

MEAT ANALOGUE COMPOSITION

FIELD OF THE INVENTION

The invention relates to meat analogue compositions comprising a fat composition, non-animal protein, water and encapsulated acidic ingredients, and the use of said meat analogue compositions in food products. In particular, the invention relates to juicy meat analogue compositions having a desired mouthfeel when cooked.

BACKGROUND OF THE INVENTION

There is an increasing demand for plant-based foods due to consumers' increasing desire to eat healthy, sustainably sourced food products and to generally lower their meat intake. This has led to the development of meat analogues; meat-free, vegetarian or vegan food products which mimic certain qualities of meat or meat-based products, such as the texture, taste and/or appearance.

Many different types of meat analogues are available, such as those based on tofu, lentils and beans, some of which aim to mimic meat completely in terms of sizzling and browning during cooking, bleeding, colour, texture and taste. One example of such meat analogues is plant-based burgers. Products such as plant-based sausages, meat balls, meat loaf and nuggets are also known in the art.

The typical composition of known meat analogues is 50 to 70% water, 10 to 25% proteins (such as soy, pea, potato and wheat), 5 to 20% fat, 0 to 10% carbohydrates, as well as flavourings and colourings. Various fats have been proposed for use in meat analogue compositions. It is important that the fat is not an animal-derived fat such that the meat analogue composition is suitable for consumption by vegetarians and vegans. Accordingly, animal fats that are typically solid at room temperature are generally not used in meat analogue compositions. In order to produce a desirable meat analogue, it is important that the final products have an appealing taste, texture and mouthfeel, and have similar taste, texture and mouthfeel to meat. Such properties are generally affected by the nature of the fat included in the meat analogue composition. The nature of the fat in meat analogue compositions also typically has an effect upon juiciness of the compositions and upon flavour release as the fats often function as carriers for fat soluble flavours. The nature of the fat is also important for the processability of the meat analogue such as during moulding of a meat analogue composition into burger patties. The nature of the fat is also important for providing visual similarity to meat products.

It has been found by the inventors of the present invention that the use of certain fats, such

as sal butter, in meat analogue compositions instead of conventional fats such as coconut oil, or sunflower oil and other fats can address and/or alleviate many of the problems discussed above associated with the use of conventional fats in such compositions.

5 WO2021142157 discloses sal butter compositions to mimic solid animal fat or animal adipose tissue and meat-like food product comprising said sal butter and/or sal butter composition. The sal butter or sal butter compositions are used to increase meat-like juiciness and fatty mouthfeel.

10 There remains a need for providing a meat analogue composition that solves or alleviates many of the problems discussed above such as to mimic the meat fat present in meat products. Furthermore, it would be also convenient to provide a meat analogue composition which provides an improved mouthfeel and juiciness when compared to said conventional fats.

SUMMARY OF THE INVENTION

15 According to a first aspect of the invention, there is provided a meat analogue composition comprising from 2.0% to 40.0% by weight of a fat composition; from 5.0% to 35.0% by weight of a non-animal protein; from 20.0% to 75.0% by weight of water; and from 0.1% to 5% by weight of one or more acidic ingredients, wherein the acidic ingredients are encapsulated.

20 The present invention is based upon the surprising finding that the encapsulated acidic ingredients, when used in meat analogues compositions, solve or alleviate many of the problems discussed above associated with mimicking animal fat present in meat products. Surprisingly, the inclusion of these encapsulated acidic ingredients in meat analogue compositions has been found to improve various properties of meat analogue compositions, and products formed therefrom, including juiciness, tenderness and mouthfeel. It is believed that the encapsulated acidic ingredients have an enhanced thermal stability leading to stable
25 acidic ingredients. In particular, it has been found that the encapsulated acidic ingredients can act like a juiciness agent to provide a juicy effect upon cooking of the meat analogue composition similar to that observed in animal meat, whilst also effectively mimicking the texture of animal meat when compared to an analogous meat analogue composition comprising the same amount by weight of non-encapsulated acidic ingredients or not
30 comprising any acidic ingredients. Indeed, the inventors have surprisingly found that by encapsulating the acidic ingredients, the acidic ingredients are substantially prevented from being degraded until cooking of the product, and that the acidic ingredients can remain intact until the point of cooking at which point the encapsulated acidic ingredients are broken down to provide a meat analogue product that is juicy. It is believed that the encapsulated acidic

ingredients collaborate with other ingredients of the meat analogue composition so as to obtain a specific chemical reaction leading to an amount of juice being released, mainly fat and water, which mimics that released by real meat upon cooking. In particular, it is believed that the released acidic ingredients affect the protein by modifying its holding capacity regarding water and fat thus increasing the amount of juice. In addition, the sensation of having a greasy coating and moisture on the tongue and surfaces of the mouth, i.e. the mouthfeel, can be felt as well as an instant flavour and taste impression from the water phase and delayed release of flavours from the fat over a longer period of time.

The term “encapsulated acidic ingredients” as used herein is used to refer to the acidic ingredients being substantially prevented from interacting with other ingredients present in the meat analogue composition whilst the meat analogue composition is in an uncooked form. Upon cooking or partial cooking of the meat analogue composition, the one or more encapsulated acidic ingredients are released from their encapsulation within the meat analogue composition such that they are able to interact with the other ingredients present in the composition.

Acidic ingredients

Preferably, the meat analogue composition comprises from 0.1% to 4% by weight of the one or more acidic ingredients; preferably the meat analogue composition comprises from 0.1% to 2.5% by weight of the one or more acidic ingredients. More preferably, the meat analogue composition comprises from 0.1% to 1.0% by weight of the one or more acidic ingredients; preferably the meat analogue composition comprises from 0.30% to 0.80% by weight of the one or more acidic ingredients; more preferably the meat analogue composition comprises from 0.40% to 0.60% by weight of the one or more acidic ingredients. It will be appreciated that the amount of one or more acidic ingredients that is included in the meat analogue composition will also be dependent upon the strength of the one or more acidic ingredients. Typically, stronger acidic ingredients will be included in the meat analogue composition in a lower amount whereas weaker acidic ingredients will be included in the meat analogue composition in relatively higher amounts.

Preferably, the one or more acidic ingredients that can be included in the meat analogue compositions comprise an inorganic acid, an organic acid or a combination thereof.

The organic acid may be selected from citric acid, acetic acid, ascorbic acid, fumaric acid, succinic acid, lactic acid, malic acid, tartaric acid, or a combination thereof.

The inorganic acid may be selected from hydrochloric acid, phosphoric acid, sulphonic acid,

sulfuric acid, or a combination thereof.

By way of example, the one or more acidic ingredients may comprise citric acid; and the one or more acidic ingredients are present in the meat analogue composition in an amount of from 0.1% to 1% by weight, and more preferably from 0.3% to 0.8% by weight; more preferably the one or more acidic ingredients comprise citric acid; and the one or more acidic ingredients are present in the meat analogue composition in an amount of from 0.3% to 0.8% by weight, and more preferably from 0.40% to 0.60% by weight. In such an embodiment, it is believed that the juiciness and the mouthfeel are further improved.

Preferably, the one or more acidic ingredients are encapsulated within a fat matrix. In such an embodiment, the encapsulation is preferably performed in a solid or substantially solid fat matrix. Such compositions may be prepared by methods such as dispersing the one or more acidic ingredients in a molten or semi-molten fat composition. After dispersion of the one or more acidic ingredients in the molten or semi-molten fat composition, the dispersions may be further processed such as crystallized in a crystallization unit such as a margarine processing unit.

More preferably, the one or more acidic ingredients are encapsulated within a fat matrix of the fat composition. In such an embodiment, the fat matrix preferably has the same chemical composition as the fat composition.

By way of example, the acidic ingredients may be encapsulated within a bulk fat matrix. Typically, the fat matrix means a sole bulk having a large size, i.e. that the fat matrix is not divided into separate units (for example small particles).

Alternatively, or in addition, the one or more acidic ingredients may be encapsulated by a coating. Typically, the coated acidic ingredients refer to several small separate units or small individual entities (for example granules or particles). Preferably, the coated acidic ingredients are within the meat analogue composition in the form of particles, flakes and/or granulates. Typically, the coating comprises a water insoluble hydrophobic coating. It is preferable that the coating does not breakdown in the presence of water so that the acidic ingredients remain substantially encapsulated and are prevented from interacting with other ingredients present until cooking. Preferably, the coating is adapted to degrade at temperatures above 30°C, preferably 45°C, more preferably 60°C and most preferably 65°C. This is also preferable so that the coating does not break down until cooking. As the temperature of the meat analogue composition increases, such as during cooking, the coating will break down meaning that the acidic ingredients are then able to interact with other ingredients.

The coating may be any suitable coating but is typically a fat coating, a carbohydrate coating, a monoacylglyceride (MAG) coating, or a combination thereof. Preferably, the coating comprises a fat coating.

- 5 Preferably, the fat coating comprises a fat selected from palm oil, rapeseed oil, hydrogenated rapeseed oil, soybean oil, hydrogenated soybean oil, coconut oil, interesterified coconut oil, shea butter, an interesterified blend of shea butter and coconut oil, an interesterified blend of shea stearin and coconut oil, any fraction thereof and/or any combination thereof. More preferably, the fat coating comprises a fat with a melting point of from 40°C to 80°C. More
- 10 preferably, the fat is a non-animal derived fat. Any suitable fats known in the art that have the abovementioned properties may be used for the coating.

- The coated particles, coated flakes and/or coated granulates preferably have a particle size distribution of from 100µm to 3mm, preferably of from 200µm to 3mm, more preferably of from
- 15 400µm to 2mm, and advantageously of from 500µm to 1.3mm. The term particle size is used in reference to the size of a discrete particle comprising the acidic ingredient and coating. It is preferable that at least 99% of the coated particles are able to pass through a sieve with a mesh size of from 400 µm to 2 mm using ASTM E11 method.

- Alternatively, the coated particles, coated flakes and/or coated granulates may have a particle
- 20 size distribution of from 1mm to 7mm and preferably of from 2mm to 6mm. In one embodiment, the coated flakes have a thickness of from 0.2mm to 1.5mm and preferably of from 0.3mm to 0.9mm or of from 0.9mm and 1.3mm; and a diameter of from 1 to 52mm. Without wishing to be bound by any theory, it is believed that the acidic ingredients can be well dispersed in the fat matrix leading to an improvement of the juiciness and mouthfeel.

- 25 As would be appreciated, the particle size distribution refers to the diameter of particles, flakes, granulates present in an amount of at least 80% by weight, preferably at least 85% by weight, and for example of 96% by weight, with respect to the total amount of particles, flakes, granulates, i.e. of 100 % by weight, in a sample to be measured. The distribution of diameters of the granulate described herein can be measured by known methods, including sieve tests
- 30 such as, ASTM E11, which is a woven wire sieve test.

- Reference herein to "diameter" when applied to non-circular (e.g. irregular shaped) granulate or flake corresponds to the largest dimension of the individual granule or flake. When a granulate diameter is measured using a sieve test, such as ASTM E11, the largest dimension
- 35 may be considered to be the largest sieve size (i.e. wire opening diameter) at which granulate is retained on the sieve.

Coated acidic particles may be manufactured using techniques known in the art. Suitable coated acidic particles are commercially available. In this embodiment, the encapsulated acidic ingredients may be produced using fluidized bed coating. The method of coated particles and/or coated granulates production comprises the transformation of a fluid material
5 into dried particles.

In addition, the one or more acidic ingredients may be encapsulated by a coating as described above, before being further encapsulated in a fat matrix, such as the fat matrix of the fat composition. The coated acidic ingredients may be dispersed in a molten or semi-molten fat composition. Alternatively or in addition, the coated acidic ingredients are dispersed in a semi
10 liquid crystallized fat composition. When adding coated acidic ingredients to a fat composition for further encapsulation, the fat composition should be at a temperature lower than the melting point of any fat present in the coating of the coated acidic ingredients.

Fats for use in meat analogue compositions

Any suitable fat composition for use in meat analogue compositions may be used in the meat
15 analogue compositions of the invention.

Preferably, the fat composition is present in the meat analogue composition in an amount of from 5% to 40%, preferably from 10 to 25% by weight, by weight of the meat analogue composition.

