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(54) Title: ION CONTROL METHOD

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ION CONTROL METHOD

The present invention relates to a method for processing a coated food product, as well as coated food products obtainable by said methods. The method is particularly suitable for processing extrusion coated food products, such as sausages.

Synthetic coatings for food products, such as sausage casing, are well known in the art. Synthetic coatings are typically made from cellulose, though collagen and even plastics may also be used. A disadvantage of these coating materials is that they tend to confer an unnatural and unappealing texture to the outside of a food product and, in some cases, the coating is inedible. This means that synthetic coatings often have to be removed from the food product before consumption, particularly where an imperceptible coating is desirable such as with a skinless sausage. This also adds to the risk of food contamination due to added handling of the food product.

Anionic polymers have been used in synthetic food coatings, such as sausage casings, for some time. Alginate is an edible anionic polymer which is made up of two different uronic acid monomers, namely guluronic acid (G-blocks) and mannuronic acid (M-blocks).

Alginate is commonly used to form sausage casings as part of a process in which a solution of alginate is extruded through a circular die around a food product and subsequently treated with a strengthening solution comprising calcium chloride (see *e.g.* WO 2016/027261). During this process, the alginate solution undergoes a gelification process in which matrices of cross-linked alginate chains form. The M-blocks form linear molecular chains (M-M-M-M-M), whilst the G-blocks form folded structures (G-G-G-G). Alternating regions consisting of M- and G-chains form the fundamental alginate structure, which can vary with seaweed type and seasonal climate.

Once coated food products have been strengthened, they are often cooked in a water bath, before being dried and packaged. Calcium ions are included in the water so that strengthening of the casing material may be continued. The coated food product may then be cooked for a second time before eating by the consumer, *e.g.* by frying.

Filling compositions for food products such as sausages will often comprise water in an amount of greater than 20 %, and animal matter in an amount of less than 60 % by weight of filling composition, particularly where the sausages are for production on a large economic scale. When these food products are cooked then moisture is driven from the filling

composition which can lead to the formation of bubbles under the coating material. This is particularly the case when the coated food product is cooked at high temperature *e.g.* by frying in oil. Bubble formation can be visually unappealing to consumers, as well as enhancing perception of the casing material during eating. In severe cases, the coating material can split, thereby damaging the structural integrity and appearance of the product.

Accordingly, there is a need for a coated food product which exhibits reduced bubble formation during second cooking.

The present invention is based on the unexpected discovery that bubble formation during second cooking, *e.g.* frying, may be reduced by using a strengthening solution during processing with a higher concentration of Group 2 metal ions than the cooking liquor in which the coated food product is first cooked.

Without wishing to be bound by theory, it is believed that the coating material is strengthened by the strengthening solution but then slightly weakened during first cooking. In particular, it is believed that some of the calcium ions that are acting as cross-linking agents in the casing material are washed into the cooking liquor. Some of the calcium ions are also believed to be sequestered into the filling composition, particularly where phosphates are used. The loss of calcium ions during this process is believed to enable gases that are formed during second cooking of the coated food product to permeate through the coating material, without significantly compromising the structural integrity of the casing.

Thus, in a first aspect, the present invention provides a method for processing a coated food product comprising a filling composition and a coating material, said method comprising:

contacting the coated food product with a strengthening solution which comprises Group 2 metal ions; and

transferring the coated food product to a cooking liquor,

wherein the cooking liquor has a lower concentration of the Group 2 metal ions than the strengthening solution.

A coated food product obtainable by the method of the present invention is also provided.

The use of a lower concentration of Group 2 metal ions in a cooking liquor than in a strengthening solution during processing of a coated food product is also provided, as is the use of a lower concentration of Group 2 metal ions in a cooking liquor than in a

strengthening solution during processing of a coated food product for improving the cooking properties of a coated food product, and for reducing the perception of the coating material during eating of a coated food product.

In a further aspect, the present invention provides an apparatus for processing a coated food product of the present invention, said apparatus comprising:

a tank comprising a strengthening solution which comprises Group 2 metal ions, and means for contacting the coated food product with the strengthening solution;

a tank comprising a cooking liquor, the cooking liquor having a lower concentration of Group 2 metal ions than the strengthening solution; and

means for transferring the coated food product from the strengthening solution to the cooking liquor.

The present invention is based on the discovery that many of the problems previously encountered during cooking of a coated food product having a filling with a high moisture content may be overcome by processing the coated food product using a method in which the coated food product is contacted with a strengthening solution which comprises Group 2 metal ions, and subsequently cooked in a cooking liquor having a lower concentration of the Group 2 metal ions than is present in the strengthening solution.

Group 2 metal ions are used in the strengthening solution because these are believed to act as cross-linkers between the chains in a coating material. For instance, where the coating material comprises an anionic polysaccharide, the group 2 metal ions may act as ionic cross-linkers between the anionic polysaccharide chains. Group 2 metal ions are particularly effective at strengthening forms of alginate which comprises homopolymeric blocks of guluronic acid monomers.

The Group 2 metal ions may be calcium ions, barium ions or magnesium ions. Calcium ions are generally preferred due their common use in food products. Calcium ions may be introduced into the strengthening solution in many forms, though preferably the calcium ions are used in the form of calcium chloride.

The Group 2 metal ions may be used in the strengthening solution in an amount of at least 0.05 % by weight, preferably at least 2.5 % by weight, and more preferably at least 4 % by weight of the strengthening solution. The Group 2 metal ions may be used in the strengthening solution in an amount of up to 45 % by weight, preferably up to 30 % by weight, and more preferably up 12 % by weight of the strengthening solution. Thus, the

strengthening solution may comprise the Group 2 metal ions in an amount of from 0.05 to 45 % by weight, preferably from 2.5 to 30 % by weight, and more preferably from 4 to 12 % by weight of the strengthening solution. In particularly preferred embodiments, the strengthening solution may comprise the Group 2 metal ions in an amount of from 4.25 to 5 % by weight of the strengthening solution.

The strengthening may be prepared by mixing water with the Group 2 metal ions, *e.g.* in the form of a Group 2 metal salt. However, it has been found that local water supplies can contain ions in a wide range of concentrations, and that these can have an adverse effect on the processing of the coated food product.

Thus, in some embodiments, the concentration of the Group 2 metal ions in the strengthening solution may be measured before it is contacted with the coated food product, compared to a target concentration (*e.g.* those concentrations described above), and if necessary, adjusted so that the target concentration is achieved.

