application, US20120288590A1 discloses edible surface-modifying particles with the combination of the use of a susceptor. The particles are made with water, but then this water is dried of before freezing the covered food product.

A still further approach is disclosed in the European patent application EP3078278A1. In the disclosed method a stabilizer solution is injected into chicken pieces. The solution seems to have the purpose of binding water inside the meat so that it cannot migrate to the surface where it would cause sogginess.

SUMMARY OF THE INVENTION

The object of the present invention was to provide a product and a preparation process thereof that at least goes part way to overcome one or more of the above-mentioned disadvantages of existing products and processes or at least provides a useful alternative. More specifically, the object of the present invention was to provide a frozen food product especially a breaded food product that is crispy after reheating the frozen food product in a microwave oven.

The object of the present invention is achieved by the subject matter of the independent claims. The dependent claims further develop the idea of the present invention.

Accordingly, the present invention in a first aspect provides a frozen food product and a process for its preparation, wherein the preparation of the frozen food product comprises the steps of:

contacting a food product with a dipping solution then

deep-freezing the product of the above step,

wherein the dipping solution at -18°C has a dielectric loss tangent of at least 0.1.

In other words, the present invention provides a frozen food product that before freezing has been contacted with a dipping solution, wherein said dipping solution at –18 °C has a dielectric loss tangent of at least 0.1

Preferably during the contacting of the food product with the dipping solution the dipping solution forms a covering layer on the food product. This means that for the present invention it is essential that some dipping solution adheres to the surface of the food product. Ideally after said contacting and before freezing the dipping solution forms a covering layer all around the food product.

Preferably said dipping solution at -18°C has a dielectric loss tangent of at least 0.13, more preferably at least 0.3, more preferably at least 0.4, more preferably at least 0.5 and still more preferably a dielectric loss tangent of at least 0.6.

In a second aspect said dipping solution at –18 °C has an unfrozen water content of at least 25 wt%, preferably at least 30 wt%, more preferably at least 40 wt%, more preferably at least 50 wt%, more preferably at least 60 wt% and even more preferably at least 90 wt% of unfrozen water content. Advantageously the dipping solution at 20°C has a viscosity of at least 10 [mPa.s], preferably has a viscosity of at least 30 [mPa.s], more preferably at least 50 [mPa.s]. Furthermore, the dipping solution has a viscosity of at most 1000 [mPa.s], preferably at most 500 [mPa.s], still more preferably at most 200 [mPa.s]. According to an especially preferred embodiment the dipping solution at 20°C has a viscosity of at least 80 [mPa.s] and at most 200 [mPa.s]. The person skilled in the art is well aware of viscosity measurement methods, e.g., viscosity can be measured by using a rotary viscometer.

In a preferred embodiment said dipping solution comprises

from 0 to 20 wt% edible salt, preferably sea salt,

at least 20 wt%, preferably at least 30 wt% sugar and/or polysaccharides, and

water.

In a still further preferred embodiment said dipping solution comprises at least 1 wt%, preferably at least 2 wt% and more preferably at least 4 wt%, more preferably at least 5 wt% and still more preferably at least 10 wt% edible salt.According to a preferred embodiment said sugar and/or polysaccharide is selected from glucose, sucrose, lactose, trehalose, starch, modified starch, maltodextrin, modified maltodextrin, soluble corn fiber, fructo-oligosaccharides, inulin, rice syrup and any combinations thereof.

In a particularly preferred embodiment said dipping solution comprises salt, soluble corn fiber, glucose and water and preferably the salt is low sodium sea salt.

Preferably said contacting of the food product with the dipping solution is achieved by dipping the food product into the dipping solution or by spraying the dipping solution onto the food product. Any other methods can be used if it achieves that the food product becomes covered with said dipping solution.

According to a preferred embodiment the preparation of said food product before said dipping comprises the following steps:

a) forming a breaded food product,
b) solidifying the crust of the breaded food product of step a),
c) baking the product of step b).

Advantageously the food product is pre-fried and/or pre-baked before it is contacted with the dipping solution.