20 Typically, the fat composition comprises one or more non-animal derived oils such as a vegetable oil. This is desirable so that the meat analogue composition qualifies as a food product suitable for consumption by vegetarians and vegans. It is more preferred that vegetable oils with higher melting points are used than lower melting point vegetable oils. This is because the fats used in real meat burgers are animal fats which typically have higher
25 melting points and higher saturated fatty acid contents. By using a high melting point vegetable oil, the functional and sensory properties of animal fat found in meat are more effectively mimicked. Examples of higher melting point vegetable fats include palm oil, shea butter and coconut oil. However, certain lower melting point vegetable oils such as sunflower oil may also be used.

30 Preferably, the fat composition comprises palm oil, coconut oil, sunflower oil, rapeseed oil, high oleic rapeseed oil, high erucic acid rapeseed oil, soybean oil, sunflower oil, high oleic sunflower oil, linseed oil, olive oil, corn oil, cottonseed oil, carinata oil, groundnut oil, shea butter, cocoa butter, allanblackia fat, kokum fat, mango kernel oil, illipe butter, palm kernel oil,
35 babassu oil, high oleic safflower oil, peanut oil, avocado oil, rice oil, camelina oil, or a fraction

of one of these oils or one or more fractions thereof or a mixture of two or more of the afore mentioned oils and/or fractions.

The term "fat" as used herein refers to glyceride fats and oils containing fatty acid acyl groups and does not imply any particular melting point. The term "oil" is used synonymously with "fat" herein.

The term "fatty acid", as used herein, refers to straight chain saturated or unsaturated (including mono- and poly unsaturated) carboxylic acids having 4 to 24 carbon atoms. A fatty acid having x carbon atoms and y double bonds may be denoted C_x:_y. For example, palmitic acid may be denoted C16:0, oleic acid may be denoted C18:1. Percentages of fatty acids in compositions referred to herein include acyl groups in tri-, di- and monoglycerides present in the glycerides and are based on the total weight of C4 to C24 fatty acids. The fatty acid profile (i.e. composition) may be determined, for example, by fatty acid methyl ester analysis (FAME) using gas chromatography according to ISO 12966-2 and ISO 12966.4.

Triglyceride content may be determined for example based on molecular weight differences (Carbon Number (CN)) by AOCS Ce 5-86. The notation triglyceride CN_{xx} denotes triglycerides having xx carbon atoms in the fatty acyl groups, e.g. CN54 includes tristearin. Amounts of triglycerides specified with each carbon number (CN) as is customary terminology in the art are percentages by weight based on total triglycerides of CN26 to CN62 present in the fat composition.

Preferably, the fat composition contains a substantially major portion of fat with very little water (i.e. the fat composition consists essentially of fat molecules). However, the fat composition may contain water and be present in the form of an emulsion such as an oil-in-water emulsion or a water-in-oil emulsion, typically with a suitable emulsifier. References to fat composition in the meat analogue composition refers to only fat molecules present in the fat composition, and not any water present in the composition. Similarly, the weight percentages given above for the amount of water present in the meat analogue composition refers to both water added in its own right during manufacture of the meat analogue composition, and also to any water present in other components of the meat analogue composition (such as water present in an emulsified fat composition), or water bound to any protein, as discussed in further detail below.

It has also been found possible to use in the meat analogue compositions of the invention certain fat compositions known for use in other food applications such as bakery products but not currently known for use in meat analogue products. Surprisingly, it has been found that these fat compositions have properties suitable for use in meat analogue compositions, and may also provide various advantages over the use of fats known for use in meat analogue

compositions such as coconut oil. It has also surprisingly been found that the fat compositions discussed in further detail below are particularly good at encapsulating the one or more acidic ingredients and preventing said ingredients from interacting with other ingredients until the point of cooking.

5 Preferably, the fat composition may comprise from 20% to 85% by weight of saturated fatty acid residues; from 10% to 50% by weight of stearic acid residues (C18:0); and from 2% to 35% by weight of lauric acid residues (C12:0); wherein said percentages of fatty acid residues refers to fatty acids bound as acyl groups in glycerides in the fat composition and being based on the total weight of C4 to C24 fatty acid residues bound as acyl groups present in the fat
10 composition. Preferably, the fat composition comprises from 20% to 70% by weight of saturated fatty acids, for example 20 to 65% by weight of saturated fatty acids, and more preferably from 20% to 60% by weight of saturated fatty acids. The fat composition may also comprise 65% to 85% by weight of saturated fatty acids. Typically, the fat composition comprises from 2 to 12 percent by weight of St2M triglycerides, preferably from 5 to 12 percent
15 by weight of St2M triglycerides. A St2M triglyceride is a triglyceride molecule comprising two stearic acid residues and one residue of either lauric acid or myristic acid. Typically, the fat composition comprises from 5 to 35 percent by weight of CN46 and CN48 triglycerides, preferably from 10 to 30 percent by weight of CN46 and CN48 triglycerides. The abbreviation CN stands for the total carbon number of the fatty acid moieties present in the triglyceride
20 molecule. For example, a triglyceride comprising two stearic acid residues and one lauric acid residue would have a total carbon number of 48. The fat composition preferably is a non-hydrogenated fat composition.

Typically, the fat composition comprises 20% by weight or less, and preferably 10% by weight
25 or less of palmitic acid (C16:0). Typically, the fat composition has a weight ratio of stearic acid (C18:0) to palmitic acid (C16:0) of from 1:1 to 12:1. Typically, the fat composition has a weight ratio of lauric acid (C12:0) to stearic acid (C18:0) of from 1:4 to 4:1. Preferably, the fat composition comprises from 10% to 25% by weight lauric acid (C12:0); and/or from 15% to 45% by weight stearic acid (C18:0). More preferably, the fat composition comprises from 10%
30 to 25% by weight lauric acid (C12:0); and from 15% to 45% by weight stearic acid (C18:0).

Typically, the fat composition has one or more of the following properties:

- (i) the fat composition has a solid fat content (SFC) N40 of less than 10, measured on
unstabilised fat according to ISO 8292-1, preferably from 1 to 9, and more preferably from 2
35 to 8;
- (ii) the fat composition has a solid fat content (SFC) N20 of from 35 to 60, preferably from

25 to 56, more preferably from 20 to 40, as measured on the unstabilised fat according to ISO 8292-1; and

- (iii) the fat composition has a solid fat content (SFC) N30 of from 5 to 35, preferably from 8 to 32; more preferably from 8 to 30, as measured on the unstabilised fat according to ISO 8292-1.

Preferably, the fat composition has all three of the above properties.

The fat composition as described above may be made from naturally occurring or synthetic fats, fractions of naturally occurring or synthetic fats, or mixtures thereof, that satisfy the requirements for fatty acids and triglyceride compositions discussed above. Preferably, the fat composition is derived from a blend of naturally occurring fats.

Preferably, the fat composition as described above comprises an interesterified fat, and more preferably wherein the fat composition comprises an interesterified fat blend. The interesterified fat or interesterified fat blend may be produced by chemical interesterification, enzymatic interesterification, or a combination thereof.

The interesterified fat or interesterified fat blend may be produced by an enzymatic interesterification reaction which does not reach an equilibrium product distribution. It has been found that this provides a fat composition product with optimum properties for use in a meat analogue composition, such as the properties discussed above. Processes for the preparation of the fat compositions such as the interesterification reactions discussed above are known in the art, and are discussed in, for example, Dijkstra, A. J. *Intesterification*. In: *The Lipids Handbook* 3rd Edition, pages 285 – 300 (F. D. Gunstone, J. L. Harwood, and A. J. Dijkstra (eds.), Taylor & Francis Group LLC, Boca Raton, FL) (2007).

Preferably, the fat composition as described above comprises an interesterified fat blend comprising a vegetable oil high in stearic acid and a vegetable oil high in lauric acid. Preferably, the vegetable oil high in stearic acid is also high in monounsaturated fatty acids such as oleic acids. Accordingly, in typical examples, the fat composition comprises an interesterified fat blend comprising at least one fat selected from shea butter, shea stearin, shea olein, cocoa butter, cocoa stearin, cocoa olein, allanblackia fat, kokum fat, mango kernel fat, sal fat, illipe butter, and mixtures thereof; and at least one oil selected from coconut oil, coconut oil stearin, coconut oil olein, palm kernel oil, palm kernel olein, palm kernel stearin, babassu oil, and mixtures thereof.

Preferably, the fat composition as described above comprises an interesterified blend of shea butter and coconut oil or an interesterified blend of shea stearin and coconut oil. For example, the fat composition may comprise an interesterified blend of from 20% to 80% by weight of shea butter and from 20% to 80% by weight of coconut oil. Alternatively, or in addition, the fat composition may comprise an interesterified blend of from 20% to 80% by weight of shea stearin and from 20% to 80% by weight of coconut oil.

In a highly preferable example, the fat composition as described above comprises a blend of (i) from 20% to 80% by weight of an interesterified blend of from 20% to 80% by weight of shea butter and/or shea stearin and from 20% to 80% by weight of coconut oil; and (ii) from 20% to 80% by weight of sunflower oil.

In another preferred embodiment, the fat composition comprises from 20% to 85% by weight of saturated fatty acid residues; from 5% to 50% by weight of stearic acid residues (C18:0); from 2 to 35% by weight of linoleic acid residues (C18:2); and from 1 to 15% by weight of α -linolenic acid residues (C18:3); from 10 to 35% by weight of lauric acid residues (C12:0), 10% being excluded; wherein said percentages of fatty acid residues refers to fatty acids bound as acyl groups in glycerides in the fat composition and being based on the total weight of C6 to C24 fatty acid residues bound as acyl groups present in the fat composition. Typically, the fat composition comprises from 20% to 70% by weight of saturated fatty acids such as from 20% to 60% by weight of saturated fatty acids; preferably from 65% to 85% by weight of saturated fatty acids or from 20% to 65% by weight of saturated fatty acids.

Typically, the fat composition has a weight ratio of stearic acid (C18:0) to palmitic acid (C16:0) of from 1:1 to 12:1. For example, the fat composition has a weight ratio of lauric acid (C12:0) to stearic acid (C18:0) of from 1:4 to 4:1. For example, the fat composition comprises from 10% to 25% by weight lauric acid (C12:0), 10% being excluded; and/or from 10% to 45% by weight stearic acid (C18:0). For example, the fat composition may comprise from 15% to 40% by weight stearic acid (C18:0). Typically, the fat composition comprises from 10 to 30% by weight of lauric acid residues (C12:0), 10% being excluded.

Typically, the fat composition has a weight ratio of linoleic acid residues (C18:2) to α -linolenic acid residues (C18:3) of from 1:1 to 20:1. For example, the fat composition has a weight ratio of linoleic acid residues (C18:2) to α -linolenic acid residues (C18:3) of from 1:1 to 10:1. The fat composition may have a weight ratio of linoleic acid residues (C18:2) to α -linolenic acid residues (C18:3) of from 10:1 to 18:1.

The fat composition may comprise from 25 to 35% by weight of linoleic acid residues (C18:2). Typically, the fat composition comprises from 1 to 10% by weight of α -linolenic acid residues (C18:3).

5 Typically, the fat composition has one or more of the following properties:

(i) the fat composition has a solid fat content (SFC) N40 of less than 10, measured on unstabilised fat according to ISO 8292-1, preferably from 0 to 9, and more preferably from 0 to 7;

10 (ii) the fat composition has a solid fat content (SFC) N20 of from 10 to 60, preferably from 10 to 45, more preferably from 10 to 30, as measured on the unstabilised fat according to ISO 8292-1; and/or

(iii) the fat composition has a solid fat content (SFC) N30 of from 1 to 35, preferably from 1 to 20; more preferably from 1 to 15, as measured on the unstabilised fat according to ISO 8292-1.

15

Preferably, the fat composition has all three of the above properties.

