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(54) **Title:** EDIBLE FAT-CONTAINING PRODUCTS HAVING A WATER PHASE AND A FAT PHASE WHEREIN THE FAT PHASE IS COMPOSED OF OIL AND STRUCTURING FAT FULLFILLING CERTAIN FATTY ACID COMPOSITIONAL CRITERIA

(57) **Abstract:** Edible fat-containing product comprising an aqueous phase and 20-50 wt.% of a fat phase, wt.% calculated on the total weight of product, wherein the fat phase comprises a liquid vegetable oil and 20-75 wt.% of a structuring fat, wt.% calculated on the fat phase, wherein the fat phase comprises triglycerides in which the product of the sum of stearic (S) and palmitic acid (P) with glyceroltristearate (SSS) [(P+S)*SSS], all in wt.%, is more than 8.

Title:

EDIBLE FAT-CONTAINING PRODUCTS HAVING A WATER PHASE AND A FAT PHASE WHEREIN THE FAT PHASE IS COMPOSED OF OIL AND STRUCTURING FAT FULLFILLING CERTAIN FATTY ACID COMPOSITIONAL CRITERIA

Field of the invention

[0001] The present invention relates to edible fat-containing products, such as a low-fat margarine, and methods for their preparation.

Background of the invention

[0002] Food compositions comprising fats and oils such as spreads, margarine and the like, whether in the form of water in oil (w/o) or oil in water (o/w) emulsions, typically contain blends of structuring fats or solid fats and oil (often vegetable oil). The structuring or solid fat provides the structure and texture to the resulting oil and water emulsion by crystallisation of the triglycerides in the blend. Typically, structuring fats contain more saturated and longer-chain fatty acids. Vegetable oils typically contain more unsaturated fatty acids and are usually liquid at room temperature. In order to incorporate suitable amounts of fats and oils in consumer products like spread and margarines, blends are made from solid fats (structuring fats) and oils wherein the solid fat (also known in the art as hard stock) provides the structure to incorporate oil into the emulsion.

[0003] Hydrogenation is a process of hardening fats and oils by converting unsaturated fatty acids in fats and oils to saturated fats. Hardening of fats is an efficient way of improving the structuring properties of fat and oils. Hydrogenation is perceived by consumers as a non-natural way of adapting fat compositions. Hydrogenation of fats to improve the structure of the resulting fat is less preferred as consumers are increasingly focused on having products that have a more natural origin. Regulatory authorities require that products containing hydrogenated fats are labelled. Incomplete or partial hydrogenation also results in products having increased levels of trans-fatty acids. Trans-fatty acids are considered less desirable in view of health considerations. There is hence also a need for fat blends that have a low content of trans-fatty acids.

[0004] For an edible fat-containing emulsion, ideally the structuring fat has such properties that it melts or dissolves at mouth temperature. Otherwise the product may have a heavy and/or waxy mouthfeel. An important indicator is the temperature at which a spread (i.e. a water in oil emulsion) breaks up in the mouth. Preferably this ‘break up temperature’ is below the in-mouth temperature. Furthermore, the overall organoleptic impression should be smooth and preferable no perceivable grains should be present upon ingestion as this may result in what is generally known as a ‘sandy mouthfeel’.

[0005] Other important aspects of an edible fat-continuous spread are for example hardness, spreadability, storage stability and ability to withstand temperature cycling. Temperature cycling means that the product is subjected to low and high temperatures (e.g. when the consumer takes the product out of the refrigerator and leaves it for some time at the table prior to use). This may have a negative influence on the structure of the spread (like for example destabilization of the emulsion, oil-exudation or crystal growth).

[0006] Generally, edible fat-continuous food products like for example margarines and similar edible fat-continuous spreads are prepared according to known processes that encompass the following steps:

1. Mixing of the liquid oil, the structuring fat and if present the aqueous phase at a temperature at which the structuring fat is liquid;
2. cooling of the mixture under high shear to induce crystallization of the structuring fat to create an emulsion;
3. formation of a fat crystal network to stabilize the resulting emulsion and give the product some degree of firmness;
4. modification of the crystal network to produce the desired firmness, confer plasticity and reduce the water droplet size.

These steps are usually conducted in a process that involves apparatus that allow heating, cooling and mechanical working of the ingredients, such as the churn process or the votator process. The churn process and the votator process are described in the Ullmans Encyclopaedia, Fifth Edition, Volume A 16, pages 156-158. The choice of fats that can practically be used as structuring agent may be limited. If the melting point of the structuring agent is too high the melting properties in the mouth are unsatisfactory. If on the other hand, the melting point is too low, the emulsion stability will be negatively affected.

[0007] Alternative processes have been described wherein the structuring fat is added as fat powder (i.e. crystallized fat or fat crystals) thereby eliminating the need to heat the whole composition to above the melting temperature of the structuring fat.

[0008] A major source of structuring fats is palm oil-based. The use of palm oil, high in saturated C16 (C16:0, palmitic acid) or enriched fractions thereof lies under scrutiny in view of the environmental demand that palm oil exerts. Hence there is a desire to use less palm oil based ingredients and the desire for using other sources of vegetable fats for structuring fats increases. Examples are the use of other plant-based fats like shea.

[0009] In general, a structuring fat has a high content of saturated fatty acids. Conventional (palm-based) structuring fats or hard stocks have a high saturated content such as in the form of POP (palmitic-oleic-palmitic), PPO (palmitic-palmitic-oleic) or SOS (stearic-oleic-stearic) triglycerides. Structuring fats having a high saturated content suffer from what is known in the art as graininess or sandiness, an unpleasant mouthfeel and appearance. The effect is

attributed to the formation of fat crystals. Products that express these effects generally experience a lower consumer acceptance level.

[0010] The present inventors have set out to develop products comprising triglyceride fats that lead to edible products that meet the above requirements, while at the same time having an increased level of saturation desired for structuring the products and providing stable products that have a good stability and spreadability over time. Based on these fats, structuring fats or hard stock fats can be developed that are suitable for the development of adequate consumers products such as margarines, spreads etc.

