Title of Invention: FOAMABLE OIL-IN-WATER EMULSION AND METHOD FOR PRODUCING SAME

Description

Technical Field

[0001] The present invention relates to a foamable (i.e. foaming) oil-in-water emulsion and a method of producing the same.

Background Art

[0002] A foamable oil-in-water emulsion, which is also called whipping cream because of its ease of whipping, has been utilized as a topping or filling material for confectionery production, bread production, and the like.

A typical foamable oil-in-water emulsion contains an oil and fat component at a high content ratio of 40 wt% or more, and hence can easily keep a stable emulsified state and is excellent in whipping property and shape-retaining property of whipped cream.

In addition, the foamable oil-in-water emulsion has been sometimes used in the following manner until now. That is, the emulsion after whipping is subjected to frozen storage and thawed at the time of its use to be directly used. In this case, work efficiency in preparation of a cake can be improved to enhance productivity.

[0003] In recent years, in association with, for example, increasingly health-conscious and increasingly budget-minded consumers, there has been a demand for a low-fat foamable oil-in-water

emulsion.

On the other hand, deliciousness of the foamable oil-in-water emulsion is felt through rich feeling of cream, mildness due to foaming (such as fluffy feeling and good aftertaste), and the like.

Of those, the rich feeling of cream tends to be felt more strongly as the content of the oil and fat component is higher.

In addition, the mildness due to foaming is also influenced by the amount of the oil and fat component. Foaming of the oil-in-water emulsion by agitation (i.e. stirring) means that air bubbles are caused to be trapped in the emulsion. Accordingly, as the amount of the oil and fat component increases, the emulsion can be more easily converted into a water-in-oil one, and its foaming property and shape-retaining property become more satisfactory.

Therefore, when only the amount of the oil and fat component is simply lowered in composition of raw materials for the existing high-fat foamable oil-in-water emulsion, the rich feeling of cream and the mildness due to foaming reduce to impair the deliciousness, and the shape-retaining property of whipped cream is impaired.

That is, the lowering of the fat content of the foamable oil-in-water emulsion tends to impair the foaming property (i.e. whipping property) and flower shape-forming property in preparation of whipped cream, and the deliciousness and shape-retaining property of the whipped cream.

[0004] Under the above-mentioned circumstances, up to now, the lowering of the fat content of the foamable oil-in-water emulsion

has been performed not by simply lowering only the amount of the oil and fat component, but by increasing amounts of a carbohydrate and the like to promote foaming of the raw materials except for the oil and fat component.

For example, Patent Literature 1 discloses a low-fat foamable oil-in-water emulsified fat containing 8 to 25 wt% of an oil and fat component and adjusted with a carbohydrate so as to contain 35 to 70 wt% of total solids. Patent Literature 1 also discloses that a preferred ratio of the carbohydrate in the emulsified fat is approximately 5 to 60%. Patent Literature 1 also discloses, as Example 3, an emulsified fat that contains 9.1% of an oil and fat component and 62.8% of total solids, and has an overrun of 130%.

The oil-in-water emulsified fat of Patent Literature 1 completely differs from the foamable emulsified fat that depends on the oil and fat component for its foaming property in that the former (i.e. the fat of Patent Literature 1) has a low content of the oil and fat component. Foaming of the raw materials except for the oil and fat component is promoted by adjusting the amounts of the total solids and the carbohydrate, to thereby compensate the insufficiency in foaming and weakness in rich feeling of cream (i.e. rich feeling of flavor) due to the low fat content.

However, the oil-in-water emulsified fat of Patent Literature 1 has a problem of bad aftertaste after ingestion (so-called heaviness in the mouthfeel), which is derived from the high content of the carbohydrate, and has room for improvement in palatability.

Citation List

Patent Literature

[0005] [Patent Literature 1] JP 62-22563 A

Summary of Invention

Problems to be Solved by Invention

[0006] An object of the present invention is to provide a foamable oil-in-water emulsion that, even though having low content ratios of a fat component and total solids, is excellent in foaming property, flower shape-forming property, shape-retaining property, rich feeling of flavor, and aftertaste (i.e. mouthfeel or texture), and moreover, is excellent in the above-mentioned characteristics (such as the foaming property) even after thawing in the case where the emulsion is subjected to frozen storage, and a method of producing the same.

Means for Solving the Problems

[0007] The inventors of the present invention have found that, even when an emulsion have low fat and solid contents (i.e. a content ratio of an oil and fat component of 8 to 22 wt% and a content ratio of total solids of 30 to 60 wt%), the following advantageous effects can be obtained by using sodium caseinate and an emulsifier, and have completed the present invention. That is, the overrun value of the emulsion, which is a value for evaluating whether or not

foaming property is good, can be enhanced to 200% or more. Satisfactory evaluations are obtained also for evaluation items other than the foaming property (i.e. flower shape-forming property, shape-retaining property, rich feeling of flavor, and aftertaste after ingestion, and these characteristics after thawing). Even when the emulsion is thawed after frozen storage, the above-mentioned characteristics can be satisfactorily maintained at comparable levels to those before the frozen storage.