In some embodiments, the concentration of Group 2 metal ions that is present in the water used to prepare the strengthening solution may be measured, and an amount of the Group 2 metal ions is added to the water selected so as to achieve a target concentration (*e.g.* those concentrations described above) in the strengthening solution.

The concentration of the Group 2 metal ions in the strengthening solution may be measured using a refractometer, *e.g.* the Atago™ digital hand-held “Pocket” refractometer (PAL)..

The coated food product may be contacted with the strengthening solution in many different ways. For instance, the coated food product may be sprayed or painted with the strengthening solution, or a layer of strengthening solution may be co-extruded onto the coated food product during its preparation. However, it is generally preferred for the coated food product to be immersed in the strengthening solution, *e.g.* in a water bath.

The strengthening solution may be used a temperature of at least 5 °C, preferably at least 10 °C, and more preferably at least 15 °C. The strengthening solution may be used at a temperature of up to 40 °C, preferably up to 25 °C, and more preferably up to 30 °C. Thus, the strengthening solution may be used at a temperature of from 5 to 40 °C, preferably from 10 to 25 °C, and more preferably from 15 to 30 °C.

The coated food product may be contacted with the strengthening solution for a period of at least 1 minute, preferably at least 2 minutes, and more preferably at least 3 minutes. The coated food product may be contacted with the strengthening solution for a period of up to 60 minutes, preferably up to 30 minutes, and more preferably up to 20 minutes. Thus, the coated food product may be contacted with the strengthening solution for a period of from 1 to 60 minutes, preferably from 2 to 30 minutes, and more preferably from 3 to 20 minutes.

Once the casing material of the coated food product has been strengthened by the strengthening solution, the coated food product may be transferred to, and preferably immersed in a cooking liquor.

The cooking liquor has a lower concentration of the Group 2 metal ions than is present in the strengthening solution. For instance, the cooking liquor may comprise the Group 2 metal ions in a concentration of less than 0.1 % by weight, preferably less than 0.05 % by weight, and more preferably less than 0.01 % by weight of the cooking liquor. Most preferably, the cooking liquor is free of the Group 2 metal ions.

The coated food product may be partially or fully cooked in the cooking liquor. The food product may be cooked to an internal core temperature of at least 60 °C, preferably at least 65 °C, and more preferably at least 70 °C.

The cooking liquor may be used at a temperature of at least 65 °C, preferably at least 70 °C, and more preferably at least 75 °C. The cooking liquor may be used at a temperature of up to 110 °C, preferably up to 100 °C, and more preferably up to 95 °C. Thus, the cooking liquor may be used at a temperature of from 65 to 110 °C, preferably from 70 to 100 °C, and more preferably from 75 to 95 °C.

The coated food product may be contacted with the cooking liquor for a a period of at least 1 minute, preferably at least 2 minutes, and more preferably at least 3 minutes. The coated food product may be contacted with the cooking liquor for a period of up to 60 minutes, preferably up to 30 minutes, and more preferably up to 20 minutes. Thus, the coated food product may be contacted with the cooking liquor for a period of from 1 to 60 minutes, preferably from 2 to 30 minutes, and more preferably from 3 to 20 minutes.

The cooking liquor is preferably an aqueous cooking liquor.

The cooking liquor may comprise an acid, preferably an organic acid such as a food grade acid. The acid is believed to increase casing adhesion to the filling, for instance in the case of anionic polysaccharides by protonating the polysaccharide chains. Suitable acids include citric acid, lactic acid, acetic acid, ascorbic acid and glucono-δ-lactone, and in particular acetic acid.

The acid may be used in the cooking liquor in an amount of at least 0.005 % by weight, preferably at least 0.01 % by weight, and more preferably at least 0.05 % by weight of the cooking liquor. The acid may be used in a total amount of up to 1 % by weight, preferably up to 0.5 % by weight, and more preferably up to 0.2 % by weight of the cooking liquor. Thus, the acid may be used in the cooking liquor in a total amount of from 0.005 to 1 % by weight, preferably from 0.01 to 0.5 % by weight, and more preferably from 0.05 to 0.2 % by weight of the cooking liquor.

Once the coated food product has been cooked, it may be dried. Thus, the method of the present invention may comprise drying the coated food product.

The coated food product may be dried at a temperature of greater than 60 °C, preferably greater than 70 °C, and more preferably greater than 80 °C. The coated food product may be dried at a temperature of up to 130 °C, preferably up to 120 °C, and more preferably up to 110 °C. Thus, the coated food product may be dried at a temperature of from 60 to 130 °C, preferably from 70 to 120 °C, and more preferably from 80 to 110 °C.

The coated food product may be dried in an atmosphere of at least 20 % relative humidity, preferably at least 25 % relative humidity, and more preferably at least 30 % relative humidity. The coated food product may be dried in an atmosphere of up to 50 % relative humidity, preferably up to 45 % relative humidity, and more preferably up to 40 % relative humidity. Thus, the coated food product may be dried in an atmosphere of from 20 to 50 % relative humidity, preferably from 25 to 45 % relative humidity, and more preferably from 30 to 40 % relative humidity.

The coated food product may be dried for a time period of at least 1 minute, preferably at least 2 minutes, and more preferably at least 3 minutes. The coated food product may be dried for a period of up to 60 minutes, preferably up to 30 minutes, and more preferably up to 20 minutes. Thus, the coated food product may be dried for a time period of from 1 to 60 minutes, preferably from 2 to 30 minutes, and more preferably from 3 to 20 minutes.

Once the coated food product has been dried, it may be further processed by at least one of chilling (*e.g.* at a temperature of between 1 and 10 °C) and freezing (*e.g.* at a temperature of less than -5 °C).

The food product may be packaged. In some embodiments, the coated food product will be packaged as a single article. Generally, however, at least two, preferably at least four, and more preferably at least six coated food products will be included in a package.

The coated food product used in the method of the present invention is preferably a coated moulded food product, in which the ingredients have been processed (*e.g.* by chopping, shredding or grinding the ingredients). Coated moulded food products include burgers, kebabs and sausages. In preferred embodiments, the coated food product is a sausage, such as a meat sausage. Skinless meat sausages are particularly preferred. Skinless meat sausages are intended to mimic the sensory attributes of traditionally prepared hotdog sausages.

The method of the present invention may further comprise preparing the coated food product by applying the coating material, preferably in the form of an aqueous composition, to the filling composition. Once the coating material has been applied to the coated food product, it may then be contacted with the strengthening solution.