[0011] While increased levels of saturated fatty acids improve the structuring effect of structuring fats, there is also a desire to reduce the relative amount of saturated fatty acids in food products in favour of unsaturated fatty acids in view of general healthcare issues attributed to diets high in saturated fats.

[0012] Thus there remains a need for products that contain structuring fats that are capable of pairing a lower content of saturated fatty acids with the same or improved structuring properties compared to conventional structuring fats. At the same time sandiness, graininess or waxiness experiences are to be avoided in the resulting consumer products together with low levels of trans fat and enhanced stability and spreadability.

Summary of the invention

[0013] The present inventors have found that novel structuring fats can be used in the formulation of fat blends that find application in a variety of consumers products, such as low fat spreads. The fat blends may have a reduced need for structuring fats while maintaining at least structural similarity to conventional (palm-oil and palm oil-derivative containing) products in terms of spreadability and emulsion stability properties. The fat blends containing these structuring fats can also incorporate more liquid oil than conventional (palm-oil and palm oil-derivative containing) products. The fat blends can contain a lower amount of saturated fatty acids compared to conventional (palm-oil and palm oil-derivative containing) products. The inventors have also found that the novel structuring fats and the ensuing application thereof in edible fat containing emulsions leads to products that have an improved mouthfeel and reduced risk of sandiness, graininess and/or waxiness and have an enhanced stability over time.

[0014] The present inventors have found that newly developed structuring fats containing structuring components having long-chain saturated fatty acids (H), such as S, stearic acid and P, palmitic acid, on the triglyceride backbone in specific amounts and ratios, provide for fat blends and products that meet the above criteria and result in edible fat-containing products such as spreads and margarines. The edible fat-containing products can have improved (lower) level of trans fatty acids, and can be made from non-palm and non-

hydrogenated fats and oils. The edible fat-containing products are applied in applications such as spreads and margarines. It was found that the structuring fats lead to fat blends that, in spite of a different composition compared conventional palm-based hard stock fats, can be processed under conventional processing conditions, yet lead to stable emulsion products (such as spreads and margarines) that have good organoleptic properties, stability taste and texture. The fats used in the invention can be characterised by a relative high level of SSS (glyceroltristearate), a high level of stearic acid versus palmitic acid (C18:0/C16;) ratio and/or a melting profile (N-line) in which N20 and N25 are the most relevant parameters. Without being bound by theory, it is believed that the high level of stearic acid and expressed in these parameters is an indication of a more stable network that stabilises the oil and helps to protect the emulsion network compared to other fat blends. The resulting product expresses an improved cycling stability.

[0015] Some of the advantages of having these structuring fats and blends thereof available are that lower amounts of structuring fats can be needed and more liquid oil can be used in the preparation of applications for spreads and margarines and the like while stability and spreadability is maintained or improved. This further improves the naturalness of the resulting product, improves nutritional value and also reduces cost, the latter being a relevant factor in this field.

Detailed description of the invention

[0016] The term “oil” or “liquid oil” is typically used for triglyceride compositions that that are liquid at room temperature. The term “liquid oil” is used for triglycerides that are liquid at room temperature, preferably also liquid at temperature below room temperature such as below 15, 10 or 5° C. Preferably the solid fat content of the liquid oil is 0 at 20° C, more preferably it is 0 at 15° C.

[0017] The term “fat”, is typically used for triglyceride compositions that that are solid at room temperature. The use of the term “oil“ or “fat” is hence interchangeable depending on the circumstances that are clear and known in the art. A fat is typically used for structuring a fat composition, i.e. to provide a structure and texture in admixture with an oil or other fat. It can also be indicated as a structuring fat or hard stock fat The fat may comprise two or more different hard fats (a blend), but is preferably a single fat. The fat may be an interesterified mixture of one or more fats.

[0018] “Fat-containing product” is herein understood as a product containing a fat and/or oil. The terms “fat” and “oil” are used interchangeably. In general a “fat” is solid at standard ambient temperature and pressure and an oil is liquid under these conditions. An “aqueous phase” encompasses water and optionally any compounds that dissolve in water, whereas a

"fat phase" encompasses any edible oil or fat and optionally any compounds that dissolve in oil or fat.

[0019] A "margarine fat" is a fat blend which is suitable for use as a fat in spreads, both fat-continuous and water-continuous. Such a margarine fat usually includes a fat and a liquid oil.

[0020] The fat fraction can also be characterized by a triacylglyceride or TAG profile. In the TAG profile and throughout this application, the following abbreviations can be used:

Sh	Saturated Short chain fatty acid (C4-C10)
M	Saturated Medium chain fatty acid (C12-C14)
H	Saturated long chain fatty acid (C16-C18)
U	Unsaturated fatty acid
X	Any fatty acid (H, U or Sh)
P	Palmitic acid, C16:0
S	Stearic acid, C18:0
O	Oleic acid C18:1
L	Linoleic acid/linolenic acid, C18:2,C18:3
St	Saturated fatty acid
StStSt	Trisaturated glyceride
StU2	Monosaturated triglyceride
StUSt	Symmetrical saturated triglyceride
St2U	Disaturated triglyceride
HUH	Symmetrical long chain triglyceride
H2U	Disaturated long chain triglyceride
HU2	Monosaturated long chain triglyceride
U3	Unsaturated triglyceride
H3	Saturated Long chain fatty acid triglyceride
H2M	Mixed (2 long, 1 medium) chain fatty acid triglyceride
M3	Medium chain fatty acid triglyceride
SSS	Glyceroltristearate

[0021] In this specification all parts, proportions and percentages are by weight. The amount of fatty acids in an oil, fat or blend is based on the total amount of fatty acids in the oil, fat or blend. The amount of fat in a fat composition is based on the total weight of the fat composition. The amount of fat in a fat-containing product is based on the total weight of the fat-containing product. The amount of fatty acids in an oil, fat or blend at a specific position of the glycerol backbone is based on the total amount of fatty acids at the specific position of the glycerol backbone in the oil, fat or blend, unless otherwise stated.