According to a further aspect of the invention the adherence of the dipping solution to the food product is facilitated by using larger particulate matters, more specifically larger breadcrumbs, cereal flakes or coconut flakes.

In a still further preferred embodiment of the present invention the food product is covered with crumbs, more specifically with breadcrumbs. In general, it is preferred that the breadcrumb has a larger average particle size. Preferably at least 30% of the breadcrumbs do not pass through a no. 20 mesh sieve. More preferably at least 40% and still more preferably at least 50% of the breadcrumbs do not pass through an 850 micrometer (no. 20 mesh) sieve.

In a further aspect the present invention relates to the use of a dipping solution to improve the crispiness of a deep-frozen food product upon heating in a microwave, wherein the dipping solution at –18 °C has a dielectric loss tangent of at least 0.1. Preferably said dipping solution at –18 °C has an unfrozen water content of at least 25 wt%.

Preferably said dipping solution at -18°C has a dielectric loss tangent of at least 0.13, preferably at least 0.3, preferably at least 0.4, more preferably at least 0.5 and still more preferably a dielectric loss tangent of at least 0.6.

In a second aspect said dipping solution at –18 °C has an unfrozen water content of at least 25 wt%, preferably at least 30 wt%, more preferably at least 40 wt%, more preferably at least 50 wt%, more preferably at least 60 wt% and more preferably at least 90 wt% of unfrozen water content.

In a preferred embodiment in said use said dipping solution comprises

from 0 to 20 wt% edible salt, preferably sea salt

at least 20 wt%, preferably at least 30 wt% sugar and/or polysaccharides, and

water.

In a still further preferred embodiment in said use said sugar and/or polysaccharide is selected from glucose, sucrose, lactose, trehalose, starch, modified starch, maltodextrin, modified maltodextrin, soluble corn fiber, fructo-oligosaccharides, inulin, rice syrup and any combinations thereof.

In a particularly preferred embodiment in said use said dipping solution comprises low sodium sea salt, soluble corn fiber, glucose and water.

DETAILED DESCRIPTION OF THE INVENTION

All of the above disclosed prior art methods try to prepare a food product in a way that they are crispy before freezing. The present invention deviates from the prior art in that it does not attempt to make a product that is crispy right before freezing and then before reheating in a microwave. Rather the food product of the present invention contains a large amount of unfrozen water in its coating at –18 °C. In other words, the products according to the present invention are designed to be soggy before freezing so that they heat better in a microwave oven. The present inventors have found out that when a food product before freezing is contacted with a dipping solution which at –18 °C has a dielectric loss tangent of at least 0.1, then this food product upon reheating in a microwave oven has an especially crispy surface. This physicochemical feature enhances the ability of the coating to absorb microwaves right after the microwave oven is started. As a result, the coating achieves elevated temperatures earlier in the heating process, which, due to its salt content, creates a so-called ‘thermal runaway’ situation. The coating maintains a higher temperature than the core throughout the heating process, especially at the edges. This temperature profile is conducive to drying out the coating and bringing it to the glassy state, i.e., making it crispy.

According to the present invention there are no further frying or drying steps after contacting the food product with said dipping solution and before deep-freezing. Ideally the dipping is performed on a fried and/or pre-baked breaded product and then the resulting product that is covered with the dipping solution is deep-frozen.

A comparison of the heating process of a state-of-the-art product and an inventive product has been made by placing samples under an infrared camera and heating the samples in a microwave oven. The infrared image surprisingly showed a marked difference. In the case of a state-of-the-art product, we experienced an uneven heating on the surface. Some areas heated up faster and earlier while other areas on the surface remained cold for a longer time. This resulted in that the earlier heated areas dried out and the cold areas became less crispy, and part of the core became less moist and less juicy. In contrast the surface of the product according to the invention warmed up more uniformly. This has led to a uniformly crispy product which retained a moist and juicy inner core.

Another advantage of the present invention is that it provides a product with which moisture migration during storage will not be a problem. This is due to the simple fact that moisture content is already high in the crust compared to the prior art products. Thus, the present invention also solves the moisture migration problem.