The coating material may be applied to the filling composition using methods that are known to the skilled person. In preferred embodiments, the coating material is extruded and applied to the filling composition.

The filling composition is preferably co-extruded with the coating material, though it will be appreciated that the coating material may be first extruded and subsequently applied to a filling composition. In some embodiments, the coating material may be extruded through a circular die which encircles the co-extruded filling composition. This is particularly preferred when the food product is a sausage, since the coating material may be extruded on to the outside surface of the sausage filling.

The coating material may be extruded (*e.g.* through a die) at a thickness of at least 50 μm, preferably at least 100 μm, and more preferably at least 150 μm. The coating material may be extruded at a thickness of up to 300 μm, preferably up to 250 μm, and more preferably up to 200 μm. Thus, the coating material may be extruded at a thickness of from 50 to 300 μm, preferably from 100 to 250 μm, and more preferably from 150 to 200 μm.

Extrusion may take place at a linear speed of at least 0.05 m/s, preferably at least 0.1 m/s, and more preferably at least 0.5 m/s. Extrusion may take place at a linear speed of up to 5 m/s, preferably up to 4.5 m/s, and more preferably up to 3.8 m/s. This, extrusion may take place at a linear speed of from 0.05 to 5 m/s, preferably from 0.1 to 4.5 m/s, and more preferably from 0.5 to 3.6 m/s. An advantage of the present invention is that the coating material may be extruded at relatively high speeds without compromising the integrity of the coating. Thus, in some embodiments, the coating material is extruded at a linear speed of greater than 1 m/s.

The coating material may be applied to the filling composition in an amount of at least 0.5 % by weight, preferably at least 1 % by weight, and more preferably at least 2.5 % by weight of the filling composition. The coating material may be applied to the filling composition in an amount of up to 20 % by weight, preferably up to 10 % by weight, and more preferably up to 5 % by weight of the filling composition. Thus, the coating material may be applied to the filling composition in an amount of from 0.5 to 20 % by weight, preferably from 1 to 10 % by weight, and more preferably from 2.5 to 5 % by weight of the filling composition.

The coating material may cover at least 50 %, preferably at least 70 %, and more preferably at least 90 % of the surface area of the coated food product. Most preferably, all of the surface area of the coated food product is covered with the coating material.

The coating material may have a tensile strength such that the load required to rupture an extruded coating of 100 µm thickness is at least 100 g, preferably at least 150 g, and more preferably at least 200 g. The extruded coating may have a tensile strength such that the load required to rupture an extruded coating of 100 µm thickness is up to 400 g, preferably up to 350 g, and more preferably up to 300 g. Thus, the extruded coating may have a tensile strength such that the load required to rupture an extruded coating of 100 µm thickness is from 100 to 400 g, preferably from 150 to 350 g, and more preferably from 200 to 300 g.

Tensile strength is measured using a Brookfield CT3 texture analyser which is operated with a TA18 sphere (12.7 mm in diameter) and a fixture TA-RT-KIT. The system settings are: test type set as rupture, a test target correction of 50 g, a trigger load of 5 g and a test speed of 1 mm/s.

The coating material preferably comprises a polysaccharide. The polysaccharide may be a neutral polysaccharide, such as cellulose, or an anionic polysaccharide. Anionic polysaccharides are particularly preferred for use in the coating material.

Anionic polysaccharides are understood to contain functional groups which exist in an anionic form at a pH of 7. In preferred embodiments, the anionic polysaccharide used in the aqueous coating material comprises uronic acid monomers. Preferably, the anionic polysaccharide comprises uronic acid monomers selected from guluronic acid and mannuronic acid. More preferably, the anionic polysaccharide is alginate, *i.e.* a polymer comprising guluronic acid and mannuronic acid monomers.

The alginate is preferably a high-guluronic acid alginate. For instance, the ratio of guluronic acid monomers to mannuronic acid monomers in the alginate may be greater than 1:1, preferably greater than 1.5:1, and more preferably greater than 2:1. The alginate preferably comprises homopolymeric blocks of guluronic acid monomers.

The anionic polysaccharide may also be a pectin (*e.g.* a low methoxyl pectin) or, more preferably, a combination of an alginate and a pectin.

Anionic polysaccharides may be included in the aqueous coating material in an amount of at least 2 %, preferably at least 2.5 %, and more preferably at least 2.8 % by weight of the coating material. Anionic polysaccharides may be included in a total amount of up to 8 %, preferably up to 6 %, and more preferably up to 4.5 % by weight of the coating material. Thus, the coating material may comprise anionic polysaccharides in a total amount of from 2 to 8 %, preferably from 2.5 to 6 %, and more preferably from 2.8 to 4.5 % by weight of the coating material. These levels of anionic polysaccharide are believed to provide a food product coating that is not overly discernible to the consumer. Where a food product is desired with a 'skinless' feel, *e.g.* a skinless sausage, then anionic polysaccharides are preferably used in a total amount of less than 3.5 % by weight of the coating material.

Preferred coating materials for use with the filling composition of the present invention may also comprise a plasticiser or an interrupting agent, and preferably both.

Plasticisers are components which soften a coating material. The plasticiser used in the aqueous coating material of the present invention is preferably a polyol, such as a C_{1-10} polyol, preferably a C_{2-8} polyol, and more preferably a C_{3-6} polyol. Suitable polyols include glycerol (propane-1,2,3-triol), propylene glycol (also known as propane-1,2-diol) or sorbitol

((2*S*,3*R*,4*R*,5*R*)-hexane-1,2,3,4,5,6-hexol). Glycerol is particularly suitable for use in the casing materials of the present invention.

Plasticisers may be included in the aqueous coating material in an amount of at least 8 % by weight, preferably at least 12 % by weight, and more preferably at least 18 % by weight of the coating material. Plasticisers may be included in a total amount of up to 42 %, preferably up to 38 %, and more preferably up to 32 % by weight of the coating material. Thus, the coating material may comprise plasticisers in a total amount of from 8 to 42 %, preferably from 12 to 38 %, and more preferably from 18 to 32 % by weight of the coating material.

Interrupting agents disrupt the spatial orientation of the anionic polysaccharide chains in the coating material. Suitable interrupting agents for use in the coating materials include microcrystalline polysaccharides, such as microcrystalline cellulose, and starches, such as tapioca starch, potato-derived starches and corn starch. Microcrystalline cellulose and tapioca starch are preferably used, with microcrystalline cellulose particularly effective.