Preferably, the fat composition comprises an interesterified fat, preferably wherein the fat composition comprises an interesterified fat blend and a blending oil. The interesterified fat
20 blend can be as described above and the blending oil is selected from: rapeseed oil, soybean oil, or any combination thereof. Preferably, the fat composition comprises a fat blend of (i) from 10% to 95% by weight of an interesterified blend of from 10% to 90% by weight of shea butter and/or shea stearin and from 10% to 90% by weight of coconut oil; and (ii) from 5% to 90% by weight of rapeseed oil. Alternatively, the fat composition comprises a blend of (i) from 10% to
25 95% by weight of an interesterified blend of from 10% to 90% by weight of shea butter and/or shea stearin and from 10% to 90% by weight of coconut oil; and (ii) from 5% to 90% by weight of soybean oil.

In another preferred embodiment, the fat composition comprises from 10% to 50% by weight of saturated fatty acid residues; from 5% to 50% by weight of stearic acid residues (C18:0);
30 from 5 to 35% by weight of linoleic acid residues (C18:2); and from 1 to 15% by weight of α -linolenic acid residues (C18:3); wherein said percentages of fatty acid residues refers to fatty acids bound as acyl groups in glycerides in the fat composition and being based on the total weight of C6 to C24 fatty acid residues bound as acyl groups present in the fat composition. Preferably, the fat composition comprises from 10% to 45% by weight of saturated fatty acids.

Typically, the fat composition comprises less than 10% by weight of lauric acid residues (C12:0). For example, the fat composition has a weight ratio of linoleic acid residues (C18:2) to α -linolenic acid residues (C18:3) of from 1:1 to 10:1. The fat composition may comprise from 10% to 40% by weight stearic acid (C18:0). The fat composition may comprise from 5 to 30% by weight of linoleic acid residues (C18:2). Typically, the fat composition comprises from 1 to 8% by weight of α -linolenic acid residues (C18:3).

Typically, the fat composition has one or more of the following properties:

- (i) the fat composition has a solid fat content (SFC) N20 of from 4 to 60, measured according to IUPAC 2.150.b, preferably of from 4 to 50, more preferably from 40 and advantageously from 6 to 30;
- (i) the fat composition has a solid fat content (SFC) N25 of from 3.5 to 55, preferably 3.5 to 45, more preferably from 3.5 to 35 and advantageously 3.5 to 24, as measured according to IUPAC 2.150.b; and/or
- (ii) the fat composition has a solid fat content (SFC) N30 of from 0 to 40, preferably from 0 to 30, more preferably from 0 to 25 and advantageously from 0 to 15, as measured according to IUPAC 2.150.b.

Preferably, the fat composition has all three of the above properties.

Preferably, the fat composition comprises a fat blend of shea butter and rapeseed oil or a fat blend of shea stearin and rapeseed oil. More preferably, the fat composition comprises a fat blend of from 10% to 90% by weight of shea butter and from 10% to 90% by weight of rapeseed oil. Alternatively, the fat composition comprises a fat blend of from 10% to 90% by weight of shea stearin and from 10% to 90% by weight of rapeseed oil.

Alternatively, the fat composition may comprise an interesterified blend of vegetable oil and fully hydrogenated vegetable oil. For such a blend, the fat composition may comprise up to 100% by weight of the fat composition of the interesterified blend of vegetable oil and fully hydrogenated vegetable oil, such as up to 80%, 70%, 60%, 50%, 40% or 30% by weight. The fat composition may comprise (a) from 5% to 95% by weight of the fat composition of the interesterified blend of vegetable oil and fully hydrogenated vegetable oil and (b) from 5% to 95% by weight of the fat composition of blending vegetable oil. For example, the fat composition may comprise (a) from 10% to 90% by weight of the fat composition of the interesterified blend of vegetable oil and fully hydrogenated vegetable oil and (b) from 10% to 90% by weight of the fat composition of blending vegetable oil. Preferably, the fat composition comprises (a) from 20% to 80% by weight of the fat composition of the interesterified blend of

vegetable oil and fully hydrogenated vegetable oil and (b) from 20% to 80% by weight of the fat composition of blending vegetable oil. More preferably, the fat composition comprises (a) from 50% to 80% by weight of the fat composition of the interesterified blend of vegetable oil and fully hydrogenated vegetable oil and (b) from 20% to 50% by weight of the fat composition of blending vegetable oil. Most preferably, the fat composition comprises (a) from 60% to 80% by weight of the fat composition of the interesterified blend of vegetable oil and fully hydrogenated vegetable oil and (b) from 20% to 40% by weight of the fat composition of blending vegetable oil.

Typically, the interesterified blend is an interesterified blend of from 20% to 60% by weight of vegetable oil and from 40% to 80% by weight of fully hydrogenated vegetable oil. Preferably, the interesterified blend is an interesterified blend of from 40% to 60% by weight of vegetable oil and from 40% to 60% by weight of fully hydrogenated vegetable oil. More preferably, the interesterified blend is an interesterified blend of from 45% to 55% by weight of vegetable oil and from 45% to 55% by weight of fully hydrogenated vegetable oil.

In the context of the present application, the term “hardstock” is used herein to refer to the interesterified blend component of the fat composition (i.e. component (a) when a blending vegetable oil is included).

Typically, the interesterified blend is an interesterified blend of liquid vegetable oil and fully hydrogenated vegetable oil. Preferably, the interesterified blend is an interesterified blend of non-tropical vegetable oil and fully hydrogenated non-tropical vegetable oil. Non-tropical vegetable oils are those that can be grown in non-tropical regions of the world such as North America and Europe.

The interesterified blend may be an interesterified blend of (i) fully hydrogenated vegetable oil and (ii) vegetable oil, each vegetable oil being selected from rapeseed oil, high oleic rapeseed oil, high erucic acid rapeseed oil, soybean oil, sunflower oil, high oleic sunflower oil, linseed oil, olive oil, corn oil, cottonseed oil, carinata oil, groundnut oil, safflower oil, high oleic safflower oil, peanut oil, rice oil, camelina oil, or any combination thereof, although it will be understood that similar vegetable oils may also be used.

Preferably, the interesterified blend is an interesterified blend of (i) fully hydrogenated vegetable oil and (ii) vegetable oil, each vegetable oil selected from rapeseed oil, high oleic rapeseed oil, high erucic acid rapeseed oil, or a combination thereof.

The term “fully hydrogenated vegetable oil” as used herein is used to refer to a vegetable oil that has undergone hydrogenation so as to convert its unsaturated fatty acid residues into

saturated fatty acid residues. Suitable process conditions and methods for hydrogenating vegetable oil are known in the art. Any suitable fat hydrogenation process known in the art can be used to produce the fully hydrogenated vegetable oils of the present invention. For example, hydrogenation processes discussed in EP2196094 can be used. The term fully hydrogenated as used herein is used to distinguish the hydrogenated vegetable oils for use in producing the hardstock from partially hydrogenated vegetable oils which typically contain a significant quantity of trans fatty acid residues. In full hydrogenation, the hydrogenation process is allowed to continue to such an extent that all or substantially all of the unsaturated fatty acid residues present in the molecule are converted to saturated fatty acid residues. Accordingly, the fully hydrogenated vegetable oil may comprise less than 5% by weight of trans fatty acids, more preferably less than 2% by weight of trans fatty acids and most preferably less than 1% by weight of trans fatty acids, wherein said percentages of fatty acid residues refers to fatty acids bound as acyl groups in glycerides in the fully hydrogenated vegetable oil and being based on the total weight of C4 to C24 fatty acid residues bound as acyl groups present in the fully hydrogenated vegetable oil.

In addition, the hardstock may be derived from interesterification of a first vegetable oil and a fully hydrogenated vegetable oil that is itself derived from the first vegetable oil, although it will be understood that this is not essential. By way of example, the interesterified blend may be an interesterified blend of (i) fully hydrogenated rapeseed oil and (ii) rapeseed oil.

In another example, the fully hydrogenated vegetable oil may comprise high erucic acid rapeseed oil, or other fully hydrogenated fats with a mixed fatty acid chain length. More preferably, the interesterified blend is an interesterified blend of (i) fully hydrogenated vegetable oil; (ii) fully hydrogenated high erucic acid rapeseed oil; and (iii) vegetable oil such as rapeseed oil or high oleic rapeseed oil. Most preferably, the interesterified blend is an interesterified blend of (i) from 40% to 60% by weight of vegetable oil such as rapeseed oil; (ii) from 5% to 15% by weight of fully hydrogenated high erucic acid rapeseed oil; and (iii) from 30% to 50% by weight of fully hydrogenated rapeseed oil. Other fully hydrogenated fats with a mixed fatty acid chain length include carinata oil.

Typically, the interesterified blend comprises less than 55% by weight of saturated fatty acid residues, wherein said percentages of fatty acid residues refers to fatty acids bound as acyl groups in glycerides in the interesterified blend and being based on the total weight of C4 to C24 fatty acid residues bound as acyl groups present in the interesterified blend.

Typically, the interesterified blend comprises stearic acid residues in amount of from 40% to 60% and/or palmitic residues in an amount of 2.5% to 7.5%, wherein said percentages of fatty acid residues refers to fatty acids bound as acyl groups in glycerides in the interesterified blend

and being based on the total weight of C4 to C24 fatty acid residues bound as acyl groups present in the interesterified blend.

Preferably, the fat composition as described above comprises from 45% to 55% by weight of saturated fatty acid residues; from 30% to 40% of monounsaturated fatty acid residues; from 5% to 15% of polyunsaturated fatty acid residues; and/or less than 1% of trans unsaturated fatty acid residues; wherein said percentages of fatty acid residues refers to fatty acids bound as acyl groups in glycerides in the interesterified blend and being based on the total weight of C4 to C24 fatty acid residues bound as acyl groups present in the interesterified blend.

Preferably, the fat composition as described above comprises from 40% to 50% by weight of C18:0; from 30% to 40% by weight of C18:1; from 5% to 12% of C18:2; from 1% to 6% of C18:3; and/or from 2.5% to 7.5% of C16:0; wherein said percentages of fatty acid residues refers to fatty acids bound as acyl groups in glycerides in the interesterified blend and being based on the total weight of C4 to C24 fatty acid residues bound as acyl groups present in the interesterified blend.

The interesterified blend as described above is produced by interesterification of the fully hydrogenated vegetable oil and liquid vegetable oil. Typically, the interesterified blend has been produced by chemical interesterification, enzymatic interesterification, or a combination thereof. Any suitable interesterification process known in the art can be used to produce the interesterified blend. Suitable processes conditions for interesterification are known. For example, the interesterification process conditions discussed in EP2196094 can be used.

The fat composition as described above also comprises blending vegetable oil component (b) which is mixed with the hardstock composition. Blending vegetable oil component (b) can be any suitable vegetable oil. Typically, blending vegetable oil component (b) is a liquid vegetable oil. Typically, blending vegetable oil component (b) is a non-tropical vegetable oil. Preferably, the blending vegetable oil of (b) comprises rapeseed oil, high oleic rapeseed oil, soybean oil, sunflower oil, high oleic sunflower oil, linseed oil, olive oil, corn oil, cottonseed oil, groundnut oil, safflower oil, high oleic safflower oil, peanut oil, rice oil, camelina oil, or any combination thereof.

Additionally or alternatively, the fat composition may comprise a blend of liquid vegetable oil and a fully hydrogenated liquid vegetable oil; or a blend of a liquid vegetable oil and a vegetable oil stearin. Preferably, the liquid vegetable oil comprises rapeseed oil.

Preferably, the fully hydrogenated liquid vegetable oil comprises fully hydrogenated rapeseed oil. Preferably, the vegetable oil stearin comprises palm stearin. Typically, in such fat blends,

the liquid vegetable oil is present in an amount of from 90% to 99% by weight of the blend; and the fully hydrogenated liquid vegetable oil or vegetable oil stearin is present in an amount of from 1% to 10% by weight of the fat blend. Such oil blends are typically semi liquid crystallized fat blends. Advantages associated with the use of such fat blends is that they tend to have lower saturated fatty acid contents compared to other fats used in meat analogue compositions.