The term “food product” according to the present specification relates generally to any food product that is suitable for human consumption.

The term “dipping solution” according to the present specification generally relates to an aqueous solution with which a food product can be contacted. There can be many ways to contact a dipping solution with a food product. For example, the food product can be dipped into the dipping solution or alternatively the dipping solution can be sprayed onto a food product.

The term “deep freezing” generally relates to an industrial technique that involves cooling quickly and viciously (a couple of minutes to an hour) food by exposing the food intensely to temperatures e.g., from -30 °C to -50 °C, until the product core temperature reaches -18 °C.

The term “dielectric loss tangent” (often denoted as tan δ) of a material denotes quantitatively dissipation of the electrical energy due to different physical processes such as electrical conduction, dielectric relaxation, dielectric resonance and loss from non-linear processes. The dielectric loss tangent can be evaluated by tan(δ): ε''/ε', i.e., the ratio between the lossy and lossless reaction to the electric field. In other words, the dielectric loss tangent is the ratio between the dielectric loss factor (ε'') and the real part of the dielectric constant (ε').

Methods of measuring dielectric properties are well known for the skilled artisan. For example, the following book chapter provides an especially relevant summary of the measurement for food substances: Per Olov Risman: Measurements of dielectric properties of foods and associated materials. (Development of packaging and products for use in microwave ovens, second edition, pages 201 – 223. Editors: Erle et al. Elsevier, 2020, ISBN: 978-0-08-102713-4)

Throughout this description the term “unfrozen water” is the water that remains unfrozen at temperature of –18°C.

The term “moistness” as used throughout this specification relates to the extent to which the product feels moist while chewing.

The term “crispiness” as used throughout this specification relates to the intensity of high pitch noise resulting from the crust of the product, experienced within first few chews.

EXAMPLES

The invention is further described with reference to the following examples. It will be appreciated that the invention as claimed is not intended to be limited in any way by these examples.

Example 1

Preparation of dipping solution

The dipping solution was prepared by weighing the dry ingredients in a beaker glass with a precision balance. Then water was added with a certain excess amount. Magnetic stir bar was used to aid dissolution of the dry ingredients. Meanwhile, the solution was heated to 80 °C until the desired amount of remaining water in the solution was reached. The resulting homogeneous solution was then transferred and stored in a sealed container to avoid moisture migration.

Quantification of unfrozen water in dipping solution

The amount of unfrozen water in the dipping solution was quantified using differential scanning calorimetry (DSC). A 40 µL aluminum standard crucible and its lid (Mettler-Toledo, part no. ME-00026763) were weighed. Approx. 20 mg of dipping solution was added, then the crucible was hermetically sealed with its lid and then reweighed. Weighing was carried out with a balance with 0.01 mg precision.

The analyses were performed using DSC1/700 (Mettler-Toledo GmbH, Germany) in nitrogen atmosphere with flow rate of 50 mL/min. The measurement involves i) a cooling step from 25 °C to -40 °C followed by ii) a heating step from -40 °C to 25 °C with heating/cooling rate of 1.5 °C per minute. The measurement was carried out in triplicate.

The amount of frozen water was quantified from the melting enthalpy of ice in the dipping solution identified in the heating step between –18 °C and 0 °C compared to the melting enthalpy of ice from a pure water sample.

Frozen water in the sample = melting enthalpy of the sample / melting enthalpy of water

The amount of unfrozen water in comparison to the total water in the dipping solution sample can then be calculated as follows:

Unfrozen water (%) = (1 – frozen water in the sample/water content of the sample) x 100%

Measurement of dielectric properties

Dielectric properties of dipping solution were measured with Agilent Network Analyzer E5071C with dielectric probe kit 85070E and Keysight software N1501A (Keysight Technologies, USA) following the Open-Ended Coaxial Line method. Measurements were made by simply immersing the probe into liquids or semi-solids as with this method no special fixtures or containers are required. Measurements were recorded at a frequency of 2.45 GHz. For measurements at or below 0 °C, dipping solutions were initially stored in a -20 °C freezer prior to measurement. For measurements above 0 °C, temperature of the dipping solution was controlled in the setup as presented by Gezahegn and coworkers (Gezahegn et al. (2021). Dielectric properties of water relevant to microwave assisted thermal pasteurization and sterilization of packaged foods. Innovative Food

Science & Emerging Technologies, 74, 102837). Dielectric properties of breadcrumbs were measured using an H_{011} resonator connected to an Agilent Network Analyzer E5071C. The measurement was carried out at 25 °C at a frequency of 2.45 GHz.