Interrupting agents may be included in the aqueous coating material in an amount of at least 0.5 %, preferably at least 1 %, and more preferably at least 1.5 % by weight of the coating material. Interrupting agents may be included in a total amount of up to 8 % by weight, preferably up to 7 % by weight, and more preferably up to 6 % by weight of the coating material. Thus, the coating material may comprise interrupting agent in a total amount of from 0.5 to 8 %, preferably from 1 to 7 %, and more preferably from 1.5 to 6 % by weight of the coating material. Microcrystalline polysaccharides will preferably be used at a lower level than starches, *e.g.* in a totally amount of up to 2.5 % by weight, with starches preferably used in an amount of at least 4 % by weight of the coating material.

The pH of the aqueous coating material used in the present invention is in the range of from 3.4 to 4.0. For instance, the pH may be in the range of from 3.5 to 3.9, and preferably in the range of from 3.6 to 3.8. In these pH ranges, the anionic polysaccharides exist in the coating material in a partially precipitated state, thereby providing desirable levels of viscosity for extrusion of the coating compositions.

The pH level may be measured using standard methods, for instance by introducing a pH probe which is attached to a pH meter into the aqueous coating material. As is conventional in the art, pH measurements will be taken at 25 °C.

The target pH level may be achieved by using an acid to lower the pH. Suitable acids include organic acids, in particular food grade acids such as citric acid, lactic acid, acetic acid, ascorbic acid and glucono-δ-lactone. Citric acid is particularly suitable for controlling the pH level of the aqueous coating material. The acid will be used in an amount suitable to achieve the target pH level.

In order to assist with maintenance of the desired pH level, the coating material may comprise an acidic buffer. The acidic buffer will generally consist of an acid and a metal salt of the same acid, such as a group 1 or group 2 metal salt. Preferably, the buffer is selected from citric acid and sodium citrate; lactic acid and sodium lactate; acetic acid and sodium acetate; and ascorbic acid and sodium ascorbate.

The acidic buffer may be used in the aqueous coating material an amount of at least 0.1 % by weight, preferably at least 0.5 % by weight, and more preferably at least 1 % by weight of the coating material. The acidic buffer may be used in a total amount of up to 10 % by weight, preferably up to 5 % by weight, and more preferably up to 3 % by weight of the coating material. Thus, the acidic buffer may be used in a total amount of 0.1 to 10 % by weight, preferably from 0.5 to 5 % by weight, and more preferably from 1 to 3 % by weight of the coating material.

Since a range of different properties are desirable in a coated food product, then one or more further ingredients may be included in the coating material to help achieve these properties. Examples of one or more further ingredients include smoke derivatives, hydrocolloids and insoluble fibres. Hydrocolloids are particularly suitable for use in the casing compositions of the present invention.

Suitable smoke derivatives include liquid smoke. The use of smoke derivatives in the coating material is desirable because of the flavour that they impart on to the coating. Smoke derivatives may also catalyse hydrolysis of the alginate chains so that texture of the casing is shortened. Smoke derivatives may also be used to increase the viscosity of the coating material.

Smoke derivatives may be included in the aqueous coating material in an amount of at least 1 % by weight, preferably at least 2 % by weight, and more preferably at least 3 % by weight of the coating material. Smoke derivatives may be included in an amount of up to 10 % by weight, preferably up to 8 % by weight, and more preferably up to 5 % by weight of the coating material. Thus, the coating material may comprise smoke derivatives in an amount

of from 1 to 10 % by weight, preferably from 2 to 8 % by weight, and more preferably from 3 to 5 % by weight of the coating material.

However, in many embodiments, the level of smoke derivatives is preferably limited since they may lead to an undesirable increase in viscosity in the coating material. Thus, the amount of smoke derivatives included in the aqueous coating material may be limited to less than 3.5 % by weight, preferably less than 1 % by weight, and more preferably less than 0.5 % by weight. In some embodiments, smoke derivatives may even be absent from the coating material.

Suitable hydrocolloids include hydrocolloidal vegetable gums, and preferably guar gum. Other suitable hydrocolloidal vegetable gums include tara gum and locust bean gum. Hydrocolloids may be useful for increasing the viscosity of the coating material.

Hydrocolloids may be included in the aqueous coating material in an amount of at least 0.1 % by weight, preferably at least 0.25 % by weight, and more preferably at least 0.4 % by weight of the coating material. Hydrocolloids may be included in an amount of up to 1 % by weight, preferably up to 0.75 % by weight, and more preferably up to 0.6 % by weight of the coating material. Thus, the coating material may comprise hydrocolloids in an amount of from 0.1 to 1 % by weight, preferably from 0.25 to 0.75 % by weight, and more preferably from 0.4 to 0.6 % by weight of the coating material.

Suitable insoluble fibres include cellulose fibres other than microcrystalline cellulose, citrus fibres and collagen. Insoluble fibres in the coating material may be useful for increasing the viscosity of the coating material.

Insoluble fibres may be included in the aqueous coating material in an amount of at least 0.5 % by weight, and preferably at least 1 % by weight of the coating material though, in preferred embodiments, insoluble fibres will not be used as preferred viscosity levels are already achieved in the coating material. Insoluble fibres may be included in an amount of up to 10 % by weight, preferably up to 5 % by weight, and more preferably up to 3 % by weight of the coating material. Thus, the coating material may comprise insoluble fibres in an amount of from 0 to 10 % by weight, preferably from 0.5 to 5 % by weight, and more preferably from 1 to 3 % by weight of the coating material.

Other ingredients that may be present in the coating material include chelating agents. Suitable chelating agents include phosphates such as sodium hexametaphosphate. Colourings and flavourings, *e.g.* spices, may also be included in the coating material.

The coating material is preferably applied to the filling composition in the form of an aqueous composition. Water may be used in the aqueous coating material in an amount of at least 50 %, preferably at least 60 %, and more preferably at least 70 % by weight of the coating material.

The aqueous coating material may have a viscosity of at least 20 Pa·s, preferably at least 25 Pa·s, and more preferably at least 30 Pa·s at 5 °C. The coating material may have a viscosity of up to 80 Pa·s, such as up to 70 Pa·s and preferably up to 60 Pa·s at 5 °C. Thus, the aqueous coating material may have a viscosity of from 20 to 80 Pa·s, such as 25 to 70 Pa·s, preferably from 30 to 60 Pa·s at 5 °C. These viscosities are preferred for extrusion of the coating material.