[0008] The present invention provides the following items (1) to (4).

(1) A foamable oil-in-water emulsion having a content ratio (i.e. content percentage) of an oil and fat component of 8 to 22 wt% (i.e. weight %) and a content ratio of total solids of 30 to 60 wt%, the foamable oil-in-water emulsion including sodium caseinate (i.e. casein sodium) and an emulsifier, and having an overrun value in an optimal foamed state of 200% or more.

(2) The foamable oil-in-water emulsion according to the above-mentioned item (1), in which the content ratio of the sodium caseinate is 0.8 to 4.0 wt%.

(3) The foamable oil-in-water emulsion according to the above-mentioned item (1) or (2), in which the emulsion, when frozen after whipping and then thawed, maintains the same shape as that immediately after the whipping.

(4) A method of producing the foamable oil-in-water emulsion according to any one of the above-mentioned items (1) to (3), the

method including: an oil phase material-preparing step of preparing a material for forming an oil phase, which contains the oil and fat component and part of the emulsifier; an aqueous phase material-preparing step of preparing a material for forming an aqueous phase, which contains the sodium caseinate and the remaining part of the emulsifier; a mixing step of mixing the material for forming an oil phase and the material for forming an aqueous phase, followed by stirring to obtain a pre-emulsion; and a homogenization treatment step of subjecting the pre-emulsion to homogenization treatment to obtain the foamable oil-in-water emulsion.

Advantageous Effects of Invention

[0009] The foamable oil-in-water emulsion of the present invention (hereinafter sometimes referred to as "emulsion of the present invention"), even though having low content ratios of a fat component and total solids, is excellent in foaming property, flower shape-forming property, shape-retaining property, rich feeling of flavor, aftertaste (i.e. free of heaviness in the mouthfeel), and is excellent in the above-mentioned characteristics (i.e. foaming property, flower shape-forming property, shape-retaining property, flavor, and mouthfeel) and other characteristics (e.g., free of water separation) after thawing in the case where the emulsion is subjected to frozen storage. In particular, in the related art, the increased content of the carbohydrate and the like for improving foaming property results

in bad aftertaste after ingestion (i.e. heaviness in the mouthfeel) due to the high content of the carbohydrate. In contrast, in the present invention, palatability can be enhanced as compared to the related art without causing such heaviness in the mouthfeel.

In addition, the emulsion of the present invention is low in calories because of a low content ratio of the oil and fat component, and can have its production cost kept low. Hence, the emulsion of the present invention can satisfy demands of both health-minded and budget-minded consumers.

In addition, according to the method of producing the emulsion of the present invention, the emulsion of the present invention can be produced easily and efficiently.

Embodiments for Carrying Out Invention

[0010] Hereinafter, the present invention is described in detail, but the present invention is not limited to any individual embodiment to be mentioned below.

As used herein, the term "foamable oil-in-water emulsion" refers to a product that is obtained by stably dispersing an oil phase (i.e. oil droplets) formed of an oil component such as milk fat or plant fat in an aqueous phase through the use of an emulsifier and that can be foamed by stirring.

In addition, as used herein, the term "foamable oil-in-water emulsion" has a concept that encompasses both of a state before foaming and a state after foaming. For example, the concept of the

foamable oil-in-water emulsion encompasses all of a liquid emulsion before foaming, an amorphous (i.e. formless) emulsion after whipping, and a flower-shaped emulsion to be ingested (so-called whipped cream).

Examples of an oil and fat to be used as a raw material for the emulsion of the present invention include: animal-derived oils and fats such as lard, milk fat, fish oil, and fractionated oils, hydrogenated oils, and transesterified oils thereof; and plant-derived oils and fats such as palm oil, safflower oil, corn oil, rapeseed oil, coconut oil, and fractionated oils, hydrogenated oils, and transesterified oils thereof.

One kind of the oils and fats may be used alone, or two or more kinds thereof may be used in combination.

[0011] The content ratio of an oil and fat component in the emulsion of the present invention is preferably 8 to 22 wt%, more preferably 10 to 20 wt%, still more preferably 10 to 16 wt%, and particularly preferably 12 to 16 wt%. When the content ratio is less than 8 wt%, foaming property, flower shape-forming property, and shape-retaining property may reduce. When the content ratio is more than 22 wt%, a low fat content as one of the purposes of the present invention cannot be sufficiently achieved. The flavor, mouthfeel, nutrient content, and the like can be adjusted by adjusting the content ratio of the oil and fat component.