[0022] The solid fat content (SFC) in this description and claims is expressed as N-value, essentially as defined in Fette, Seifen Anstrichmittel 80 180-186 (1978). The stabilisation profile applied is heating to a temperature of 80 °C, keeping the oil for at least 10 minutes at 60 °C. or higher, keeping the oil for 16 hours at 0 °C. and then 30 minutes at the measuring temperature, except where indicated otherwise.

[0023] Non-hydrogenated means that the fat or oil has not undergone hydrogenation treatment. This entails the fats as well as blends and interesterified mixtures of the fats. Non-hydrogenated fats have essentially no trans-fatty acids. Preferably the fat of the invention has less than 5 wt.%, preferably less than 2 wt.%, of trans fatty acids, more preferably less than 1 wt.%, 0.5, 0.1 wt.% or even 0 wt.% (non-detectable using analysis methods common in the art).

[0024] Conventionally partially hardened fat typically has as one of its disadvantages a relative high level of trans fat. Conventionally partially hardened fats are made by partial hydrogenation of an oil, typically a highly unsaturated oil. A highly unsaturated oil, such as sunflower oil, contains a high amount of unsaturated fatty acids (typically more than 90%), also at the 2-position. Partial hardening through hydrogenation is known to lead to the formation of trans-fatty acids, also at the 2-position. The structuring fat of the invention is obtained by transesterification or glycerolysis with saturated free fatty acids. This avoids trans-fat formation and leads to a fat that has an inherently lower trans-fat level.

[0025] In the known highly saturated fats, the fat has appeared to crystallize as coarse grains, which are unacceptable for a spread which ought to possess a smooth appearance and mouthfeel. Such effect is known in the art as sandiness or graininess.
In the case of sandiness, the particles have higher melting points, they do not melt so readily when rubbing them between the fingers. The well-known graininess consists of particles which also melt at relatively low temperature but the particle sizes are much smaller. It is known in the art that such effects are caused by fats that contain POP an PPO and in certain ratio's. By increasing the level of stearic acid overall and/or reducing the level of palmitic acid overall, the presence of POP, PPO and SOS is reduced. The resulting fat blend and edible fat containing products of the invention thus avoid or reduce the risk of sandiness or graininess. This is determinable for instance by mouthfeel or by microscopy.

[0026] Interesterification and transesterification are a methods for adapting the fatty acid composition of a fat composition.

[0027] Interesterification as used in the present disclosure and distinguished in the present disclosure from transesterification refers to the exchange of fatty acids between triglycerides in a triglyceride mixture. In interesterification, the total fatty acid composition of the triglyceride mixture remains substantially the same, yet the distribution of the fatty acids over the glycerol

backbone may be different. Interesterification typically results in a redistribution of the fatty acids over the glycerol backbone.

[0028] Transesterification, as used in the present disclosure and distinguished in the present disclosure from interesterification, refers to the exchange of fatty acids between fatty acids (or fatty acid esters) and triglycerides. In transesterification, the total fatty acid composition of the triglyceride mixture changes. Transesterification results in a different fatty acid composition of the triglyceride mixture.

[0029] Thus, in a first aspect, the invention relates to an edible fat-containing product comprising an aqueous phase and 20-50 wt.% of a fat phase, wt.% calculated on the total weight of product,
wherein the fat phase comprises a liquid vegetable oil and 20-75 wt.% of a structuring fat, wt.% calculated on the fat phase,
wherein the fat phase has one or more of

- the product of the sum of stearic and palmitic acid with glyceroltristearate [(P+S)*SSS] is more than 8;
- the product of the sum of the N20 and N25 with glyceroltristearate [(N20+N25)*SSS] is more than 5;
- the sum of H3 plus H2U triglycerides (H3 + H2U) is less than 6 wt.%;
- the amount of SSS (glyceroltristearate) is more than 0.50 wt.%
- the ratio of stearic and palmitic acid (P/S) is less than 2.6;
- the amount of P is less than 12 wt.% and/or the amount of S is more than 5 wt.%

wherein H is a saturated fatty acid having 16 or 18 carbon atoms, P is palmitic acid (C16:0) and S is stearic acid (C18:0).

Fats and oils

[0030] The fat phase is an essential element of the edible fat-containing product of the invention. Such a fat phase typically comprises edible fats and oils. There is a strong preference for non-hydrogenated fats and oils. Non-hydrogenated means that the fat or oil has not undergone any hydrogenation treatment. Preferably, the oils and fats in the fat phase contains at most 0.01 wt.% hydrogenated fat (wt.% drawn on the total fat phase), preferably no hydrogenated fat. This entails the starting fats and oils as well as blends and interesterified mixtures and even fractions of fats. Non-hydrogenated fats have essentially no trans-fatty acids.

[0031] The fat phase preferably comprises a sufficient amount of solid fat at low temperatures in order to yield a desired composition. Simultaneously, in order to instil desirable

organoleptic properties in terms of mouthfeel and appearance, the fat phase preferably essentially melts in the mouth upon consumption.

Sources of fat and oils

[0032] A suitable fat phase may be derived from many different fat sources. The fat phase of the edible oil-in-water or oil-in–water emulsion composition according to the present invention preferably comprises vegetable oil or vegetable fat or a combination thereof. It is preferred that the fat phase consists of vegetable oils and fats. The vegetable fats or oils may suitably be derived from coconut oil, rapeseed oil, linseed oil, soy bean oil, maize oil, sunflower oil, cotton seed, shea, cocoa butter, illipe butter or mixtures thereof. The fat phase of a product according to the invention may comprise a liquid oil fraction and a (solid) structuring fat.