Viscosity is measured in Pa·s using a Brookfield R/S-CPS+ Rheometer (cone and plate) which is operated with an external temperature control system at 5 °C, with a C25-1 spindle utilizing a sample volume of 0.08 ml. The system settings are: CSR setting, with a shear time of 120 s but a measuring point at 60 s under linear point distribution with the shear rate parameter selected, with a start and end value set at 20 s^{-1}, and a distribution measuring points number of 60. The measuring temperature is set to 4 °C.

The aqueous coating material used in the present invention may be prepared by a method in which the anionic polysaccharide (preferably in an anhydrous form), plasticiser and interrupting agent are combined in the presence of water, and the pH of the coating material is adjusted so that it is in the range of from 3.4 to 4.0.

In some embodiments, the water is combined with components of the composition that are in liquid form (*e.g.* plasticisers) and subsequently combined with the dry components of the composition (*e.g.* powdered anionic polysaccharide and interrupting agent). Preferably, the method for preparing the coating material comprises the step of pre-mixing the dry components (*e.g.* anionic polysaccharide and interrupting agent) and pre-mixing the liquid components (*e.g.* water and plasticiser), and subsequently combining the dry and liquid components.

The step of forming the coating material may comprise the step of mixing the water, anionic surfactant, plasticiser, interrupting agent and any additional ingredients. Methods of mixing are known in the art. High shear mixing is preferably used. Suitable devices for carrying out high shear mixing are readily available.

Once the components of the coating material have been mixed, the viscosity of the coating material may increase over time. Thus, the coating material may be prepared over a period of greater than 10 minutes, preferably greater than 30 minutes, and more preferably greater than 1 hour. Whilst an increase in viscosity may be observed in these periods, it is generally preferable for the viscosity of the coating material to reach a steady state. Thus, in preferred embodiments, the coating material may be prepared over a period of greater than 3 hours, and preferably greater than 6 hours, such as 8 or 10 hours, and such as for a period of greater than 12 hours.

The coating material will generally be prepared at a temperature of from 10 to 40 °C, preferably from 15 to 30 °C, and more preferably from 20 to 25 °C.

The coating material is preferably prepared in batches.

Once the coating material has been prepared, it is preferably homogenised before it is used *e.g.* in an extrusion process. This is because, during the preparation of the coating material, pockets of insoluble anionic polysaccharide (in which many of the anionic moieties on the polysaccharide chain have been protonated) and soluble anionic polysaccharide (in which few of the anionic moieties on the polysaccharide chains have been protonated) may form. Homogenisation distributes protonated anionic polysaccharide in the form of insoluble particles throughout the gel. The viscosity of the coating material may reduce as a result of homogenisation.

Homogenisation may be carried out by mixing the coating material, *e.g.* using a mechanical mixer, a bowl cutter, vacuum blending, or ultrasonification. Slow blending, *e.g.* for a period of at least 8 hours, may also be used. Other mixing methods will be known to the person of skill in the art and may also be used. Where vacuum blending it used, the homogenisation process may be carried out for a period of at least 10 minutes, preferably at least 20 minutes, and more preferably at least 30 minutes. Vacuum blending may be carried out at a temperature of from 1 to 8 °C, preferably from 2 to 6 °C, for instance at about 4 °C. In order to remove air, the vacuum setting is preferably set high, *e.g.* at its maximum.

The filling composition of the coated food product preferably comprises animal matter. For instance, the animal matter may comprise red meat (*e.g.* beef, lamb, goat or bison), pork, poultry (*e.g.* chicken or turkey), fish or combinations thereof. In preferred embodiments, the animal matter is shredded, minced, pureed or in the form of a paste in the filling composition.

Animal matter may be used in the filling composition in an amount of at least 20 % by weight, preferably at least 25 % by weight, and more preferably at least 30 % by weight of the filling composition. Animal matter may be used in a total amount of up to 60 % by weight, preferably up to 50 % by weight, and more preferably up to 45 % by weight of the filling composition. Thus, the filling composition may comprise animal matter in a total amount of from 20 to 60 % by weight, preferably from 25 to 50 % by weight, and more preferably from 30 to 45 % by weight of the filling composition.

The coating compositions of the present invention are particularly suited to filling compositions which have a relatively high moisture content. Water may be used in filling composition in an amount of at least 30 % by weight, preferably at least 35 % by weight, and more preferably at least 40 % by weight, by weight of the filling composition. Water may be used in an amount of up to 60 % by weight, preferably up to 55 % by weight, and more preferably up to 50 % by weight of the filling composition. Thus, the filling composition may comprise water in an amount of from 30 to 60 % by weight, preferably from 35 to 55 % by weight, and more preferably from 40 to 50 % by weight of the filling composition. It will be appreciated that these amounts relate to the water that is added to the filling composition during its preparation, and do not include water that has been added to the filling composition as part of the animal matter.

Preferred filling compositions comprise modified starch. The modified starch is preferably a heat-sensitive modified starch. Heat-sensitive modified starches are starches in which particular properties are activated at a high temperature. In the present case, the heat-sensitive starches are preferably activated to become firmer at certain temperatures. This has the advantage that the filling composition remains soft during extrusion, but firms up on cooking. Preferably, the heat-sensitive modified starches that are used in the present invention are activated at a temperature of greater than 50 °C, preferably greater than 60 °C, and more preferably greater than 70 °C. The heat-sensitive modified starches may be activated at a temperature of lower than 120 °C, preferably lower than 110 °C, and more preferably lower than 100 °C. Thus, the heat-sensitive modified starches may be activated at a temperature in the range of from 50 to 120 °C, preferably from 60 to 110 °C, and more preferably from 70 to 100 °C.

The modified starch may be derived from potato, maize, tapioca or wheat. Modified starches derived from potato, maize (*e.g.* waxy maize) or tapioca are particularly suitable for use in the filling compositions of the present invention.

The modified starch may be starch in which -OH groups have been modified, *e.g.* esterified or etherified. It will be appreciated that modified starches typically have some, and not all, of the -OH groups modified.

-OH groups in the starch may have be esterified to give a group having the formula: $-OC(O)R_1$, where R_1 is selected from C_{1-6} alkyl groups. Preferably, R_1 is a methyl group. Esterification may be carried out using acetic anhydride or vinyl acetate.

-OH groups in the starch may have been etherified to give a group having the formula: $-OR_2$, where R_2 is a C_{1-6} alkyl group or a C_{1-6} hydroxyalkyl group. Preferably, R_2 is a hydroxy propyl group. Etherification may be carried out using propylene oxide.