In a preferred instance, the fat compositions comprise (i) a blend of liquid vegetable oil and a fully hydrogenated liquid vegetable oil and also (ii) a fat composition comprising from 20% to 85% by weight of saturated fatty acid residues; from 10% to 50% by weight of stearic acid residues (C18:0); and from 2% to 35% by weight of lauric acid residues (C12:0); wherein said percentages of fatty acid residues refers to fatty acids bound as acyl groups in glycerides in the fat composition and being based on the total weight of C4 to C24 fatty acid residues bound as acyl groups present in the fat composition. Preferably, component (ii) comprises an interesterified blend of coconut oil and shea butter or coconut oil and shea stearin, such as those interesterified blends described above. The fat composition may further comprise a liquid vegetable oil such as rapeseed oil in addition to components (i) and (ii) discussed above.

In other instances such as described above, the fat composition comprises (i) a blend of a liquid vegetable oil and a vegetable oil stearin; and (ii) a fat composition comprising from 20% to 85% by weight of saturated fatty acid residues; from 10% to 50% by weight of stearic acid residues (C18:0); and from 2% to 35% by weight of lauric acid residues (C12:0); wherein said percentages of fatty acid residues refers to fatty acids bound as acyl groups in glycerides in the fat composition and being based on the total weight of C4 to C24 fatty acid residues bound as acyl groups present in the fat composition. The fat composition may further comprise a liquid vegetable oil such as rapeseed oil in addition to components (i) and (ii) discussed above.

Where the fat compositions comprise a (i) blend of liquid vegetable oil and a fully hydrogenated liquid vegetable oil; or a blend of a liquid vegetable oil and a vegetable oil stearin; and (ii) a liquid vegetable oil, components (i) and (ii) are typically present in a weight ratio of from 3:1 to 1:1.

Where the fat compositions comprise a (i) blend of liquid vegetable oil and a fully hydrogenated liquid vegetable oil; or a blend of a liquid vegetable oil and a vegetable oil stearin; and (ii) a fat composition comprising from 20% to 85% by weight of saturated fatty acid residues; from 10% to 50% by weight of stearic acid residues (C18:0); and from 2% to 35% by weight of lauric acid residues (C12:0); wherein said percentages of fatty acid residues refers to fatty acids bound as acyl groups in glycerides in the fat composition and being based on the total weight of C4 to C24 fatty acid residues bound as acyl groups present in the fat composition; components

(i) and (ii) are typically present in a weight ratio of from 1:1 to 1:3.

Other components of the meat analogue compositions

The meat compositions of the invention comprise one or more non-animal proteins, such as one or more proteins derived from fungi, plants, bacteria or a combination thereof.

- 5 Typically, the non-animal protein comprises plant protein. Preferably, the plant protein is selected from algae protein, black bean protein, canola wheat protein, chickpea protein, fava protein, lentil protein, lupin bean protein, mung bean protein, oat protein, pea protein, potato protein, soy protein, sunflower seed protein, wheat protein, white bean protein, and protein isolates or concentrates thereof. Alternatively or additionally, the non-animal protein may also
- 10 comprise seitan, rice protein, mushroom protein, legume protein, tempeh, yam flour, tofu, mycoprotein, peanut flour, yuba, or a combination thereof. Alternatively or additionally, the non-animal protein may also comprise methylococcus, hydrogenotropic bacteria, Heme-containing protein, or a combination thereof.

- More preferably, the non-animal protein comprises texturized vegetable proteins, preferably
- 15 wherein the texturized vegetable proteins comprise texturized pea proteins, texturized fava proteins, texturized soy proteins, texturized wheat proteins or a combination thereof. Preferably, the texturized vegetable protein is present in the meat analogue composition in an amount of from 10% to 20% by weight of the meat analogue composition.

- The non-animal protein is present in the meat analogue composition in an amount of from 5%
- 20 to 30% by weight of the meat analogue composition. Preferably, the non-animal protein is present in the meat analogue composition in an amount of from 10% to 30% by weight of the meat analogue composition, and more preferably from 15% to 25% by weight of the meat analogue composition.

- Plant protein is a source of protein which is obtained or derived from plants. The plant protein
- 25 may be any suitable plant protein and may comprise a mixture of plant proteins and/or may include protein isolates or concentrates. Examples of suitable plant proteins include those discussed above. As discussed above, preferably, the plant protein comprises textured vegetable proteins (TVP). TVPs are extruded proteins, which may be either dry, moist (i.e. hydrated), by low-moisture extrusion, high-moisture extrusion or other technologies. TVP is
- 30 widely available and may be made from plant sources as mentioned above, such as soy flour or concentrate. In dry form, TVP can comprise up to about 70 wt.% of protein, typically about 60 to 70 wt.% of protein, and when hydrated comprises typically about 10 to 20 wt.% of protein. Typically, when hydrated TVPs can contain up to 3 to 4 times their dry weight in water. As

discussed above, the weight percentage ranges referred to above for water present in the meat analogue compositions include both water added in its own right and water present in other components of the meat analogue composition such as in textured vegetable proteins or emulsified with fat. Similarly, the weight percentage ranges given above for the amount of
5 non-animal protein present in the meat analogue composition refer to dry weight of protein, and do not include water bound to the non-animal protein such as in textured vegetable protein.

The plant protein used in the preparation of the meat analogue composition may be either dry (also referred to as 'dry phase' herein) or moist. Thus, the plant protein may be included in a
10 dry mix of ingredients, which may include additional ingredients intended for inclusion in the meat analogue composition, such as carbohydrates, fibre and/or hydrocolloids, in addition to protein. If the plant protein is dry, it may be hydrated prior to and/or during the formation of the meat analogue composition. The term 'dry' used in relation to the plant protein and 'dry phase' used herein, is intended to mean that the phase comprising plant protein comprises less than
15 10 wt.% water, less than 5 wt.% water, preferably less than 2 wt.% water, more preferably less than 1 wt.% water, even more preferably that it is substantially free from water. In other examples, the a_w of the dry phase is 0.90 or lower, more preferably below 0.80. The dry phase comprising plant protein is typically provided in a substantially dehydrated state to reduce microbial growth as far as possible so as to extend shelf life.

20 The meat analogue composition comprises water, which may be added as a separate component to the composition, or derived from other components of the composition as discussed above. The amount of water is not particularly limited and, as the skilled person will appreciate, will vary depending on the intended consistency of the meat analogue composition. Reference to 'water' herein is intended to include drinking water, demineralized
25 water or distilled water, unless specifically indicated. As the skilled person will appreciate, deionized water is also a sub-class of demineralized water. Typically, the water is present in the meat analogue composition in an amount of from 20.0% to 70.0% by weight of the meat analogue composition, such as from 20.0% to 50.0% by weight.

The meat analogue composition typically comprises one or more additional ingredients. Whilst
30 these one or more additional ingredients may be preferable to include in the meat analogue compositions, it will be understood that the inclusion of the one or more additional ingredients is not essential.

The meat analogue composition preferably further comprises a stabilizer blend. Typically, the stabilizer blend is present in an amount of from 2% to 20% by weight of the meat analogue
35 composition. Preferably, the stabilizer blend is present in the meat analogue composition in

an amount of from 5% to 10% by weight of the meat analogue composition. Typically, the stabilizer blend comprises vegetable derived protein, vegetable fibre and/or a polysaccharide. Preferably, the vegetable derived protein comprises pea protein, the vegetable fibre comprises pea fibre, and/or the polysaccharide comprises methylcellulose.

- 5 Most preferably, the stabilizer blend comprises vegetable derived protein comprising pea protein, vegetable fibre comprising pea fibre, and polysaccharide comprising methylcellulose.

The meat analogue composition may comprise one or more flavouring additives. Preferably, the one or more flavouring additives are present in an amount of from 0.5% to 5% by weight of the meat analogue composition. Suitable flavouring additives known in the art may be used
10 in the meat analogue compositions.

The meat analogue composition may comprise one or more colouring additives. Preferably, the one or more colouring additives are present in an amount of from 0.5% to 5% by weight of the meat analogue composition. Suitable colouring additives known in the art may be used in the meat analogue compositions.

- 15 The meat analogue composition may further comprise one or more of: i) polysaccharides and/or modified polysaccharides, preferably selected from methylcellulose, hydroxypropyl methylcellulose, carboxymethyl cellulose, maltodextrin, carrageenan and salts thereof, alginic acid and salts thereof, agar, agarose, agarpectin, pectin and alginate; ii) hydrocolloids; and
20 iii) gums, preferably selected from xanthan gum, guar gum, locust bean gum, gellan gum, gum arabic, vegetable gum, tara gum, tragacanth gum, konjac gum, fenugreek gum, and gum karaya.

Examples of other additives that may be included in the meat analogue compositions include an ionic or non-ionic emulsifier, a polyhydroxy compound, milk, alcohols, humectants, honey, liquid preservatives, liquid sweeteners, liquid oxidizing agents, liquid reducing agents, liquid
25 anti-oxidants, liquid enzymes, milk powder, hydrolysed protein isolates (peptides), amino acids, yeast, sugar substitutes, starch, salt, spices, fibre, thickening agents, egg powder, enzymes, gluten, vitamins, preservatives, sweeteners, oxidizing agents, reducing agents, and anti-oxidants.

Preferably, the meat analogue is suitable for consumption by vegetarians and vegans.
30 Accordingly, the meat analogue composition may be substantially free of animal protein, and more preferably, the meat analogue composition is free of animal protein.

Preferably, the meat analogue composition is substantially free of animal-derived products, and more preferably, the meat analogue composition is free of animal-derived products.

Preferably, the meat analogue composition is free of hydrogenated oils.

Preferably, the meat analogue composition is free of sal butter, heme-containing protein, iron salt, transgenic plant cells, added lactic acid producing bacteria fungal cell, alkali ingredients or any combination thereof, with which the juiciness and mouthfeel decreases.

- 5 However, alternatively, the meat analogue compositions may comprise animal-derived products such as animal derived proteins or fats. Accordingly, the meat analogue composition may further comprise one or more animal-derived products such as animal oils, marine oils, animal-derived proteins, animal-derived polysaccharides, or any combination thereof. The one or more animal-derived products may comprise animal milk proteins, animal milk fats, or a
10 combination thereof. Thus, the meat analogue compositions may be suitable for consumption by vegetarians on the basis that they comprise nonanimal protein and proteins or fats derived from animal milk. These meat analogue compositions are suitable for consumption by vegetarians since they do not include fats or proteins derived from meat. However, it will of course be understood that such meat analogue compositions are not suitable for consumption
15 by vegans.

Where the meat analogue compositions comprise one or more animal-derived products, the one or more animal-derived products are typically present in the meat analogue composition in an amount of from 1% to 20% by weight of the meat analogue composition, such as from 1% to 10% by weight of the meat analogue composition.

20 Food products

According to a second aspect of the invention, there is provided a food product comprising a meat analogue composition of the invention. The food product may be an uncooked food product, a cooked food product, or a partially cooked food product.

- Typically, the food product is a vegetarian or vegan substitute food product. Preferably, the
25 food product is a meat food substitute product or a seafood substitute product. Preferably, the meat substitute food product is a cut of meat, fish meat, burger, sausage, pepperoni, meat ball, nugget, patty, mince product, meatloaf, bacon, steak, whole muscle, cold cuts, or other product intended to mimic conventional meat-based food products. In another preferred embodiment, the seafood substitute food product is a calamari analogue product; crustacean
30 product such as a prawn analogue product, a lobster analogue product, a crab analogue product, a crabstick analogue product, a scampi analogue product; or a fish analogue product such as a fish cake or a fish filet; or other product intended to mimic conventional seafood-based food products.

The properties of the meat analogue composition or food products prepared using the composition may be measured by any suitable means. Properties of interest may include juiciness (and/or dryness), hardness, adhesiveness, springiness, cohesiveness, gumminess, chewiness and resilience. Such means include taste testers, which can provide feedback on properties of the composition or food product such as juiciness (or dryness), texture, chewiness and hardness. Typically multiple testers will be asked to mark one or more properties of the composition or food product, such as on a scale from 1 to 5. If multiple testers are asked, an average of the results can be taken to observe the general impression of the food product.

Properties of the composition or food product may also be measured using specialized equipment. For example, texture profile analysis (TPA) is a technique used to characterize textural attributes of solid and semisolid materials and may be used to determine the hardness, adhesiveness, springiness, cohesiveness, gumminess, chewiness and resilience.