Liquid oil fraction

[0033] The fat phase may comprise from 0 (absent) up to 99 wt.% of liquid oil, drawn on the fat phase. The liquid oil fraction can be an element of the fat phase of the fat-containing product of the invention. In embodiments, the amount of liquid oil varies between 10 and 95 wt.%, preferably between 15 and 90, 20-85, 25-75 wt.% liquid oil.

[0034] The liquid oil fraction can be selected from the group consisting of rapeseed oil, linseed oil, soy bean oil, maize oil, sunflower oil, or mixtures thereof, preferably selected from the group consisting of rapeseed oil, sunflower oil, linseed oil, cotton oil and mixtures thereof. There are embodiments in which there is no liquid oil and wherein the structuring fat hence constitutes the fat phase.

Structuring Fat

[0035] The structuring fat is an element of the fat phase of the edible composition. The fat phase may comprise from 5 to 90 (or 100) wt.% of structuring fat (wt.% calculated on the total weight of the fat phase). In certain embodiments from 20 to 60 wt.% (low fat spreads) and in certain other embodiments (high fat spreads) from 45 to 75 wt.%. The structuring fat used in the present invention can be a blend of fats and may be an interesterified blend of fats or a combination thereof. The structuring fat of the invention is characterized as having a high content of stearic acid and a relative low content of palmitic acid. The structuring fat is preferably a non-palm based fat and/or is free from hydrogenated fat or fat fractions.

[0036] Preferably, the structuring fat comprises an interesterified blend of a fat wherein one of the fats in the blend that is interesterified has a very high C18:0 content (>75, 80, 85, 90 or even 95 wt.% of the fatty acids are C18:0) and/or very low C16:0 content (<10 wt.% of the fatty acids are C16:0). This fat can be interesterified with another fat (such as coconut oil, shea and/or other vegetable oils such as sun flower) that can provide mid-range fatty acids

such as C12:0 and C14:0. An example thereof is described in WO20221620026. The advantage associated with the use of a first fat that is relative low in C16:0 and relative high in C18:0 is believed to reside in the increased capability of C18:0 of forming a structuring scaffold wherein the second fat that is interesterified with the feed stock to from the structuring fat can contain a higher amount of mid-range fatty acids to form the structuring fat to be used in fat blends of the spreads and wrappers of the invention. This is thought to lead to increased cycling stability of the resulting fat blends and/or the need for less structuring fat (and more oil) in the blend while still achieving the desired spread properties. A typical example of such a first fat is a fat that predominantly (more than 50, 60, 70, 80 or even 90 %) contains glyceroltristearate. From this first fat, structuring fats can be made that have a high content in S and also a high content in stearic acid on the SN2 position of the glycerol backbone. Also the amount of SSS is typically relatively high in these fats. These characteristics alone or in combination increase the structuring capacity of the resultant structuring fat.

[0037] Typically, the structuring fat used can contain from about 5 to 60 wt.% of C18:0. The structuring fat may further contain between 2 to 25 wt.% of C16:0. Preferably, the fats in the blend of fats to be interesterified are non-palm, non-hydrogenated. Preferably, the fat to be interesterified with the feed stock is a natural fat.

[0038] The fats resulting from the blend of the liquid oil and the structuring fat have advantageous properties in having a specific combination of structuring triglycerides that can be characterised in having one or more of the following characteristics:

- the product of the sum of stearic and palmitic acid with glyceroltristearate [(P+S)*SSS] is more than 8;
- the product of the sum of the N20 and N25 with glyceroltristearate [(N20+N25)*SSS] is more than 5
- the sum of H3 plus H2U triglycerides (H3 + H2U) is less than 6 wt.%;
- the amount of SSS (glyceroltristearate) is more than 0.50 wt.%
- the ratio of stearic and palmitic acid (P/S) is less than 2.6;
- the amount of P is less than 12 wt.% and/or the amount of S is more than 5 wt.%

[0039] In certain embodiments, the product of the sum of stearic and palmitic acid with glyceroltristearate [(P+S)*SSS] is more than 5, 7, 8, preferably more than 9 or 10. In certain embodiments, the product of the sum of stearic and palmitic acid with glyceroltristearate [(P+S)*SSS] is less than 20, preferably less than 18, 15, 12. This parameter is indicative and descriptive for the balance of long chain saturated fatty acids P and S, as well as the amount of SSS in the fats described herein. For instance, a relative low level of SSS can be to an extent compensated by a high level of S in other triglycerides, and relative high level of P can be compensated by a higher level of SSS. All elements of this formula (wt.% S, wt.% P and

wt.% SSS) are available through common analytical methods such as FAME, Carbon number analysis etc.

[0040] In certain embodiments, the product of the sum of the N20 and N25 with glyceroltristearate is more than 4, preferably more than 5, 6, 7 or 10. In certain embodiments, the product of the sum of N20 and N25 with glyceroltristearate [(N20+N25)*SSS] is less than 20, preferably less than 18, 15, 12.This parameter is indicative for the presence of a balance between the level of SSS as a structuring fat, with the values of N20 and N25 as an indicator of the hardness of the fat blend. For instance, a relative low level of SSS can be to an extent be compensated by a high level of other structuring triglycerides as indicated by a higher value of N20+N25 , and relative low value of N20+N25 can be compensated by a higher level of SSS. All elements of this formula (N20, N25 and wt.% SSS) are available through common analytical methods such as N-line determination, FAME, Carbon number analysis etc.

[0041] In certain embodiments, the sum of H3 plus H2U triglycerides (H3 + H2U) is less than 5 wt.%, preferably less than 4 wt.%, 3 wt.%, 2 wt.% . In certain embodiments, the sum of H3 plus H2U triglycerides (H3 + H2U) is more than 0.1 wt.%, preferably more than 0.5 wt.%, 1 wt.%, 2 wt.%, 3 wt.%. The sum of H3 plus H2U triglycerides is indicative of the amount of long chain saturated TAGs that are present in the fat. In the context of the present invention it should be relative low.