Preferably, the modified starch is starch which has been cross-linked, *e.g.* using a phosphate compound (e.g. sodium trimetaphosphate or phosphorus oxychloride) or an anhydride (e.g. adipic anhydride).

It will be appreciated that the modified starches used in the filling compositions may be modified at their -OH groups and cross-linked.

Preferred modified food starches for use in the filling composition include:

- acetylated distarch adipate (EU food additive E1422, a cross-linked starch having esterified -OH groups; *e.g.* derived from waxy maize such as that sold under the tradename Purity™ HPC);
- acetylated starch (EU food additive E1420, a starch having esterified -OH groups; *e.g.* derived from tapioca starch such as that sold under the tradename Elastitex™)
- hydroxypropyl distarch phosphate (EU food additive E1442, a cross-linked starch having etherified-OH groups; *e.g.* derived from waxy maize such as that sold under the tradename Firm-tex™); and
- Almidón National™ 1317, a cross-linked starch.

Modified starches may be used in the filling composition in an amount of at least 3.5 % by weight, preferably at least 4 % by weight, and more preferably at least 4.5 % by weight of the filling composition. Modified starches may be used in a total amount of up to 9.5 % by weight, preferably up to 8.5 % by weight, and more preferably up to 7.5 % by weight of the filling composition. Thus, the filling composition may comprise modified starches in a total amount of from 3.5 to 9.5 % by weight, preferably from 4 to 8.5 % by weight, and more preferably from 4.5 to 7.5 % by weight of the filling composition.

The filling composition may optionally comprise unmodified starch. The unmodified starch may be derived from potato, maize, tapioca or wheat. Preferably, the unmodified starch is derived from potato. An example of a preferred unmodified starch for use in the filling composition of the present invention is a potato-derived starch sold under the tradename N-Hance®.

Unmodified starches may be used in the filling composition in an amount of at least 0.75 % by weight, and preferably at least 1.25 % by weight of the filling composition. Unmodified starches may be used in a total amount of up to 4 % by weight, preferably up to 3.5 % by weight, and more preferably up to 3 % by weight of the filling composition. Thus, the filling composition may comprise unmodified starches in a total amount of from 0 to 4 % by weight, preferably from 0.75 to 3.5 % by weight, and more preferably from 1.25 to 3 % by weight of the filling composition.

The ratio of modified starch to unmodified starch in the filling composition may be greater than 1 : 1, preferably greater than 1.25 : 1, and more preferably greater than 1.5 : 1. The ratio of modified starch to unmodified starch in the filling composition may be up to 10 : 1, preferably up to 8 : 1, and more preferably up to 5 : 1. Thus, the ratio of modified starch to unmodified starch in the filling composition may be from 1 : 1 to 10 : 1, preferably from 1.25 : 1 to 8 : 1, and more preferably from 1.5 : 1 to 5 : 1.

Protein extenders are also preferably used in the filling composition. Protein extenders enhance the protein content of the filling composition.

The protein extender used in the filling composition may be derived from soya beans. For instance, the protein extended may be a soya isolate or a soya concentrate. As is known in the art, soya concentrate is prepared by removing the fat and water-soluble non-protein components from soya beans. Thus, soya concentrate may contain some carbohydrates

and fibre. Soya isolates are prepared by removing all non-protein components from soya beans, and these are substantially carbohydrate and fibre free.

Protein extenders may be used in the filling composition an amount of at least 2 % by weight, preferably at least 2.5 % by weight, and more preferably at least 3 % by weight of the filling composition. Protein extenders may be used in the filling composition in a total amount of up to 7 % by weight, preferably up to 6 % by weight, and more preferably up to 5 % by weight of the filling composition. Thus, the filling composition may comprise protein extenders in a total amount of from 2 to 7 % by weight, preferably from 2.5 to 6 % by weight, and more preferably from 3 to 5 % by weight of the filling composition. .

Fibre is also preferably used in the filling composition of the present invention. The fibre may be derived from wheat or soya beans. Particularly preferred is fibre derived from soya beans.

Fibre may be used in the filling composition in an amount of at least 1 % by weight, preferably at least 1.5 % by weight, and more preferably at least than 2 % by weight of the filling composition. Fibre may be used in the filling composition in a total amount of up to 4.5 % by weight, preferably up to 4 % by weight, and more preferably up to 3.5 % by weight of the filling composition. Thus, the filling composition may comprise fibre in a total amount of from 1 to 4.5 % by weight, preferably from 1.5 to 4 % by weight, and more preferably from 2 to 3.5 % by weight of the filling composition.

The ratio, by weight, of protein extender to fibre may be greater than 0.8 : 1, preferably greater than 1 : 1, and more preferably greater than 1.2 : 1.

Without wishing to be bound by theory, it is believed that by adding modified starch to a filling composition having a high moisture content, in combination with a protein extender and fibre, a filling composition may be prepared which is readily extrudable with a synthetic casing material and which also exhibits desirable properties on eating.

Particularly preferred filling compositions comprise animal matter, water, protein extender, starch (modified and, if used, unmodified) and fibre in a combined total amount of at least 80 % by weight, preferably at least 90 % by weight, and more preferably at least 95 % by weight of the filling composition.

The filling composition will generally comprise further ingredients, such as flavourings (synthetic or natural, *e.g.* herbs), seasonings, breadcrumbs, oats, vegetable matter, additives *etc.*

In some embodiments, the filling composition may comprise a calcium compound or a phosphate compound, and preferably both. The use of these components is believed to improve binding of the coating material to the filling composition.

Suitable calcium compounds include $CaCl_2$, calcium lactate or calcium acetate, with calcium lactate particularly preferred. Calcium compounds may be used in the filling composition in an amount of at least 0.1 % by weight, preferably at least 0.15 % by weight, and more preferably at least 0.2 % by weight of the filling composition. Calcium compounds may be used in a total amount of up to 0.5 % by weight, preferably up to 0.4 % by weight, and more preferably up to 0.3 % by weight of the filling composition. Thus, the filling composition may comprise calcium compounds in a total amount of from 0.1 to 0.5 % by weight, preferably from 0.15 to 0.4 % by weight, and more preferably from 0.2 to 0.3 % by weight of the filling composition.