Table 1: Unfrozen water content and dielectric properties of the dipping solution (DS)

	DS 1	DS 2	DS 3	DS 4	DS 5
Promitor SCF 90 [g]		9	18.5	18	37
Glucose, anhydrous ultrapure [g]		9	5.2	18	10.5
Low sodium salt [g]		2	5.5	4	11
Tap water [g]	100	80	70.8	60	41.5
Melting enthalpy [J/g]	333.7	207.0	146.3	110.5	16.6
Unfrozen water per total water in dipping solution [%]	0	38	56	67	95
Viscosity [mPa.s]	1	5	12	32	180
Dielectric loss tangent at temperatures[1]					
-18°C	0.0001[a]	0.13	0.30	0.40	0.67
-1°C	0.001[a]	0.44	0.55	0.62	0.78
20°C	0.13[b]	0.39	0.49	0.56	0.85
80°C	0.04[b]	0.67	0.84	0.94	1.45
120°C	.03[b]	0.59	0.65	0.68	0.74

[a] Dielectric loss tangent for ice is based on literature data according to Evans, S. (1965). Dielectric Properties of Ice and Snow–a Review. Journal of Glaciology, 5(42), 773-792. doi:10.3189/S0022143000018840

[b] Dielectric loss tangent for water is based on literature data according to Gezahegn et al. (2021). Dielectric properties of water relevant to microwave assisted thermal pasteurization and sterilization of packaged foods. Innovative Food Science & Emerging Technologies, 74, 102837.

Example 2

Product application

Chicken patty was prepared with the following recipe:

Table 2: Composition of the food product - chicken

Ingredients	Weight percentage %
Chicken split breasts, with ribs	81.5
Canola oil	5.5
Water	6.5
Corn starch	3.2
Garlic powder	0.15
Pepper White Ground	0.15
Methyl cellulose	1
Wheat Gluten	2

Preparation of the patty

All the dry ingredients were mixed then water was added at 4 °C and further mixed. Then, ground chicken meat was added. A patty was then prepared by taking 72 grams of the mixes and molding it into a patty. A big batch of patty can be produced at once, and then the patty can be stored frozen for further process. Then, the frozen patty was dipped in liquid batter and rolled onto Breadcrumb-Wheat Tstd Jpns (Newly Wed Foods Inc, USA). The coated patty was then fried in soybean oil at controlled temperatures between 190 and 196 °C for 30 s. The fried coated patty was then baked in a steam oven to reach at least 74 °C in the core. The resulting patty was then subjected to dipping in solutions prior to being packed and stored at -20 °C for at least 14 days prior to sensory tests.

Sample preparation for sensory test

A single frozen patty was directly placed in microwave and subjected to microwave heating at 1100 Watt for 180 s. Product was taken out from the microwave, allowed to cool for 5 minutes, and then subjected to sensory tests by eight experienced panelists.

Table 3:

	Comp. Example 3	Example 4	Example 5	Example 6
Dipping with	**No dipping**	**DS2**	**DS4**	**DS5**
Chicken patty [g]	72	72	72	72
Liquid batter composition				
Bleached flour [g]	7	7	7	7
Promitor 90 [g]	4	4	4	4

Soy protein isolate [g]	1	1	1	1
Double acting baking powder [g]	0.5	0.5	0.5	0.5
Soybean oil [g]	0.5	0.5	0.5	0.5
Water [g]	9	9	9	9
Breadcrumbs [g]	12	12	12	12
Oil absorbed during frying [g]	15	15	15	15
Dipping [g]	0	8	9	12
Dipping solution composition				
Promitor 90 [%-wt]		9	18	37
Glucose [%-wt]		9	18	10.5
Low sodium salt [%-wt]		2	4	11
Water [%wt]		80	60	41.5
Sensory assessment				
Crispiness	2	4	4	5
Moistness	5	5	6	6
Saltiness	3	4	4	5

Promitor 90 was sourced from Tate and Lyle. It is a soluble corn fiber with 90% non-digestible (resistant) maltodextrin (fibers). The average molecular weight of the non-digestible fiber is 1600 Da.