Gumminess is defined as the product of hardness x cohesiveness. Chewiness is defined as the product of gumminess x springiness (hardness x cohesiveness x springiness). In this technique, the test material may be compressed two times in a reciprocating motion, mimicking the chewing movement in the mouth, producing a Force versus Time (and/or distance) graph, from which the above information can be obtained. TPA and the classification of textural characteristics is described further in Bourne M. C., Food Technol., 1978, 32 (7), 62-66 and Trinh T. and Glasgow S., 'On the texture profile analysis test', Conference Paper, Conference: Chemeca 2012, Wellington, New Zealand, and may be performed as described therein.

The Force versus Time (and/or distance) graph typically includes two peaks in force, corresponding to the two compressions, separated by a trough. Force may be measured in gravitational force equivalent (g-force, g) or Newtons (N).

Hardness (g or N) is defined as the maximum peak force experienced during the first compression cycle.

Adhesiveness is defined as the negative force area for the first bite, i.e. the area of the graph between the two peaks in force which is at or below a force of 0 g or N. This represents the work required to overcome the attractive forces between the surface of a food and the surface of other materials with which the food comes into contact, i.e. the total force necessary to pull the compression plunger away from the sample. For materials with a high adhesiveness and low cohesiveness, when tested, part of the sample is likely to adhere to the probe on the upward stroke. Lifting of the sample from the base of the testing platform should, if possible,

be avoided as the weight of the sample on the probe would become part of the adhesiveness value. In certain cases, gluing of the sample to the base of a disposable platform has been advised but is not applicable for all samples.

- 5 Springiness, also known as elasticity, is related to the height that the food recovers during the time that elapses between the end of a first compression and the start of a second compression. During the first compression, the time from the beginning of the compression at force = 0 g or N to the first peak in force is measured (referred to as 'Cycle 1 Duration'). During the second cycle, the time from the beginning of the second compression at force
10 = 0 g or N to the second peak in force is measured (referred to as 'Cycle 2 Duration'). Springiness is calculated as the ratio of these values, i.e. 'Cycle 2 Duration' / 'Cycle 1 Duration'.

- 15 Cohesiveness is defined as the ratio of the positive force area, i.e. the area under the curve above a force of 0 g or N, during the second compression to that during the first compression. Cohesiveness may be measured as the rate at which the material disintegrates under mechanical action. Tensile strength is a manifestation of cohesiveness. If adhesiveness is low compared with cohesiveness then the probe is likely to remain clean as the product has the ability to hold together. Cohesiveness is usually tested in terms of the secondary parameters
20 brittleness, chewiness and gumminess.

- Gumminess is defined as the product of hardness x cohesiveness and is a characteristic of semisolid foods with a low degree of hardness and a high degree of cohesiveness. Chewiness is defined as the product of gumminess x springiness (which equals hardness x
25 cohesiveness x springiness) and is therefore influenced by the change of any one of these parameters.

- Resilience is a measurement of how the sample recovers from deformation both in terms of speed and forces derived. It is taken as the ratio of areas from the first probe reversal point,
30 i.e. the point of maximum force, to the crossing of the x-axis, i.e. at 0 g or N, and the area produced from the first compression cycle between the start of compression and the point of maximum force. In order to obtain a meaningful value of this parameter, a relatively slow test speed should be selected that allows the sample to recover, if the sample possesses this property.

35

Uses of meat analogue compositions and food products

According to a third aspect of the invention, there is provided the use of one or more encapsulated acidic ingredients as a juiciness agent in a meat analogue composition. Preferably, the use further comprises using the fat matrix or coating to improve the juiciness of the meat analogue composition when cooked when compared to an analogous meat analogue composition comprising acidic ingredients as such, and/or an analogous meat analogue composition not comprising acidic ingredients. Without being limited by theory, the juiciness compared to an analogous meat analogue composition comprising acidic ingredients as such, and/or an analogous meat analogue composition not comprising acidic ingredients is believed to be due to the encapsulated acidic ingredients. It is believed that the acidic ingredients released upon cooking react with the other components including water and the fat composition to improve the quantity of juice that is released by the meat analogue composition, particularly closer to eating rather than during storage and during the early steps of cooking. Improved juiciness of the meat analogue composition or a cooked food product comprising the composition is believed to make the meat analogue composition more closely resemble the mouthfeel, juiciness and succulence of meat products.

According to a fourth aspect of the invention, there is provided the use of one or more encapsulated acidic ingredients as a mouthfeel agent in a meat analogue composition. Preferably, the use further comprises using the fat matrix or coating to improve the mouthfeel of the meat analogue composition when cooked when compared to an analogous meat analogue composition comprising acidic ingredients as such, and/or an analogous meat analogue composition not comprising acidic ingredients. It is believed that the acidic ingredients improving the juiciness of the meat analogue composition will release a higher amount of juice when compared to an analogous meat analogue composition comprising acidic ingredients as such, and/or an analogous meat analogue composition not comprising acidic ingredients (particularly closer to eating). Thus, the sensation of having a greasy coating and moisture on the tongue and surfaces of the mouth can be felt as well as an instant flavour and taste impression from the water phase and delayed release of flavours from the fat over a longer period of time. The mouthfeel is believed to enable the meat analogue composition to more closely resemble the mouthfeel and delayed flavors release of meat.

According to a fifth aspect of the invention, there is provided the use of one or more encapsulated acidic ingredients as a tenderness agent in a meat analogue composition. Preferably, the use further comprises using the fat matrix or coating to further provide improved tenderness of the meat analogue composition when cooked when compared to an analogous meat analogue composition comprising acidic ingredients as such, and/or an analogous meat analogue composition not comprising acidic ingredients.

Preferably, the use of the third, fourth and fifth aspects of the invention further comprises using the meat analogue in a food product.

Preferably, in the use of the third, fourth and fifth aspects of the invention, the meat analogue composition, fat composition and/or food product are as described above.

- 5 Preferably, the use further comprises using the fat matrix or coating to substantially reduce, inhibit or prevent interaction of the one or more encapsulated acidic ingredients in the meat analogue composition prior to cooking of the meat analogue composition.

Process of manufacturing

10 According to a sixth aspect of the invention, there is provided a process of manufacturing a meat analogue composition or a food product according as described herein, wherein the process comprises: combining water; non-animal protein; the fat composition; one or more acidic ingredients being optionally encapsulated; and optionally one or more additional components so as to form the meat analogue composition; and optionally forming the meat analogue composition into food products.

- 15 Preferably, the process comprises:
- a) providing a mixture of water; non-animal protein; and optionally one or more additional components;
 - b) combining the mixture from step (a) with the fat composition and one or more acidic ingredients so that the acidic ingredients are encapsulated within a fat matrix of the fat composition; or combining the mixture from step (a) with the fat composition and one or more encapsulated acidic ingredients already coated by a coating and;
 - 20 c) optionally forming the meat analogue composition into food products.

Alternatively, the process comprises:

- 25 (i) providing a mixture of water; non-animal protein; one or more encapsulated acidic ingredients already coated by a coating and optionally one or more additional components;
- (ii) combining the mixture from step (a) with the fat composition to form the meat analogue composition; and
- (iii) optionally forming the meat analogue composition into food products.

30

Preferably, before the combining step b) or ii), the fat composition and optionally the one or more encapsulated acidic ingredients are heated at a temperature of from 26 to 50°C, preferably from 30 to 45°C and advantageously from 35 and 45°C.

Preferably, before the combining step b) or ii), the fat composition and optionally the one or more encapsulated acidic ingredients are cooled down at a temperature of from -5 to 15°C, and preferably from 0 to 10°C.

Preferably, before the combining step b) or ii), the fat composition and optionally the one or more encapsulated acidic ingredients are kept at ambient temperature.

Typically, the process further comprises cooking the food product to form a cooked food product or partially cooked food product.

Whilst the above-described steps are preferable steps for manufacturing the meat analogue compositions or food products described herein, it will be appreciated that other suitable processes may also be used to manufacture the meat analogue compositions and food products.

The meat analogue composition of the present invention may be readily prepared by blending a fat composition as described herein with plant protein and any other components of the composition. By way of example, a process for preparing a meat analogue composition may comprise the step of forming the meat analogue composition by blending a plant protein with a fat composition as described herein. Optionally, further ingredients may be present. Water may be added to the composition if required at any stage during the process. The process may further comprise the step of preparing the plant protein by providing a dry phase comprising plant protein and blending the dry phase with an amount of water, which precedes the step of forming the meat analogue composition. This step may also include other ingredients which are in dry form, such that these dry ingredients are hydrated simultaneously with the plant protein. Additionally, and/or alternatively, any other dry ingredients may be hydrated separately from the plant protein in any combination. Where TVPs are included, the TVP is preferably hydrated separately from any other dry ingredients. Without being bound by theory, this is believed to limit competition between the dry components for the water and ensure satisfactory hydration for all dry components present.

Thus, disclosed herein is a process for preparing a meat analogue composition, said process comprising the steps of: a) providing a dry phase comprising plant protein and optionally any other dry ingredients of the composition and blending the dry phase with an amount of water to form a mixture; b) forming the meat analogue composition by blending the mixture formed

in step a) with a fat composition as described herein. The plant protein may comprise TVPs. Preferably, dry ingredients other than the TVP are hydrated separately from the TVP. Examples of such dry ingredients include, but are not limited to, fibres, flavours, emulsifiers, gums, hydrocolloids, thickeners, plant protein isolate and powdered colourants. Preferably, the mixture of step a) comprising the hydrated plant protein and any other mixtures comprising hydrated dry ingredients are combined prior to step b). Without being bound by theory, it is believed that the hydration of dry ingredients prior to the addition of the fat composition (for example, in step a)) results in an optimal distribution of water in the product, resulting in a more stable meat analogue composition.

10

The dry phase comprising plant protein used in the above process is not particularly limited. The plant protein is as described hereinabove. The term 'dry phase' is intended to mean that the phase comprising plant protein comprises less than 10% water, such as less than 5 wt.% water, preferably less than 2 wt.% water, more preferably less than 1 wt.% water, even more preferably that it is substantially free from water. The a_w of the dry phase may be 0.90 or lower, more preferably below 0.80. The dry phase comprising plant protein is typically provided in a substantially dehydrated state to reduce microbial growth as far as possible so as to extend shelf life.

15

The dry phase, which may comprise plant protein, may take any physical form before being blended with water, however typically it is in powder, granule or pelletized, strip or chunk form. The amount of water added to the dry phase is not particularly limited. Typically, an amount of water is added in order to bind the dry components into a paste or dough with which the fat composition may be readily blended. The amount of water added to the dry phase is preferably calculated such that the total amount of water in the meat analogue composition after addition of the other components of the fat composition are within the ranges described above.

20

The temperature of the water added is not particularly limited, so long as it does not materially impact the intended characteristics of the components (e.g. does not lead to protein denaturation or hydrolysis). Preferably, the water is below room temperature (i.e. below 20°C). More preferably, ice water is used. This is particularly preferred when water is added to the dry phase. The term "ice water" is defined herein as having a temperature of above 0°C and below 6°C, preferably from 0.5 to 5 °C, more preferably from 1 to 4 °C, more preferably from 1 to 3 °C. An advantage of using ice water is that it slows microbial growth as far as possible during preparation of the meat analogue composition and it is particularly suitable for the hydration of certain dry ingredients as methylcellulose.

30

The blending of the dry phase with water may be performed for any duration of time. For example, blending may be performed until the dry phase and water are intimately mixed and typically until a paste or dough is formed. Where TVPs are hydrated, blending is limited to a minimum so as not to overly disturb the fibrous structures. Preferably, this may be performed
5 for a duration of from 1 second to 30 minutes, preferably from 1 second to 10 minutes, more preferably from 5 seconds to 5 minutes.

Following blending of the dry phase and water, for example in step a), the mixture may be allowed to rest prior to the addition of the fat composition, for example in step b). This may
10 ensure full hydration of the dry phase prior to addition of the fat composition. This rest may be performed under cold storage (thereby further controlling microbial growth), which has a temperature of from 0.5 to 15 °C, preferably from 1 to 12 °C, more preferably from 5 to 10 °C. This rest may be performed for a duration of from 5 minutes to 5 hours, preferably from 5 minutes to 2 hours, more preferably from 5 minutes to 30 minutes.