[0042] In certain embodiments, the amount of SSS (glyceroltristearate) is more than 0.5 wt.%, preferably more than 0.6 wt.%, 0.7 wt.%, 0.8 wt.%, 0.9 wt.%, 1 wt.%, 1.5 wt.%, 2 wt.%. In certain embodiments, the amount of SSS (glyceroltristearate) is less than 3 wt.%, preferably less than 2.5 wt.%, 2 wt.%, 1.5 wt.%. The amount of SSS is relevant for the formation of a structuring network that enhances the stability of the product.

[0043] In certain embodiments, the ratio of palmitic and stearic acid (P/S) is less than 2.5, preferable less than 2.2, less than 2, less than 1.5. Thus, the amount of S exceeds the amount of P in the fat blend. In certain embodiments, the ratio of stearic and palmitic acid (P/S) is more than 0.1, preferably more than 0.2, more than 0.5, more than 1, more than 1.5, more than 2.

[0044] In certain embodiments, the amount of P is less than 12 wt.%, preferably less than 10 wt.%, less than 9 wt.%, less than 8 wt.%, less than 7 wt.%. In certain embodiments, the amount of P is more than 1 wt.%, preferably more than 2 wt.%, 3 wt.%, 4 wt.%. A lower amount of P has a positive effect on the ratio of P/S and hence on the structuring capacity of the fat and hence the stability of the product.

[0045] In certain embodiments, the amount of S is more than 5 wt.%, preferably more than 6 wt.%, 7 wt.%, 8 wt.%. In certain embodiments, the amount of S is less than 15 wt.%, preferably less than 14 wt.%, 13 wt.%, 12 wt.%. A higher amount of S has a positive effect on

the ratio of P/S and hence on the structuring capacity of the fat and therefore on the stability of the product.

[0046] In an exemplary embodiment, the edible fat-containing product comprises an aqueous phase and 20-50 wt.% of a fat phase, wt.% calculated on the total weight of product, wherein the fat phase comprises a liquid vegetable oil and 20-75 wt.% of a structuring fat, wt.% calculated on the fat phase, wherein the fat phase comprises triglycerides in which the product of the sum of stearic (S) and palmitic acid (P) with glyceroltristearate (SSS) [(P+S)*SSS], all in wt.%, is more than 8.

[0047] In an exemplary embodiment, the edible fat-containing product comprises an aqueous phase and 20-50 wt.% of a fat phase, wt.% calculated on the total weight of product, wherein the fat phase comprises a liquid vegetable oil and 20-75 wt.% of a structuring fat, wt.% calculated on the fat phase, wherein the fat phase comprises triglycerides in which the product of the sum of the N20 and N25 (in %) with glyceroltristearate in wt.% [(N20+N25)*SSS], is more than 5, wherein the fat-containing product contains a plant-based protein in an amount of between 0.01 and 0.75 wt.%, wt.% calculated on the total amount of the product.

[0048] The method for the preparation of an edible fat-containing product according to the invention comprises the steps of:

- providing an aqueous component;
- providing a fat phase; and
- mixing the fat phase with the aqueous phase to obtain the edible fat-containing product.

Plant protein

[0049] In certain embodiments, the edible fat containing product may comprise a plant-based protein. A plant-based protein is obtained from plants, including parts such as fruits or seeds, leaves, stems, roots etc.

[0050] The plant-based protein of the present invention, has an average molecular weight in the range of 50-500 kDa (kiloDalton or a Molecular weight (SI-unit) of 50.000 to 500.000), preferably from 100-400 kDA, more preferably from 125-300 kDa. Typical plant-based protein differ from dairy-based protein in their Mw.

[0051] Edible fat-containing product according to any of the previous claims, wherein the plant-based protein is selected from plant-based protein is from Broad bean (*Vicia faba*), Chickpea (*Cicer arietinum*), Lentil (*Lens culinaris*), Canola (*B. napus subsp. napus*) and/or almond (Prunus dulcis, syn. Prunus amygdalus), preferably Broad bean (*Vicia faba*).

[0052] The plant-based protein can be isolated from the plant or parts thereof in the form of a plant-based protein isolate or concentrate. A plant-based protein isolate or concentrate

contains plant-based proteins but may also contain other plant-based elements, depending on the origin of the plant material and the method of obtaining the isolate or concentrate. The plant-based protein in the emulsion of the invention can be in the form of a plant-based protein itself or in the form of an isolate or concentrate comprising the plant-based protein. Thus, in a preferred embodiment of this element of the invention, the plant-based protein is in the form of an plant-based protein isolate or concentrate. Typically, the plant-based protein isolate or concentrate contains plant-based protein in an amount of 20-80 wt.%, but varies per type of plant. It was found that the protein (isolate or concentrate) was capable of providing desired and preferred characteristics to the water in oil emulsion of the invention.

[0053] In embodiments of the invention. wherein the plant-based protein is present in an amount of between 0.01 and 0.75 wt.%, wt.% calculated on the total amount of the product, preferably 0.02-0.6, 0.05-0.5, 0.1-0.4 wt.%

[0054] Good results in terms of the edible fat-containing product have been obtained with plant-based proteins or isolates from broad bean (*Vicia faba),* Chickpea (*Cicer arietinum*), Lentil (*Lens culinaris*), canola (*B. napus subsp. napus*) and/or almond (*Prunus dulcis, syn. Prunus amygdalus*) protein isolates, preferably in an amount of 0.01-1.5 wt.% protein isolate drawn on the total emulsion.

[0055] Therefore, the proteins included in the Edible fat-containing product preferably comprise (and more preferably (substantially) consist of) broad bean (*Vicia faba),* Chickpea (*Cicer arietinum*), Lentil (*Lens culinaris*), canola (*B. napus subsp. napus*) and/or almond (*Prunus dulcis, syn. Prunus amygdalus*) proteins. Preferably, the protein comprised in the edible fat-containing product substantially consists (up to 99 wt.%, drawn on the total amount of plant-based protein in the emulsion) of broad bean (*Vicia faba),* Chickpea (*Cicer arietinum*), Lentil (*Lens culinaris*), canola (*B. napus subsp. napus*) and/or almond (*Prunus dulcis, syn. Prunus amygdalus*) proteins.