Sensory assessment was done on a scale of 1 to 8, where 1 would be a product with breading that is soggy or chewy without any crispiness and dry center while 8 would be comparable to a deep-fried product with a very crispy breading and moist center.

Examples 7 to 10

Examples 7 to 10 were prepared and tested in the same way as Example 6 with the only difference that instead of Promitor different carbohydrates were used.

Table 4: Effects of using other carbohydrate ingredients than Promitor

	Example 7	**Example 8**	**Example 9**	**Example 10**
Chicken patty [g]	72	72	72	72
Batter [g]	*22*	*22*	*22*	*22*
Liquid batter composition				

Bleached flour [%-wt]	31.30	31.30	31.30	31.30
	18.00	18.00	18.00	18.00
	4.20	4.20	4.20	4.20
	2.10	2.10	2.10	2.10
	3.50	3.50	3.50	3.50
Water [%-wt]	40.90	40.90	40.90	40.90
Breadcrumbs [g]	12	12	12	12
Oil absorbed during frying [g]	15	15	15	15
Dipping [g]	12	12	12	12
Dipping solution composition				
Ingredient	Maltodextrin DE 17-21	Maltodextrin DE 30	Rice syrup	Inulin Orafti GR
Amount [%-wt]	37	37	37	37
Glucose [%-wt]	10.5	10.5	10.5	10.5
Low sodium salt [%-wt]	11	11	11	11
Water [%wt]	41.5	41.5	41.5	41.5
Sensory assessment				
Crispiness	6	5	5	6
Moistness	5	5	5	5
Saltiness	5	5	5	5

Example 11

Product application for a plant-based meat analogue core

The patty was prepared as described above in Example 2 but using a plant-based meat analogue core and with a slight difference in the batter composition. Example 11 shows that a crispy reheated product can be achieved in the case of a plant-based meat analogue core also.

	Example 11
Plant based chicken analogue [g]	20
Batter [g]	6
Batter composition	
Bleached flour [%-wt]	50

Water [%-wt]	50
Breadcrumbs [g]	5
Oil absorbed during frying [g]	3
Dipping [g]	4
Dipping solution composition	
Promitor 90 [%-wt]	37
Glucose [%-wt]	10.5
Low sodium salt [%-wt]	11
Water [%wt]	41.5
Sensory assessment	
Crispiness	5
Moistness	4
Saltiness	3
Note	Crispy surface but moistness is low as the chicken analogue itself is inherently not as moist as chicken

Example 12 and 13

Product application in case when coconut flakes are used as particulate matter

Examples 12 and 13 were prepared in a similar way as described above for Example 2. Examples 12 and 13 show the effect of using a dipping solution on a chicken product which instead of breadcrumbs is covered with coconut flakes. Our results show that a much crispier reheated product could be achieved when the coconut flake covered chicken meat patty was dipped into a dipping solution of the present invention.

	Example 12	Example 13
Cut chicken breast [g]	20	20
Bleached flour [g]	3	3
Spices and seasonings [g]	0.5	0.5
Egg [g]	5	5
Coconut flakes [g]	5	5
Oil absorbed during frying [g]	4	4
Dipping [g]		3
Dipping solution composition		
Promitor 90 [%-wt]		37
Glucose [%-wt]		10.5
Low sodium salt [%-wt]		11
Water [%wt]		41.5
Sensory assessment		
Crispiness	2	4

Moistness	3	6
Saltiness	3	4
Note	The center meat is chewy, and the coconut flake is not crispy	The center meat is moist, and the coconut flake is markedly crispier than Example 12

CLAIMS

1. A process for preparing a frozen food product comprising the steps of:

   1) contacting a food product with a dipping solution thereby covering the food product with said dipping solution then
   2) deep-freezing the product of step 1,

   wherein the dipping solution at –18 °C has a dielectric loss tangent of at least 0.1 and wherein the frozen food product is suitable for heating in an oven or a microwave oven.