15 Preparation of the meat analogue composition may also comprise the step of adding further ingredients to the composition. These ingredients may be added at any stage in the preparation of the meat analogue composition. By way of example, further ingredients may be added after the addition of the fat composition, for example after step b). Preferably, dry
20 ingredients are hydrated prior to addition to the fat composition. By way of further example, dry ingredients may be hydrated with any dry plant protein, such as in step a), prior to the addition of the fat composition. Such ingredients may include one or more of additives as disclosed in more detail herein. The addition of these ingredients may be performed by blending, mixing or any suitable means.

25 Once the meat analogue composition has been prepared, this may be formed into a food product. This may include the step of forming the meat analogue composition into the desired shape. The shape and size of the resulting food product is not particularly limited. Examples of shaped food products which can be made from the meat analogue composition according
30 to the present invention include burgers, sausages, nuggets, meatballs and mince.

Any suitable method may be used to shape the meat analogue composition into the desired shape. By way of example, this may be performed by cutting, moulding, pressing, extrusion, rolling, grinding or any combination thereof. These processes may be performed using an
35 apparatus, which may be operated manually or may be automated. The meat analogue composition may be compressed for a few seconds to a few hours. The duration and pressure of compression is determined by the desired properties of the resulting food product, such as

its size and density, taking into account the properties of the meat analogue composition, such as adhesiveness, among other factors. This may form the desired shape of the food product, or it may be further processed such as by pelletizing, grinding or cutting, for instance to replicate the attributes of ground/minced meat.

5

The process of preparing a meat analogue composition may further comprise cooking or part-cooking the composition, which may have been formed into a food product. Cooking may comprise boiling, baking, grilling, frying and/or microwaving. Preferably, cooking is at sufficient temperature such that the Maillard reaction may occur (for example, above 80°C and up to 10 180 °C, preferably from 130 °C to 170 °C). The Maillard reaction is useful for desirable browning of the food product.

Typically, the food product may have a pH of from 4.5 to 7.

Fats for use

15 According to a seventh aspect of the invention, there is provided a non-animal derived fat composition comprising one or more encapsulated acidic ingredients present in an amount of from 0.25% to 95% by weight of the fat composition.

Preferably, the one or more acidic ingredients and fat composition are as described above.

20 Preferably, the one or more acidic ingredients are dispersed within a fat matrix of the fat composition. By way of example, the one or more acidic ingredients may comprise one or more acidic ingredients encapsulated by a coating so as to be coated acidic ingredients; and the coated acidic ingredients are further encapsulated in a fat matrix of the fat composition.

25 Preferably, the one or more acidic ingredients are present in the fat composition in an amount of from 0.5% to 90% by weight of the fat composition; preferably, the one or more acidic ingredients are present in the fat composition in an amount of from 0.5% to 40 % by weight of the fat composition; or the one or more acidic ingredients are present in the fat composition in an amount of from 40% to 69% or 75 to 90% by weight of the fat composition.

30 Where the one or more acidic ingredients are encapsulated in a coating, the one or more acidic ingredients are typically present in the fat composition in an amount of from 5 to 90%; preferably from 40 to 69%, or from 75 to 85% by weight and advantageously from 75 to 85%. This embodiment is particularly suitable where the coated acidic ingredients are in a form of particles. Alternatively, the one or more acidic ingredients are present in the fat composition 35 in an amount of from 5 to 40%, preferably, more preferably from 5 to 30% and advantageously

from 5 to 20% This embodiment is particularly suitable when the coated acidic ingredients are in a form of granulates and/or flakes. The reference to the weight percentage of the one or more acidic ingredients refers to the weight of the acidic ingredients themselves, and not the coating of the one or more alkali ingredients, if present. The weight percentage of the one or more acidic ingredients is with respect to the total weight of the fat composition and the one or more acidic ingredients.

Where the one or more acidic ingredients are not encapsulated in a coating, the one or more acidic ingredients are typically present in the fat composition in an amount of from 0.5 to 30%, preferably from 1 to 20%, and more preferably from 1 to 10% by weight. The fat compositions may be prepared by any suitable methods such as the methods discussed above.

DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a graph representing the content of moisture in a juice released upon cooking depending on the content of encapsulated acid ingredients into plant-based burgers.

DETAILED DESCRIPTION OF THE INVENTION

The following examples are for illustrative purposes only and are not intended to limit the scope of the invention in any way.

Example 1

Fat A is rapeseed oil.

Fat B is a fat prepared by chemical interesterification of a blend of 70 wt.% shea butter and 30 wt.% coconut oil. Fat B was pre-crystallized ('plasticized') using a series of three scraped surface heat exchangers, followed by a pin rotor. The start temperature was about 58°C and the exit temperatures after respectively the three scraped surface heat exchangers and the pin rotor were 27.4°C, 26.1°C, 19.4°C and 24.6°C.

Method for preparation of plant-based burgers

Plant-based burgers A0b to B4b were made from meat analogue compositions comprising Fat A or B.

The following procedure was used for the preparation of the plant-based burgers A0b to B4b of the following examples:

1. The proteins were hydrated with cold water (5 °C) according to the quantities shown in Table 1 and further hydrated for 30 minutes in cold storage (5°C); during hydration the protein

mixture was stirred every 10 min

2. All other ingredients in powder form (stabilizer blend⁺⁺⁺ and flavours) were mixed and hydrated with ice water (1-3°C) by blending for at least 1 minute, following which they were stored in a fridge (5 °C) for at least 30 minutes;

- 5 • regarding samples A2b, B1b and B2b: the acidic ingredients, optionally encapsulated, were added in step 2.

3. The proteins were chopped for 20 seconds at low speed;

4. The ingredients from steps 2 and 3 and any further ingredients (e.g. colours, fats in molten form or in pre-crystallized form, oils) according to the quantities shown in Table 1 were
10 combined and the resulting dough blended for about 2 minutes;

- regarding samples B3a: before adding Fat B, said Fat was kept at room temperature, i.e. around 20-25°C or
- regarding the other samples: before adding Fat A or Fat B, said Fats were heated in a heating cabinet at 40°C
- 15 • regarding samples A3b, A4b, B3a and B4b: the acidic ingredients were homogenously mixed into the fat before the addition of the fat in step 4.

5. The dough was rested in a fridge (operating at a temperature of 5 °C) for at least 30 minutes;

6. Burgers (diameter 8 cm; height 2 cm; weight 100g) were made from this dough and stored in the freezer (operating at a temperature of -18°C) for at least 24 hours. Prior to cooking,
20 burgers were thawed in the fridge (5°C) overnight.

7. Samples were cooked by heating on a frying pan with rapeseed oil (5g) for 10 min (and turned every 1.5 minutes).

* PO 80% refers to citric acid (around 80wt.%) coated with palm oil.

25 ** The proteins referred to above are a blend of textured pea proteins (protein content minimum 70%; format: strips) and textured fava proteins (protein content minimum 60%; format: chunks).

 *** The stabiliser blend referred to above is a blend of pea proteins (protein content minimum 83%; format: powder), pea fibre and methylcellulose.

30 The compositions of the burgers are shown below in Table 1.

Table 1

Samples	Comparative Sample A0b	Sample A2b	Sample A3b	Sample A4b	Comparative Sample B0b	Comparative Sample B1b	Sampl e B2b	Sampl e B3a	Sampl e B4b
Ingredients	Amounts (wt.%)								
cold Water (5°C)	37,6	37,5	37,5	37,5	37,6	37,5	37,5	37,5	37,5
Citric acid	-	-	-	-	-	0,22	-	-	-
Citric acid coated with PO 80% ⁺	-	0,28	-	-	-	-	0,28	-	-
Citric acid encapsulated in Fat composition	-	-	0,22	-	-	-	-	0,22	-
Citric acid coated with PO 80% ⁺ encapsulated in Fat composition	-	-	-	0,28	-	-	-	-	0,28
Fat A (40°C)	18,2	18,1	18,1	18,1	-	-	-	-	-
Fat B (Room temperature)	-	-	-	-	-	-	-	18,1	-
Fat B (40°C)	-	-	-	-	18,2	18,1	18,1	-	18,1
textured protein ⁺⁺	15,1	15,1	15,1	15,1	15,1	15,1	15,1	-	15,1
Stabilizer ⁺⁺⁺	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6
Ice water (1°C)	20,8	20,7	20,8	20,7	20,8	20,8	20,7	20,8	20,7
Flavour	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
colourants	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7
TOTAL	100	100	100	100	100	100	100	100	100

Properties of the burgers of the examples after frying

- 5 The hardness and chewiness of the burgers was measured by TPA using the following method:

Texture profile analysis (TPA) was used to determine the hardness, defined as the maximum

peak force during the first compression cycle (first bite) which has often been substituted by the term firmness. TPA was performed on a TA.XT₂ machine (by Stable Micro Systems) fitted with a 10 kg load cell and a 25 mm Dia Cylinder Aluminium Probe (P/25). The machine was programmed to run with the following settings: pre-test speed: 1 mm/s; test speed: 5 mm/s; 5 post-test speed: 5 mm/s; compression depth: 5 mm; time between cycles: 5 s; trigger type: automatic on 5 g; data acquisition rate: 200 pps. The test material was compressed two times in a reciprocating motion, mimicking the chewing movement in the mouth. A Force versus Time (and/or distance) graph was obtained, from which the desired information was obtained. TPA and the classification of textural characteristics is described further in Bourne M. C., *Food* 10 *Technol.*, 1978, 32 (7), 62-66 and Trinh T. and Glasgow S., 'On the texture profile analysis test', Conference Paper, Conference: Chemeca 2012, Wellington, New Zealand, and may be performed as described therein.

The juiciness after frying was evaluated by the following method:

- After frying, the sample is taken out of the pan and the sample weight is recorded;
- 15 • The sample is left to cool for 5 min (exactly 5 min)
- Weight of the dish to collect the juice is recorded (e.g. cup) and aeropress (Aerobie Model A80; use without filter paper) is positioned on the dish;
- The sample is chopped into pieces via 6 parallel and 6 perpendicular cuts;
- Chopped samples are placed in the aeropress and compressed using a force / weight 20 of 7 kg for 5 min; and
- Weight of extracted juice is recorded and juice per cooked mass (%) is calculated.

$$\bullet \text{ Juice per cooked mass (\%)} = \frac{\text{Weight of extracted juice}}{\text{Sample weight after cooking}} \times 100$$

The Moisture in juice released (%) was evaluated by the following method:

- 25 • Extracted juice from the juiciness after frying evaluation is decanted in a test tube and sealed
- Extracted juice is heated to a temperature above the fats' melting points in a heating cabinet, typically 50°C
- Moisture content of the juice is analyzed with a moisture analyzer (Halogen Moisture 30 Analyzer HE73, Mettler Toledo) in triplicate, the average is calculated and recorded as Moisture in juice released (%).

The weight loss (%) was determined by weighing the sample prior to cooking and afterwards

and calculating as follows:

$$\text{Weight loss (\%)} = \frac{\text{Sample weight prior to cooking}}{\text{Sample weight after cooking}} \times 100$$

Table 2

Property After Frying	Comparative Sample A0b	Sample A2b	Sample A3b	Sample A4b	Comparative Sample B0b	Comparative Sample B1b	Sample B2b	Sample B3a	Sample B4b
Juice per cooked mass (%)	3.1	5.2	4.5	5.7	7.2	7.3	9.1	10.4	8.5
Moisture in juice released (%)	7	27	24	28	36	42	45	43	43
weight loss (%)	-	-	-	-	-	28	27	27	27
Hardness (g)	-	-	-	-	-	1674	1561	-	1500
Chewiness (g)	-	-	-	-	-	1073	990	-	897

- 5 Samples A2b, A3b, A4b, B2b, B3a and B4b have a significantly higher percentage of juice per cooked mass when compared respectively to Comparative Sample A0b and Comparative Sample B0b, which both contain no acid, and Comparative Sample B1b, which contains a non-encapsulated acid. Furthermore, Samples A2b, A3b, A4b, B2b, B3a and B4b have a higher percentage of moisture content when compared respectively to Comparative Sample A0b, Comparative Sample B0b and Comparative Sample B1b. In addition, the weight loss is similar for Samples B2b, B3a and B4b compared to Comparative Sample B1b. It shows that the acidic ingredients released upon cooking interact with the other components to improve the quantity of juice that is released by the plant-based burger and the moisture in the juice. The mouthfeel sensation is therefore also improved leading to plant-based burgers mimicking animal-based burgers.