[0056] It was found that that the edible fat-containing product could be prepared using the plant-based proteins described herein. The emulsions can be suitably used as a spread with the preferred plant-based proteins of broad bean (*Vicia faba),* Chickpea (*Cicer arietinum*), Lentil (*Lens culinaris*), canola (*B. napus subsp. napus*) and/or almond (*Prunus dulcis, syn. Prunus amygdalus*) where these proteins provide up to 60wt.% of the total protein fraction.

[0057] The use of plant- based proteins provided in increased spreadiblity and salt release vis-à-vis non-vegan or dairy-containing spreads.

Other ingredients

[0058] The fat-containing product according to the invention may contain other ingredients as well, such as emulsifiers, flavoring agents, coloring agents, salt, preservatives, etc. Emulsifiers may be selected from natural mono- and diglycerides, citric acid, lecithin, eggs,

carrageenan, guar gum, mustard, preferably non- synthetic esters of mono- and diglycerides, or combinations thereof. In some embodiments, emulsifiers are used that contain fatty acids are derived from palm oil and/or are hydrogenated. These amounts are typically low (< 2 wt.%). When reference is made to fats and oils being non-palm derived or non-hydrogenated, this does not include these type of emulsifiers (such as e.g. Dimodan). There is a preference for natural emulsifiers such as lecithin.

Examples

[0059] The invention is illustrated by the non-limiting examples and comparative examples described below.

Characterization of the starting components and products

[0060] The fats and products were analysed using the following analytical methods:

FA analysis

[0061] For starting fat or fat-containing products, the overall fatty acid analysis and the triglyceride composition are determined using conventional procedures in the art such as FAME analysis, GLC/Carbon number method and HPLC silver phase method such as described for example in EP78568 and EP652289.

Solid Fat Content (SFC) measurements

[0062] The solid fat content (SFC) in this description and claims is expressed as N-value, as defined in Fette, Seifen Anstrichmittel 80, 180-186 (1978). The stabilization profile applied is heating to a temperature of 80 degrees Celsius, keeping the oil for at least 10 minutes at 60 degrees Celsius or higher, keeping the oil for 1 hour at 0 degrees Celsius and then 30 minutes at the measuring temperature (tempered). An alternative method is described in IUPAC 2.150 method, serial, non-tempered.

Water Droplet Size Distribution of Spreads (D3,3 Measurement)

[0063] The normal terminology for Nuclear Magnetic Resonance (NMR) is used throughout this method. On the basis of this method the parameters D3,3 and exp(σ) of a lognormal water droplet size distribution can be determined. The D3,3 is the volume weighted mean droplet diameter and σ is the standard deviation of the logarithm of the droplet diameter. A D3,3 < 6 is acceptable for a low fat spread, but a D3,3 < 4 is preferred. A e-sigma of < 3 is desired.

[0064] The NMR signal (echo height) of the protons of the water in a water-in-oil emulsion are measured using a sequence of 4 radio frequency pulses in the presence (echo height E) and

absence (echo height E*) of two magnetic field gradient pulses as a function of the gradient power. The oil protons are suppressed in the first part of the sequence by a relaxation filter. The ratio (R=E/E*) reflects the extent of restriction of the translational mobility of the water molecules in the water droplets and thereby is a measure of the water droplet size. By a mathematical procedure—which uses the log-normal droplet size distribution—the parameters of the water droplet size distribution D3,3 (volume weighed geometric mean diameter) and σ (distribution width) are calculated. A Bruker magnet with a field of 0.47 Tesla (20 MHz proton frequency) with an air gap of 25 mm is used (NMR Spectrometer Bruker Minispec MQ20 Grad, ex Bruker Optik GmbH,DE).

Spreadability

[0065] Spreadability is determined according to the following protocol.
A flexible palette knife is used to spread a small amount of the spread on to fat free paper. The spreading screen is evaluated according to standardized scaling. A score of 1 represents a homogeneous and smooth product without any defects, a 2 refers to the same product but then with small remarks as slightly inhomogeneous or some vacuoles, a 3 refers to the level where defects become detectable and visible but are not unacceptable, like loose moisture or coarseness during spreading. A score of 4 or 5 refers to less acceptable products, where the 4 refers to a product still having some spreading properties, but a high level of defects.

Free Water

[0066] After spreading a sample of a fat spread, the stability of the emulsion after spreading is determined by using indicator paper (Wator, ref 906 10, ex Machery-Nagel, DE) which develops dark spots where free water is adsorbed. A stable product does not release any water and the paper does not change. Very unstable products release free water easily and this is indicated by dark spots on the paper.

[0067] A six point scale is used to quantify the quality of fat spread (DIN 10 311):

0 (zero) is a very stable and good product;

1 (one) is showing some loose moisture (one or two spots, or the paper changes a little in color as a total);

2 (two) as one but more pronounced;

3 (three) as one but to an almost unacceptable level;

4 (four) indicator paper is almost fully changing into a darker color;

5 (five) the paper changes completely and very fast into the maximum level of color intensity.

Spreads with a score of 4 or 5 are rejected for their stability. Spreads with a score of 0 or 1 show an acceptable quality with respect to free water.

Salt Release

[0068] The salt release is expressed as increasing of conductivity per degree Celsius. The salt release can be measured with a conductivity meter type H14321 (HANNA) according the following protocol.