Suitable phosphate compounds include sodium tripolyphosphate (STPP). Phosphate compounds may be used in the filling composition in an amount of at least 0.01 % by weight, preferably at least 0.05 % by weight, and more preferably at least 0.1 % by weight of the filling composition. Phosphate compounds may be used in a total amount of up to 0.35 % by weight, preferably up to 0.30 % by weight, and more preferably up to 0.25 % by weight of the filling composition. Thus, the filling composition may comprise phosphate compounds in a total amount of from 0.01 to 0.35 % by weight, preferably from 0.05 to 0.30 % by weight, and more preferably from 0.1 to 0.25 % by weight of the filling composition.

The ratio of calcium compounds to phosphate compounds in the filling composition is preferably greater than 1 : 1, and more preferably greater than 1.5 : 1 by weight.

The filling composition of the present invention may be prepared by a method in which the the components of the filling composition (*e.g.* animal matter, water, protein extender, starch and fibre) are combined.

In some embodiments, the method for preparing the filling composition comprises the step of combining the dry components (*e.g.* protein extender, starch and fibre), and combining the liquid components (*e.g.* animal matter and water), and subsequently combining the dry

components with the liquid components. The dry components may be premixed before they are combined with the liquid components and/or the liquid components may be premixed before they are combined with the dry components.

The method of preparing the filling composition may comprise the step of mixing the components of the filling composition. Methods of mixing are known in the art. Mechanical mixing methods are preferably used. Suitable devices for carrying out mechanical mixing are readily available.

The filling composition will generally be prepared at a temperature of from 0 to 30 °C, preferably from 2 to 20 °C, and more preferably from 4 to 15 °C.

The filling composition is preferably prepared in batches.

The present invention provides a food product which is obtainable by a method of the present invention. Thus, in some instances, the food product may be in a dried, chilled, frozen and/or packaged form.

The present invention also provides an apparatus for processing a coated food product according to the method of the present invention. The apparatus comprises:

a tank comprising a strengthening solution which comprises Group 2 metal ions, and means for contacting the coated food product with the strengthening solution;
a tank comprising a cooking liquor, the cooking liquor having a lower concentration of Group 2 metal ions than is present in the strengthening solution; and
means for transferring the coated food product from the strengthening solution to the cooking liquor.

The tanks may have a volume of greater than 1 L, preferably greater than 5 L, and more preferably greater than 10 L.

The apparatus preferably further comprises a coating device, *e.g.* extrusion device, for preparing the coated food product from a filling composition and a coating material.

The present invention will now be illustrated by way of the following examples.

Examples

Example 1: Optimising strengthening and cooking conditions

Sausages were prepared using a high-throughput extrusion process in which an alginate-based casing material was extruded at a thickness of 180 µm onto an animal-based filling material having a high moisture content. The extruded sausages were immersed in a strengthening solution, and then transferred to a cooking liquor. A range of strengthening solutions and cooking liquors were used, each having a different concentration of calcium chloride.

The sausages were then dried (90 °C, 6 minutes, 35 % relative humidity) and deep fried. The cooking properties of the coated sausages were assessed based on the degree of bubble formation under the coating.

A reduction in bubble formation was observed when the concentration of calcium ions in the cooking liquor was reduced to a level lower than that used in the strengthening solution. The best results were obtained where calcium chloride was used in the strengthening solution in an amount of 4.67 % by weight of the strengthening solution, and where the cooking liquor was free from calcium ions.

Claims

1. A method for processing a coated food product comprising a filling composition and a coating material, said method comprising:

contacting the coated food product with a strengthening solution which comprises Group 2 metal ions; and

transferring the coated food product to a cooking liquor,

wherein the cooking liquor has a lower concentration of the Group 2 metal ions than the strengthening solution.

2. The method of Claim 1, wherein the strengthening solution comprises the Group 2 metal ions in an amount of from 0.05 to 45 % by weight, preferably from 2.5 to 30 % by weight, and more preferably from 4 to 12 % by weight of the strengthening solution.

3. The method of Claim 1 or Claim 2, wherein the coated food product is immersed in the strengthening solution.

4. The method of any of Claims 1 to 3, wherein the strengthening solution has a temperature of from 5 to 40 °C, preferably from 10 to 25 °C, more preferably from 15 to 30 °C.

5. The method of any of Claims 1 to 4, wherein the coated food product is contacted with the strengthening solution for a period of from 1 to 60 minutes, preferably from 2 to 30 minutes, and more preferably from 3 to 20 minutes.

6. The method of any of Claims 1 to 5, wherein the cooking liquor comprises the Group 2 metal ions in a concentration of less than 0.1 % by weight, preferably less than 0.05 % by weight, more preferably less than 0.01 % by weight of the cooking liquor, and most preferably is substantially free of the Group 2 metal ions.

7. The method of any of Claims 1 to 6, wherein the cooking liquor has a temperature of greater than 65 °C, preferably greater than 70 °C, and more preferably greater than 75 °C.

8. The method of any of Claims 1 to 7, wherein the coated food product is cooked for a period of from 1 to 60 minutes, preferably from 2 to 30 minutes, and more preferably from 3 to 20 minutes.

9. The method of any of Claims 1 to 8, wherein the cooking liquor is an aqueous cooking liquor.

10. The method of any of Claims 1 to 9, wherein the cooking liquor comprises an acid, preferably an organic acid such as a food grade acid, and more preferably acetic acid.

11. The method of Claim 10, wherein the acid is used in the cooking liquor in an amount of at least 0.005 % by weight, preferably at least 0.01 % by weight, and more preferably at least 0.05 % by weight of the cooking liquor.

12. The method of any of Claims 1 to 11, wherein the Group 2 metal ions are selected from calcium ions, barium ions and magnesium ions, and preferably are calcium ions.

13. The method of Claim 12, wherein the calcium ions are used in the form of calcium chloride.

14. The method of any of Claims 1 to 13, wherein the method further comprises:
preparing the coated food product by applying the coating material to the filling composition.

15. The method of Claim 14, wherein the coating material is applied to the filling composition in an amount of from 0.5 to 20 % by weight, preferably from 1 to 10 % by weight, and more preferably from 2.5 to 5 % by weight of the filling composition.

16. The method of Claim 14 or Claim 15, wherein the coating material is extruded on to the filling composition, and preferably the filling composition is co-extruded with the coating material.

17. The method of any of Claims 14 to 16, wherein the coating material is applied to the filling composition in the form of an aqueous coating material.

18. The method of Claim 17, wherein the aqueous coating material has a pH in the range of from 3.4 to 4.0, preferably in the range of from 3.5 to 3.9, and more preferably in the range of from 3.6 to 3.8.