2. The process according to claim 2, wherein the dipping solution at –18 °C has an unfrozen water content of at least 25 wt% measured via DSC as defined in the description.

3. The process according to any preceding claim, wherein the dipping solution has a viscosity of at least 10 [mPa.s].

4. The process according to any preceding claim, wherein the dipping solution comprises

   a) from 0 to 20 wt% edible salt, preferably sea salt
   b) at least 20 wt%, preferably at least 30 wt% sugar and/or polysaccharides, and
   c) water.

5. The process according to any preceding claim, wherein the sugar and/or polysaccharide is selected from glucose, sucrose, lactose, trehalose, starch, modified starch, maltodextrin, modified maltodextrin, soluble corn fiber, fructo-oligosaccharides, inulin, rice syrup and any combinations thereof.

6. The process according to any preceding claim, wherein the dipping solution comprises salt, soluble corn fiber, glucose and water.

7. The process according to any preceding claim, wherein in step 1 the contacting is achieved by dipping the food product into the dipping solution or by spraying the dipping solution onto the food product.

8. The process according to any preceding claim, wherein before step 1 the following steps are performed:

a) forming a breaded food product,
b) solidifying the crust of the breaded food product of step a),
c) baking the product of step b),
d) applying the food product of step c) in step 1 of claim 1.

9. The process according to any preceding claim, wherein the breaded food product contains breadcrumbs characterized in that at least 30% of the breadcrumbs do not pass through a no. 20 mesh sieve, preferably at least 40% and still more preferably at least 50% of the breadcrumbs do not pass through a 850 micrometer (no. 20 mesh) sieve.

10. A frozen food product that before freezing has been contacted with a dipping solution, wherein said dipping solution at –18 °C has a dielectric loss tangent of at least 0.1, wherein the frozen food product is suitable for heating in an oven or a microwave oven.

11. The frozen food product according to claim 10, wherein the dipping solution at –18 °C has an unfrozen water content of at least 25 wt%.

12. The frozen food product according to any of claims 10 to 11, wherein the dipping solution has a viscosity of at least 10 [mPa.s].

13. The frozen food product according to any of claims 10 to 12, wherein the dipping solution comprises

a) from 0 to 20 wt% edible salt, preferably sea salt
b) at least 20 wt%, preferably at least 30 wt% sugar and/or polysaccharides, and
c) water.

14. The frozen food product according to any of claims 10 to 13, wherein the sugar and/or polysaccharide is selected from glucose, sucrose, lactose, trehalose, starch, modified starch, maltodextrin, modified maltodextrin, soluble corn fiber, fructo-oligosaccharides, inulin, rice syrup and any combinations thereof.

15. The frozen food product according to any of claims 10 to 14, wherein the dipping solution comprises salt, soluble corn fiber, glucose and water.

16. Use of a dipping solution to improve the crispiness of a deep-frozen food product upon heating in a microwave oven, wherein the dipping solution at –18 °C has a dielectric loss tangent of at least 0.1.

17. The use according to claim 16, wherein the dipping solution at –18 °C has an unfrozen water content of at least 25 wt%.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/060814

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23B4/06 A23L3/36 A23L5/30 A23L13/00 A23P20/10
A23L3/365 A23L5/10 A23L29/206
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)
A23B A23P 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)

EPO-Internal, WPI Data, FSTA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

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"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
4 July 2024	16/07/2024

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	Groh, Björn

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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A	Risman Per Olov: "Measurements of dielectric properties of foods and associated materials" In: "Development of packaging and products for use in microwave ovens, second edition", 2020, Elsevier, XP093181084, ISBN: 978-0-08-102713-4 pages 201-223, page 201 - page 223 -----	1,10

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