[0069] A sample hold cell type ESE4-10-50PAMA (FESTO) is filled with 1.5 gram of the sample (5 degrees Celsius). The cell is placed above a heating plate (having a temperature of 250 degrees Celsius). A glass beaker (Scott Duran) provided with magnetic stirrer [4×200 mm] is filled with 150 gram water (5 degrees Celsius) and placed on a heating plate (stirring speed 600 rpm). Simultaneously the software controlled measurement is started (Raak Lab Informatics BV). When the water has reached a temperature of 20 degrees Celsius the sample is pushed out of the sample hold cell into the beaker automatically and the conductivity versus temperature will be measured every second. When the content of the beaker reaches 75 degrees Celsius the measurement is stopped. The measurement is done in duplicate. The results are incorporated in a graph of temperature versus conductivity. From this graph the temperature at which the conductivity starts to increase rapidly, indicating release of salt from the sample, is determined. The temperature at which the conductivity has increased 41 micro-s from the baseline is defined as the salt release temperature. Alternatively, salt release is determined qualitatively (1- good, 5 – unacceptable) by trained tasting panels.

Preparation of a spread

[0070] The fat phase and the aqueous phase were mixed and kept at 55-65 degrees Celsius. The mixtures was then passed through a series of scraped surface heat exchangers (A – units) and stirred crystallisers (C-units) at various speeds. The product leaving the last unit had a temperature of below 20 and in some occasions below 5-7 degrees Celsius. The product was filled in tubs or wrappers and stored at 5 degrees Celsius. A stable spread was obtained. Various products were prepared. The results are presented in Table 4.

Materials

[0071] The ingredients used to prepare the fat-containing products are all commercially free available compounds and compositions or are described in public documentation.

Structuring fat

[0072] The structuring fats used are blends of fats or interesterified blends of fats. The structuring fats may be combinations of palm-oil derived fats and oils with non-palm oil derived fats and oils. Some of the fats used may be hydrogenated.

Fat blends:

Table 1 Fat & oil fractions	
Abbreviation	**Fat fraction**
dfPOs	dry fractionated palm oil stearin
PK	Palm kernel oil
PO	Palm oil
mfPOs	Multiple fractionated palm oil stearin
dfSHf	dry fractionated Shea olein
GTS	Glyceroltristearate
CN	Coconut fat
PK39	Fully hydrogenated palm kernel oil
PO58	Fully hydrogenated palm oil
SF	Sunflower oil
RP	Rapeseed oil
LN	Linseed oil

Table 2 Fat blends (wt.%)			
	Structuring fat		Oil
#	Palm based	Non-palm based	RP
1	33 EIE* (65dfPOs/35PK)		67
2	22 EIE (50PO/10dfPOs/40PK)/9 EIE 35PK/65mfPOs14IV)		69
3	30 EIE (50PO/10dfPOs/40PK)/	3 CIE** (50GTS/50CN)	67
4	27 EIE (50PO/10dfPOs/40PK)/	5 CIE (50GTS/50CN)	68
5	22 EIE(50PO/10dfPOs/40PK)/9 EIE (40PO58/60PK39)		69
6	22 EIE (50PO/10dfPOs/40PK)/	9 CIE (50GTS/50CN)	69
7		19 CIE (20GTS/25SF/55CN)/7 CIE (50GTS/50CN)	74
8		35 CIE (20GTS/25SF/55CN)/5 CIE (50GTS/50CN)	60
9		22 CIE (20GTS/25SF/55CN)/9 CIE (50GTS/50CN)	69
10	55 CIE (33dfPOs/29PK/28dfSHf/10RP)		45
*EIE: Enzymatically interesterified			
**CIE: Chemically interesterified			

Table 3 Characteristics of Fat blends													
#	**H3**	**H2U**	**H3+H2U**	**P**	**S**	**P+S**	**SSS**	**P/S**	**(P+S) *SSS**	**N20**	**N25**	**N20+N25**	**SSS* (N20+N25)**
	wt.%												
1	3,34	6,31	9,65	16,84	2,50	19,33	0,003	6,74	0,06	8,90	5,00	13,90	0,04
2	2,46	4,87	7,33	14,83	2,32	17,15	0,002	6,38	0,03	8,30	6,20	14,50	0,02
3	1,24	4,76	6,00	12,57	3,67	16,23	0,314	3,43	5,10	5,30	2,90	8,20	2,58
4	1,40	4,42	5,82	11,81	4,51	16,31	0,523	2,62	8,53	5,70	3,50	9,20	4,81
5	1,91	3,64	5,55	11,88	5,18	17,05	0,570	2,29	9,72	7,90	4,60	12,50	7,12
6	1,75	3,88	5,62	10,56	6,21	16,77	0,940	1,70	15,76	8,30	4,80	13,10	12,32
7	1,19	1,85	3,05	5,10	8,45	13,55	0,945	0,60	12,80	4,20	2,00	6,20	5,86
8	1,23	2,40	3,63	5,55	10,59	16,15	0,917	0,52	14,81	6,30	3,30	9,60	8,80
9	1,49	1,99	3,48	5,25	9,93	15,18	1,188	0,53	18,04	8,20	4,70	12,90	15,32
10	2.47	8.78	11.25	15.71	6.86	0.12	22.57	2.29	2.71	11.1	6.2	17.30	2.15

Table 4 Experimental data on spreads						
	2 weeks	**2 weeks**	**2 weeks**	**B2 cycling**	**B2 cycling**	**B2 cycling**
#	Spreading	Free water	Oil exudation	Spreading	Free water	Oil exudation
1	1	1	1	5	5	5
2	1	1	1	5	5	5
3	1	1	1	5	5	4
4	1	1	1	5	5	4
5	1	1	1	2	1	1
6	1	1	1	2	1	2
7	1	1	1	4	3	3
8	2-3	1	1	1	1	1
9	1	1	1	1	1	1

Cycling stability: the product is stabilized for a set number of days at a temperature after which the temperature is varied per day over a period of 7 days. B2 and C3 cycles are preceded by B or C cycle, respectively (Table 4).