Desirable values for hardness after frying are from 500 to 5000. Samples B2b and B4b and Comparative Sample B1b are within this range. Samples B2b and B4b have comparable textural properties to Comparative Sample B1b but have a hardness and chewiness slightly lower than the hardness of Comparative Sample B1b reflecting an improved tenderness.

Example 2

Fat B as described in Example 1 was used.

Method for preparation of plant-based burgers

- 5 Plant-based burgers C0 to C4 were made from meat analogue compositions comprising Fat B.

The procedure described in Example 1 was used for the preparation of the plant-based burgers C0 to C4. Plant-based burgers C0 to C4 differ from each other in the way that the content of acidic ingredients varies.

- 10 The compositions of the burgers are shown below in Table 3.

Table 3

Samples	Comparative Sample C0	Sample C1	Sample C2	Sample C3	Comparative Sample C4
Ingredients	(amount wt.%)				
cold Water (5°C)	37.1	36.9	36.7	36.3	34.1
Citric acid encapsulated in Fat composition	0	0.5	1.0	2.0	8.0
Fat B (Room temperature)	14.9	14.8	14.8	14.6	13.7
textured protein ⁺⁺	18.7	18.6	18.6	18.4	17.2
Stabilizer ⁺⁺⁺	6.3	6.3	6.3	6.2	5.8
Ice water (1°C)	20.5	20.4	20.3	20.1	18.8
Flavour	0.8	0.8	0.8	0.8	0.7
colourants	1.7	1.7	1.7	1.7	1.6
TOTAL	100	100	100	100	100

Properties of the burgers of the examples after frying

Moisture in juice released (%) was measured according to the method described in Example

1.

Table 4

Property After Frying	Comparative Sample C0	Sample C1	Sample C2	Sample C3	Comparative Sample C4
Moisture in juice released (%)	33.1	42.5	47.6	50.1	39.1

Figure 1 and the above Table clearly show that Samples C1 to C3 according to the invention have the highest percentage of moisture in the juice released upon cooking. The inventors have surprisingly found that an optimum moisture is reached when the meat analogue composition to form plant-based burgers comprises from 0.1% to 5% by weight of one or more encapsulated acidic ingredients. An optimized moisture leads to an optimized mouthfeel sensation.

Example 3

Fat A and Fat B described in Example 1 were used.

Fat C is coconut oil.

Method for preparation of plant-based burgers

Plant-based burgers D0, D1, E0, E1, F0 and F1 were made from meat analogue compositions comprising Fat A, B or C.

The procedure described in Example 1 was used for the preparation of the plant-based burgers D0 to F1.

The compositions of the burgers are shown below in Table 5.

Table 5

Samples	Comparative Sample D0	Sample D1	Comparative Sample E0	Sample E1	Comparative Sample F0	Sample F1
Ingredients	(amount wt.%)					
cold Water (5°C)	39,6	39,6	39,6	39,6	39,6	39,6
Fat B granulates including 10% citric acid	-	2,3	-	2,3	-	2,3
textured protein ⁺⁺	16,0	16,0	16,0	16,0	16,0	16,0
Fat A (40°C)	11,7	9,3	-	-	-	-
Fat B (40°C)	-	-	11,7	9,3	-	-
Fat C (40°C)	-	-	-	-	11,7	9,3
Stabilizer ⁺⁺⁺	8,5	8,5	8,5	8,5	8,5	8,5
Ice water (1°C)	21,6	21,6	21,6	21,6	21,6	21,6
Flavour	0,8	0,8	0,8	0,8	0,8	0,8
colourants	1,9	1,9	1,9	1,9	1,9	1,9
Potassium Sorbate	0,1	0,1	0,1	0,1	0,1	0,1
TOTAL	100	100	100	100	100	100

Properties of the burgers of the examples after frying

- Juiciness after frying and Moisture in the juice released were measured according to the methods described in Example 1.

Table 6

Property After Frying	Comparative Sample D0	Sample D1	Comparative Sample E0	Sample E1	Comparative Sample F0	Sample F1
Juice per cooked mass (%)	3	3.8	4	5.8	4.2	5.4
Moisture in juice released (%)	37	42	36	44	35	47

Samples D1, E1 and F1 have a higher percentage of juice per cooked mass when compared

respectively to Comparative Sample D0, Comparative Sample E0 and Comparative Sample F0. Furthermore, Samples D1, E1 and F1 have a higher percentage of moisture content when compared respectively to Comparative Sample D0, Comparative Sample E0 and Comparative Sample F0.

5 Sensory evaluation of the burgers of the examples after frying

All the burgers were subjected to sensory evaluation. Multiple testers were asked to compare Comparative Sample E0 with Sample E1 and Comparative Sample F0 with F1, respectively, regarding juiciness and preference. The evaluation is based on the number of people that selected one sample. For example, regarding the juiciness, the number 6 means that 6 testers preferred the juiciness of Comparative Sample 0. The results of this evaluation are shown in Table 7.

Table 7

Property After Frying	Comparative Sample E0	Sample E1	Comparative Sample F0	Sample F1
Juiciness	6	10	5	11
Preference	5	10	-	-

Samples E1 and F1 according to the invention score highly on juiciness and preference.

CLAIMS

1. A meat analogue composition comprising from 2.0% to 40.0% by weight of a fat composition; from 5.0% to 35.0% by weight of a non-animal protein; from 20.0% to 75.0% by weight of water; and from 0.1% to 5% by weight of one or more acidic ingredients, wherein the acidic ingredients are encapsulated.
2. The meat analogue composition according to Claim 1, wherein the meat analogue composition comprises from 0.1% to 4% by weight of the one or more acidic ingredients; preferably wherein the meat analogue composition comprises from 0.1% to 2.5% by weight of the one or more acidic ingredients.
3. The meat analogue composition according to claim 1 or claim 2, wherein the meat analogue composition comprises from 0.1% to 1.0% by weight of the one or more acidic ingredients; preferably wherein the meat analogue composition comprises from 0.30% to 0.80% by weight of the one or more acidic ingredients; more preferably wherein the meat analogue composition comprises from 0.40% to 0.60% by weight of the one or more acidic ingredients.
4. The meat analogue composition according to any preceding claim, wherein the one or more acidic ingredients comprise an inorganic acid, an organic acid or a combination thereof.
5. The meat analogue composition according to Claim 4, wherein the organic acid is selected from citric acid, acetic acid, ascorbic acid, fumaric acid, succinic acid, lactic acid, malic acid, tartaric acid, or a combination thereof.
6. The meat analogue composition according to Claim 4 or 5, wherein the inorganic acid is selected from hydrochloric acid, phosphoric acid, sulphonic acid, sulfuric acid, or a combination thereof.
7. The meat analogue composition according to any preceding claim, wherein the one or more acidic ingredients comprise citric acid; and wherein the one or more acidic ingredients are present in the meat analogue composition in an amount of from 0.1% to 1% by weight, and more preferably from 0.3% to 0.8% by weight; more preferably wherein the one or more acidic ingredients comprise citric acid; and wherein the one or more acidic ingredients are present in the meat analogue composition in an amount of from 0.3% to 0.8% by weight, and more preferably from 0.40% to 0.60% by weight.
8. The meat analogue composition according to any preceding claim, wherein the one or

more acidic ingredients are encapsulated within a fat matrix.

9. The meat analogue composition according to Claim 8, wherein the one or more acidic ingredients are encapsulated within a fat matrix of the fat composition.

10. The meat analogue composition according to any one of claims 8 or 9, wherein the
5 acidic ingredients are encapsulated within a fat matrix in a form of bulk.

11. The meat analogue composition according to any preceding claim, wherein the one or more acidic ingredients are encapsulated by a coating.

12. The meat analogue composition according to any preceding claim, wherein the acidic ingredients are in the meat analogue composition in the form of coated particles, coated flakes
10 and/or coated granulates.

13. The meat analogue composition according to Claim 11 or 12, wherein the coating comprises a water insoluble hydrophobic coating.

14. The meat analogue composition according to any one of Claims 11 to 13, wherein the coating is adapted to degrade at temperatures above 30°C, preferably 45°C, more preferably
15 60°C and most preferably 65°C.

15. The meat analogue composition according to any one of Claims 11 to 14, wherein the coating comprises a fat coating, a carbohydrate coating, a monoacylglyceride (MAG) coating, or a combination thereof.

16. The meat analogue composition according to any one of Claims 11 to 15, wherein the
20 coating comprises a fat coating selected from palm oil, rapeseed oil, hydrogenated rapeseed oil, soybean oil, hydrogenated soybean oil, coconut oil, interesterified coconut oil, shea butter, an interesterified blend of shea butter and coconut oil, an interesterified blend of shea stearin and coconut oil, any fraction thereof and/or any combination thereof.

17. The meat analogue composition according to any one of Claims 11 to 16, wherein the
25 coating comprises a fat coating, and wherein the fat coating comprises a fat with a melting point of from 40°C to 80°C.

18. The meat analogue composition according to any one of Claims 12 to 17, wherein the coated particles, coated flakes and/or coated granulates have a particle size distribution of from 100µm to 3mm, preferably of from 200µm to 3mm, more preferably of from 400µm to
30 2mm, and advantageously of from 500µm to 1.3mm

19. The meat analogue composition according to any one of Claims 12 to 17, wherein the

coated particles, coated flakes and/or coated granulates have a particle size distribution of from 1mm to 7mm and preferably of from 2mm to 6mm.

20. The meat analogue composition according to claim any one of Claims 12 to 19, wherein the coated flakes have a thickness of from 0.2mm to 1.5mm and preferably from 0.3mm to 0.9mm or of from 0.9mm to 1.3mm; and a diameter of from 1 to 52mm.

21. The meat analogue composition according to any preceding claim, wherein the fat composition comprises one or more non-animal derived oils.

22. The meat analogue composition according to any preceding claim, wherein the fat composition comprises palm oil, coconut oil, sunflower oil, rapeseed oil, high oleic rapeseed oil, high erucic acid rapeseed oil, soybean oil, sunflower oil, high oleic sunflower oil, linseed oil, olive oil, corn oil, cottonseed oil, carinata oil, groundnut oil, shea butter, cocoa butter, allanblackia fat, kokum fat, mango kernel oil, illipe butter, palm kernel oil, babassu oil, high oleic safflower oil, peanut oil, avocado oil, rice oil, camelina oil, and a fraction of one of these oils or one or more fractions thereof or a mixture of two or more of the aforementioned oils and/or fractions.

23. The meat analogue composition according to any preceding claim, wherein the fat composition comprises from 20% to 85% by weight of saturated fatty acid residues; from 10% to 50% by weight of stearic acid residues (C18:0); and from 2% to 35% by weight of lauric acid residues (C12:0); wherein said percentages of fatty acid residues refers to fatty acids bound as acyl groups in glycerides in the fat composition and being based on the total weight of C4 to C24 fatty acid residues bound as acyl groups present in the fat composition.

24. The meat analogue composition according to any preceding claim, wherein the fat composition comprises from 20% to 85% by weight of saturated fatty acid residues; from 5% to 50% by weight of stearic acid residues (C18:0); from 2 to 35% by weight of linoleic acid residues (C18:2); and from 1 to 15% by weight of α -linolenic acid residues (C18:3); from 10 to 35% by weight of lauric acid residues (C12:0), 10% being excluded; wherein said percentages of fatty acid residues refers to fatty acids bound as acyl groups in glycerides in the fat composition and being based on the total weight of C6 to C24 fatty acid residues bound as acyl groups present in the fat composition.