19. The method of any of Claims 14 to 18, wherein the coating material has a viscosity of from 20 to 80 Pa·s, preferably from 25 to 70 Pa·s, and more preferably from 30 to 60 Pa·s at 5 °C.

20. The method of any of Claims 14 to 19, wherein the coating material is applied to the filling composition at a thickness of from 50 to 300 µm, preferably from 100 to 250 µm, and more preferably from 150 to 200 µm.

21. The method of any of Claims 1 to 20, wherein at least 50 %, preferably at least 70 %, more preferably at least 90 %, and most preferably all of the surface area of the coated food product is coated with the coating material.

22. The method of any of Claims 1 to 21, wherein the method further comprises:

drying the coated food product.

23. The method of Claim 22, wherein the coated food product is dried at a temperature of greater than 60 °C, preferably greater than 70 °C, and more preferably greater than 80 °C

24. The method of Claim 22 or Claim 23, wherein the coated food product is dried in an atmosphere of from 20 to 50 % relative humidity, preferably from 25 to 45 % relative humidity, and more preferably from 30 to 40 % relative humidity.

25. The method of any of Claims 22 to 24, wherein the coated food product is dried for a time period of from 1 to 60 minutes, preferably from 2 to 30 minutes, and more preferably from 3 to 20 minutes.

26. The method of any of Claims 1 to 25, wherein the coating material comprises a polysaccharide, and preferably an anionic polysaccharide.

27. The method of Claim 26, wherein the anionic polysaccharide is an alginate.

28. The method of Claim 26 or Claim 27, wherein the coating material further comprises a plasticiser.

29. The method of Claim 28, wherein the plasticiser is a polyol, preferably a C_{1-10} polyol, more preferably a C_{2-8} polyol, and still more preferably a C_{3-6} polyol.

30. The method of Claim 29, wherein the polyol is glycerol, propylene glycol or sorbitol, and preferably is glycerol.

31. The method of any of Claims 26 to 30, wherein the coating material further comprises an interrupting agent.

32. The method of Claim 31, wherein the interrupting agent is selected from tapioca starch and microcrystalline cellulose, and preferably is microcrystalline cellulose.

33. The method of any of Claims 26 to 32, wherein the coating material further comprises an acid, preferably an organic acid, and more preferably citric acid.

34. The method of any of Claims 26 to 33, wherein the coating material further comprises a hydrocolloid, and preferably guar gum.

35. The method of any of Claims 1 to 34, wherein the filling composition comprises animal matter.

36. The method of Claim 35, wherein the animal matter is used in the filling composition in an amount of from 20 to 60 % by weight, preferably from 25 to 50 % by weight, and more preferably from 30 to 45 % by weight of the filling composition.

37. The method of Claim 35 or Claim 36, wherein the animal matter comprises red meat, pork, poultry, fish or combinations thereof.

38. The method of any of Claims 35 to 37, wherein the filling composition further comprises modified starch.

39. The method of Claim 38, wherein the modified starch is a heat-sensitive modified starch, preferably derived from potato, maize, tapioca or wheat, and preferably from potato, maize or tapioca.

40. The method Claim 38 or Claim 39, wherein the modified starch is starch in which -OH groups have been modified, *e.g.* esterified or etherified, and/or is starch which

has been crosslinked, *e.g.* using a phosphate compound (*e.g.* sodium trimetaphosphate or phosphorus oxychloride) or an anhydride (*e.g.* adipic anhydride).

41. The method of any of Claims 35 to 40, wherein the filling composition further comprises a protein extender.

42. The method of Claim 41, wherein the protein extender is derived from soya beans, and preferably is a soya isolate or a soya concentrate.

43. The method of any of Claims 35 to 42, wherein the filling composition further comprises fibre.

44. The method of Claim 43, wherein the fibre is derived from wheat or soya beans, and preferably is derived from soya beans.

45. The method of any of Claims 35 to 44, wherein the filling composition further comprises a calcium compound and/or a phosphate compound.

46. The method of any of Claims 1 to 45, wherein the filling composition comprises water in an amount of from 30 to 60 % by weight, preferably at least 35 to 55 % by weight, and more preferably at least 40 to 50 % by weight of the filling composition.

47. The method of any of Claims 1 to 46, wherein the method comprises:
measuring the concentration of the Group 2 metal ions in the strengthening solution before it is contacted with the coated food product,
comparing the measured concentration to a target concentration, and
if necessary, adjusting the concentration of the strengthening solution so that the target concentration is achieved.

48. The method of any of Claims 1 to 47, wherein the method comprises:
preparing the strengthening solution by:
measuring the concentration of Group 2 metal ions that is present in water used to prepare the strengthening solution, and
selecting an amount of the Group 2 metal ions that is added to the water so as to achieve a target concentration in the strengthening solution.

49. A coated food product obtainable by a method according to any of Claims 1 to 48.

50. Use of a lower concentration of Group 2 metal ions in a cooking liquor than in a strengthening solution during processing of a coated food product.

51. Use of a lower concentration of Group 2 metal ions in a cooking liquor than in a strengthening solution during processing of a coated food product, for improving the cooking properties of the coated food product.

52. Use of a lower concentration of Group 2 metal ions in a cooking liquor than in a strengthening solution during processing of a coated food product, for reducing the perception of the coating material during eating of the coated food product.

53. An apparatus for processing a coated food product according to any of Claims 1 to 48, said apparatus comprising:

a tank comprising a strengthening solution which comprises Group 2 metal ions, and means for contacting the coated food product with the strengthening solution;

a tank comprising a cooking liquor, the cooking liquor having a lower concentration of the Group 2 metal ions than the strengthening solution; and means for transferring the coated food product from the strengthening solution to the cooking liquor.

54. The apparatus of Claim 53, wherein the apparatus further comprises:

a coating device for preparing the coated food product from a filling composition and a coating material.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/052931

A. CLASSIFICATION OF SUBJECT MATTER
INV. A22C13/00 A23P30/25 A23L13/00
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)
A22C 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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 2016/050963 A1 (DU PREEZ JOHANNES CHRISTIAAN [ZA] ET AL) 25 February 2016 (2016-02-25) paragraphs [0002] - [0132]	1-54
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A	WO 2010/113137 A1 (FREDDY HIRSCH GROUP PROPRIETAR [ZA]; LE ROUX ANTON SCHUTTE [ZA]; JOHNS) 7 October 2010 (2010-10-07) page 7, line 1 - page 13, paragraph 5; figures 1-9b	1-54

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

☒ See patent family annex.

* Special categories of cited documents :

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 March 2019	11/03/2019

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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