Table 4	Stabilization	Simulation (day)						
Module	14 days	1	1	1	1	1	1	1
B (°C)	15	25	25	15	15	15	15	10
B2 (°C)	5	25	5	25	5	25	5	10

Low fat Margarine

[0073] A margarine was prepared by blending a structuring fat with (a blend of) rapeseed, sunflower oil and/or linseed oil together (see Table 2) with other (minor) ingredients and water to result in 100 parts by weight of a product as shown below (Table 5). The product is subject to stability testing (B2- cycle).

Table 5	
Product	40% spread
Ingredients	g per 100g
Oil (SF/RP/LN)	See Table 2
Structuring fat	See Table 2
Emulsifiers	0,5
Fat soluble minors	0,1

Water	Up to 100
Starch	1,5
Salt	1,5
Water soluble minors	0,6

Plant-based Protein in spreads

[0074] Spreads were prepared containing dairy-based protein (BMP, butter milk powder) or plant-based protein based on the above recipe (the protein is calculated as part of the water phase). It was found that the palm-free fat blends (fat blend 8 and 9) replacing the palm-based fat blends (fat blend 10) led to stable spreads when tested after 2 weeks. The inclusion of dairy-based protein led to a loss of spreadability. Lowering the level of dairy protein improved spreadability but the taste was impaired. Substituting the dairy base protein with a plant protein at various levels improved the spreadability while maintaining salt release as an indicator of taste. Similar observations are achieved with 0.2 wt.% pea protein and 0.05 wt.% faba protein.

Table 6 The effect of plant-based proteins vs dairy based proteins in palm free spreads

# Fatblend (table 2)	Protein Source level, wt.%	Protein source	Spreadabiity	Free water	Oil exudation	Salt release
9	0	No protein	1	1	1	1
8	1	BMP	5	2	1	3
9	1	BMP	5	2	1	3
9	0,5	BMP	5	4	1	3
9	0,25	BMP	5	4	1	3
9	0,07	BMP	1	1	1	2
9	0,2	Faba	1	1	1	1
10	1	BMP	1	1	1	1

CLAIMS

1. Edible fat-containing product comprising an aqueous phase and 20-50 wt.% of a fat phase, wt.% calculated on the total weight of product,
wherein the fat phase comprises a liquid vegetable oil and 20-75 wt.% of a structuring fat, wt.% calculated on the fat phase,
wherein the fat phase comprises triglycerides in which the product of the sum of stearic (S) and palmitic acid (P) with glyceroltristearate (SSS) [(P+S)*SSS] , all in wt.% calculated on the fat phase, is more than 8.

2. Edible fat-containing product according to any of the previous claims, wherein the fat phase contains at least 5.10 wt.% of C16:0 (palmitic acid).

3. Edible fat-containing product according to any of the previous claims, wherein the fat phase contains at least 7 wt.%, preferably 10.6 wt.% of C16:0 (palmitic acid).

4. Edible fat-containing product according to any of the previous claims, wherein the fat phase comprises 45-60 wt.% of a structuring fat, wt.% calculated on the fat phase.

5. Edible fat-containing product according to claim 1, wherein the fat phase does not contain palm oil or palm oil-derived fractions.

6. Edible fat-containing product according to any of the previous claims, wherein the fat phase does not contain hydrogenated triglycerides or fractions thereof.

7. Edible fat-containing product according to any of the previous claims, wherein the sum of H3 plus H2U triglycerides (H3 + H2U) is less than 5.75 wt.%.

8. Edible fat-containing product according to any of the previous claims, wherein the amount of SSS (glyceroltristearate) is more than 0.5 wt.%.

9. Edible fat-containing product according to any of the previous claims, wherein the ratio of palmitic and stearic acid (P/S) is less than 2.6.

10. Edible fat-containing product according to any of the previous claims, wherein [(P+S)*SSS] is less than 20.

11. Edible fat-containing product according to any of the previous claims, wherein the fat phase contains less than 12 wt.% of C16:0 (palmitic acid).

12. Edible fat-containing product according to any of the previous claims, wherein the fat phase contains more than 5 wt.% of C18:0 (stearic acid).

13. Edible fat-containing product according to any of the previous claims, wherein the fat-containing product contains a plant-based protein.

14. Edible fat-containing product according to any of the previous claims, wherein the plant-based protein is selected from plant-based protein is from Broad bean (*Vicia faba),* Chickpea (*Cicer arietinum*), Lentil (*Lens culinaris*), Canola (*B. napus subsp. napus*) and/or almond (*Prunus dulcis, syn. Prunus amygdalus*), preferably Broad bean (*Vicia faba)*.

15. Edible fat-containing product according to any of the previous claims, wherein the plant-based protein is present in an amount of between 0.01 and 0.75 wt.%, wt.% calculated on the total amount of the product, preferably 0.02-0.6, 0.05-0.5, 0.1-0.4.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/076405

A. CLASSIFICATION OF SUBJECT MATTER

INV. A23D7/015 A23D7/00 A23D7/005 C11C3/08 C11C3/10
C12P7/6454 C12P7/6458
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A23D C12P C11C

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, FSTA, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	page 1, paragraph 2 - paragraph 8 page 3, paragraph 2 - page 5, paragraph 4 page 7 - page 12, paragraph 2 claims 1-18; examples 1-5,7	13-15
A	WO 2022/248578 A1 (UPFIELD EUROPE BV [NL]) 1 December 2022 (2022-12-01) paragraphs [0022], [0070]; claims 1-14; examples 1,3; table 1	1-15
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[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 November 2024	29/11/2024

Name and mailing address of the ISA/	Authorized officer
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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/076405

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	WO 2022/038290 A1 (UPFIELD EUROPE BV [NL]) 24 February 2022 (2022-02-24) page 3, line 4 - line 41 page 5, line 20 - page 13, line 30 claims 1-16; examples 4,5,10	1-15
A	WO 2022/162026 A1 (UPFIELD EUROPE BV [NL]) 4 August 2022 (2022-08-04) page 1 - page 15 claims 1-16	1-15

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Information on patent family members

International application No
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