25. The meat analogue composition according to any preceding claim, wherein the fat composition comprises from 10% to 50% by weight of saturated fatty acid residues; from 5% to 50% by weight of stearic acid residues (C18:0); from 5 to 35% by weight of linoleic acid residues (C18:2); and from 1 to 15% by weight of α -linolenic acid residues (C18:3); wherein

said percentages of fatty acid residues refer to fatty acids bound as acyl groups in glycerides in the fat composition and being based on the total weight of C6 to C24 fatty acid residues bound as acyl groups present in the fat composition.

26. The meat analogue composition according to any preceding claim, wherein the fat composition comprises an interesterified blend of vegetable oil and fully hydrogenated vegetable oil; preferably, wherein the fat composition comprises (a) from 5% to 95% by weight of the fat composition of a blending vegetable oil and (b) from 5% to 95% by weight of the fat composition of the interesterified blend of vegetable oil and fully hydrogenated vegetable oil.

27. The meat analogue composition according to any preceding claim, wherein the fat composition comprises (a) a fat composition as defined in Claim 26; and (b) (i) a blend of a liquid vegetable oil and a fully hydrogenated liquid vegetable oil, or (ii) a blend of a liquid vegetable oil and a vegetable oil stearin; preferably, wherein the liquid vegetable oil of (b) (i) or (b) (ii) comprises rapeseed oil; the fully hydrogenated liquid vegetable oil of (b) (ii) comprises fully hydrogenated rapeseed oil; and/or the vegetable oil stearin of (b) (ii) comprises palm stearin.

28. The meat analogue composition according to any of the preceding claims, wherein the fat composition is present in the meat analogue composition in an amount of from 5% to 40%, preferably from 10 to 25% by weight, by weight of the meat analogue composition.

29. The meat analogue composition according to any preceding claim, wherein the non-animal protein comprises protein derived from fungi, plants, bacteria or a combination thereof.

30. The meat analogue composition according to any preceding claim, wherein the nonanimal protein comprises plant protein, preferably, wherein the plant protein is selected from algae protein, black bean protein, canola wheat protein, chickpea protein, fava protein, lentil protein, lupin bean protein, mung bean protein, oat protein, pea protein, potato protein, rice protein, soy protein, sunflower seed protein, wheat protein, white bean protein, and protein isolates or concentrates thereof.

31. The meat analogue composition according to any preceding claim, wherein the nonanimal protein comprises seitan, rice protein, mushroom protein, legume protein, tempeh, yam flour, tofu, mycoprotein, peanut flour, yuba, or a combination thereof.

32. The meat analogue composition according to any preceding claim, wherein the nonanimal protein comprises methylococcus, hydrogenotropic bacteria, Heme-containing protein, or a combination thereof.

33. The meat analogue composition according to any preceding claim, wherein the nonanimal protein comprises texturized vegetable proteins, preferably wherein the texturized vegetable proteins comprise texturized pea proteins, texturized fava proteins, or a combination thereof.
- 5 34. The meat analogue composition according to any preceding claims, wherein the non-animal protein is present in the meat analogue composition in an amount of from 5 to 30% by weight, preferably from 10 to 30% or from 15 to 25% by weight, of the meat analogue composition.
- 10 35. The meat analogue composition according to any preceding claims, wherein water is present in the meat analogue composition in an amount of from 20 to 70% by weight, preferably from 20 to 50% by weight, of the meat analogue composition.
36. The meat analogue composition according to any preceding claim, wherein the meat analogue composition comprises a stabilizer blend.
- 15 37. The meat analogue composition according to Claim 36, wherein the stabilizer blend is present in the meat analogue composition in an amount of from 2% to 20%, preferably from 5 to 10%, by weight of the meat analogue composition.
38. The meat analogue composition according to Claim 36 or Claim 37, wherein the stabilizer blend comprises vegetable derived protein, vegetable fibre and a polysaccharide; preferably, wherein the vegetable derived protein comprises pea protein, the vegetable fibre comprises pea fibre, and the polysaccharide comprises methylcellulose.
- 20 39. The meat analogue composition according to any preceding claim, wherein the meat analogue composition comprises one or more flavouring additives, preferably wherein the one or more flavouring additives are present in an amount of from 0.5% to 5% by weight of the meat analogue composition.
- 25 40. The meat analogue composition according to any of the preceding claims, wherein the meat analogue composition comprises one or more colouring additives, wherein the one or more colouring additives are present in an amount of from 0.5% to 5% by weight of the meat analogue composition.
- 30 41. The meat analogue composition according to any preceding claim, wherein the composition further comprises one or more of: i) polysaccharides and/or modified polysaccharides, preferably selected from methylcellulose, hydroxypropyl methylcellulose, carboxymethyl cellulose, maltodextrin, carrageenan and salts thereof, alginic acid and salts

thereof, agar, agarose, agaropectin, pectin and alginate; ii) hydrocolloids; and iii) gums, preferably selected from xanthan gum, guar gum, locust bean gum, gellan gum, gum arabic, vegetable gum, tara gum, tragacanth gum, konjac gum, fenugreek gum, and gum karaya.

42. The meat analogue composition according to any preceding claim, wherein the meat analogue composition further comprises an ionic or non-ionic emulsifier, a polyhydroxy compound, milk, alcohols, humectants, honey, liquid preservatives, liquid sweeteners, liquid oxidizing agents, liquid reducing agents, liquid anti-oxidants, liquid enzymes, milk powder, hydrolysed protein isolates (peptides), amino acids, yeast, sugar substitutes, starch, salt, spices, fibre, thickening agents, egg powder, enzymes, gluten, vitamins, preservatives, sweeteners, oxidizing agents, reducing agents, and anti-oxidants.

43. The meat analogue composition according to any preceding claim, wherein the meat analogue composition is substantially free of animal protein, preferably, wherein the meat analogue composition is free of animal protein.

44. The meat analogue composition according to any preceding claim, wherein the meat analogue composition is substantially free of animal-derived products, preferably, wherein the meat analogue composition is free of animal-derived products.

45. The meat analogue composition according to any preceding claim, wherein the meat analogue composition is free of hydrogenated oils.

46. The meat analogue composition according to any preceding claim, wherein the meat analogue composition is free of sal butter, heme-containing protein, iron salt, transgenic plant cells, added lactic acid producing bacteria, fungal cell, alkali ingredients or any combination thereof.

47. The meat analogue composition according to any preceding claim, wherein the meat analogue composition is substantially free of animal-derived products, preferably, wherein the meat analogue composition is free of animal-derived products.

48. The meat analogue composition according to any preceding claim, wherein the meat analogue composition further comprises one or more animal-derived products such as animal oils, marine oils, animal-derived proteins, animal-derived polysaccharides, or any combination thereof.

49. The meat analogue composition according to Claim 48, wherein the one or more animal-derived products comprise animal milk proteins, animal milk fats, or a combination

thereof.

50. The meat analogue composition according to Claim 48 or Claim 49, wherein the one or more animal-derived products are present in the meat analogue composition in an amount
5 of from 1% to 20% by weight of the meat analogue composition.

51. A food product comprising a meat analogue composition according to any preceding claim.

52. The food product according to Claim 51, wherein the food product is an uncooked food
10 product, a cooked food product, or a partially cooked food product.

53. The food product according to claim 51 or 52, wherein the food product is a vegetarian or vegan substitute food product.

54. The food product according to any one of claims 51 to 53, wherein the food product is a meat substitute food product or a seafood substitute product.
15

55. The food product according to claim 54, wherein the meat substitute food product is a burger, sausage, pepperoni, meat ball, nugget, patty, mince product, chicken breast, meatloaf, bacon, steak, whole muscle, cold cuts, or other product intended to mimic conventional meat-based food products.
20

56. The food product according to claim 54, wherein the seafood substitute food product is a calamari analogue product; crustacean product such as a prawn analogue product, a lobster analogue product, a crab analogue product, a crabstick analogue product, a scampi analogue product; or a fish analogue product such as a fish cake or a fish filet; or other product
25 intended to mimic conventional meat-based food products.

57. Use of one or more encapsulated acidic ingredients as a juiciness agent in a meat analogue composition.

58. Use according to Claim 57, wherein the use further comprises using the fat matrix or
30 coating to improve juiciness of the meat analogue composition when cooked when compared to an analogous meat analogue composition comprising acidic ingredients as such, and/or an analogous meat analogue composition not comprising acidic ingredients.

59. Use of one or more encapsulated acidic ingredients as a mouthfeel agent in a meat

analogue composition.

60. Use according to claim 59, wherein the use further comprises using the fat matrix or coating to improve the mouthfeel of the meat analogue composition when cooked when compared to an analogous meat analogue composition comprising acidic ingredients as such, and/or an analogous meat analogue composition not comprising acidic ingredients.

61. Use of one or more encapsulated acidic ingredients as a tenderness agent in a meat analogue composition.

62. Use according to claim 61, wherein the use further comprises using the fat matrix or coating to further provide improved tenderness of the meat analogue composition when cooked when compared to an analogous meat analogue composition comprising acidic ingredients as such, and/or an analogous meat analogue composition not comprising acidic ingredients.

63. Use according to any one of claims 57 to 62, wherein the use further comprises using the meat analogue composition in a food product.

64. Use according to any one of Claims 57 to 63, wherein the use further comprises using the fat matrix or coating to substantially reduce, inhibit or prevent interaction of the one or more encapsulated acidic ingredients in the meat analogue composition prior to cooking of the meat analogue composition.

65. A process of manufacturing a meat analogue composition according to any one of Claims 1 to 50, or a food product according to any one of Claims 51 to 56, wherein the process comprises: combining water; non-animal protein; the fat composition; one or more acidic ingredients being optionally encapsulated; and optionally one or more additional components so as to form the meat analogue composition; and optionally forming the meat analogue composition into food products.

66. The process according to Claim 65, wherein the process comprises:

- a) providing a mixture of water; non-animal protein; and optionally one or more additional components;
- b) combining the mixture from step (a) with the fat composition and one or more acidic ingredients so that the acidic ingredients are encapsulated within a fat matrix of the fat composition; or combining the mixture from step (a) with the fat composition and one or more encapsulated acidic ingredients already coated by a coating; and

c) optionally forming the meat analogue composition into food products.

67. The process according to Claim 65, wherein the process comprises:

- 5 (i) providing a mixture of water; non-animal protein; one or more encapsulated acidic ingredients already coated by a coating and optionally one or more additional components;
- (ii) combining the mixture from step (a) with the fat composition to form the meat analogue composition; and
- (iii) optionally forming the meat analogue composition into food products.

10 68. The process according to any one of claims 65 to 67, wherein before the combining step b) or ii), the fat composition and optionally the one or more encapsulated acidic ingredients are heated at a temperature of from 26 to 50°C, preferably from 30 to 45°C and advantageously from 35 and 45°C.

15 69. The process according to any one of claims 65 to 67, wherein before the combining step b) or ii), the fat composition and optionally the one or more encapsulated acidic ingredients are cooled down at a temperature of from -5 to 15°C, and preferably from 0 to 10°C.

20 70. The process according to any one of claims 65 to 67, wherein before the combining step b) or ii), the fat composition and optionally the one or more encapsulated acidic ingredients are kept at ambient temperature.

71. The process according to any one of Claims 65 to 70, wherein the process further comprises cooking the food product to form a cooked food product or partially cooked food product.

25 72. A non-animal derived fat composition comprising one or more acidic ingredients present in an amount of from 0.25% to 95% by weight of the fat composition, wherein the acidic ingredients are optionally encapsulated.

30 73. The non-animal derived fat composition according to Claim 72, wherein the one or more acidic ingredients are present in the fat composition in an amount of from 0.5% to 90% by weight of the fat composition; preferably wherein the one or more acidic ingredients are present in the fat composition in an amount of from 0.5% to 40% by weight of the fat composition; or wherein the one or more acidic ingredients are present in the fat composition in an amount of from 40% to 69% or 75 to 90% by weight of the fat composition.

74. The non-animal derived fat according to Claim 72 or Claim 73, wherein the one or more acidic ingredients are as defined in any one or more of Claims 1 to 20, and/or wherein the fat composition is as defined in any one or more of Claims 21 to 28.
75. The non-animal derived fat according to any one of Claims 72 to 74, wherein the one
5 or more acidic ingredients are dispersed within a fat matrix of the fat composition.