As used herein, the terms "oil and fat" and "oil and fat component" mean an "oil and fat as a raw material before the

preparation of the emulsion" and an "oil and fat component in the prepared emulsion," respectively.

[0012] As sodium caseinate to be used as a raw material for the emulsion of the present invention, a commercially available product of sodium caseinate may be used.

The content ratio of sodium caseinate in the emulsion of the present invention is preferably 0.8 to 4.0 wt%, more preferably 0.8 to 3.0 wt%, and particularly preferably 1.0 to 2.0 wt%. When the content ratio is 0.8 wt% or more, the foaming property, the flower shape-forming property, and the shape-retaining property improve more. When the content ratio is 4.0 wt% or less, the deterioration of flavor due to excessive addition of sodium caseinate can be certainly avoided.

[0013] As an emulsifier to be used as a raw material for the emulsion of the present invention, there may be used an emulsifier that is commercially available as a raw material for a foamable oil-in-water emulsion.

The kind and amount to be added of the emulsifier may be appropriately determined depending on the kinds and amounts to be added of other raw materials constituting the emulsion of the present invention.

The content ratio of the emulsifier in the emulsion of the present invention has only to be such that the overrun value of the emulsion is 200% or more and the flavor and the like of the emulsion are not impaired.

Specifically, the content ratio of the emulsifier in the emulsion of the present invention is preferably 0.1 to 5 wt%, more preferably 0.3 to 3 wt%, still more preferably 0.5 to 2 wt%, and particularly preferably 0.7 to 1.5 wt%. When the content ratio is less than 0.1 wt%, it is difficult to allow the overrun value of the emulsion to be 200% or more, even if the kinds and amounts to be added of the raw materials constituting the emulsion are selected appropriately. When the content ratio is more than 5 wt%, the cost of the emulsifier increases and the flavor of the emulsion may be impaired.

[0014] From the viewpoints of the foaming property, the flower shape-forming property, the shape-retaining property, and the like, preferred examples of the emulsifier include a higher fatty acid monoglyceride having an HLB (i.e. Hydrophile-Lipophile Balance value) of 7 or less, a sucrose fatty acid ester having an HLB of 7 or less (each of which may be used in any of an oil phase and an aqueous phase), a polyglycerin fatty acid ester having an HLB of 9 or more (which may be used only in the aqueous phase), and lecithin (HLB: 3 to 4) (which may be used only in the oil phase).

One kind of those emulsifiers may be used alone, or two or more kinds thereof may be used in combination.

In the present invention, from the viewpoints of the foaming property, the flower shape-forming property, the shape-retaining property, and the like, it is preferred to use two or more kinds of emulsifiers in combination for each of the aqueous phase and

the oil phase.

As a preferred example of the kind and amount to be added (i.e. content ratio in the emulsion; wt%) of the emulsion in the case where the content ratio of sodium caseinate in the emulsion of the present invention is 0.8 to 4.0 wt%, there is given a combination of 0.01 to 1.0 wt% of a higher fatty acid monoglyceride having an HLB of 7 or less, 0.01 to 1.0 wt% of a sucrose fatty acid ester having an HLB of 7 or less, 0.01 to 0.2 wt% of a polyglycerin fatty acid ester having an HLB of 9 or more, and 0.01 to 0.2 wt% of lecithin (HLB: 3 to 4). In this case, for each of the higher fatty acid monoglyceride and the sucrose fatty acid ester, one having a lower HLB (e.g., 4 or less) for the oil phase, and one having a higher HLB (e.g., 6 to 7) for the aqueous phase may be used in combination.

[0015] Examples of the other raw materials (except for water) to be used as the raw materials for the emulsion of the present invention include: a carbohydrate (e.g., sugar, starch syrup, powdered starch syrup, fructose, glucose, or isomerized sugar, or a syrup such as a liquid sugar thereof); a sugar alcohol (e.g., sorbitol, maltitol, xylitol, lactulose, or trehalose); a milk solid-containing substance (e.g., milk, skim milk, concentrated skim milk, skim milk powder, whey powder, and condensed milk); a food for enhancing taste (e.g., a solid, paste, or liquid food for enhancing taste except for the carbohydrate, the sugar alcohol, and the milk solid-containing substance, such as coffee, an egg, soy milk, or fruit juice); and other foods and food additives (e.g.,

a polysaccharide thickener, cellulose, an inorganic salt, and a flavoring).

One kind or two or more kinds of the other raw materials may be appropriately selected and used depending on the intended kind of the emulsion of the present invention.

[0016] In the present invention, any one or both of the carbohydrate and the sugar alcohol are preferably used as the other raw materials.

The content ratio of the carbohydrate or sugar alcohol in the emulsion of the present invention (which means a value in terms of solids when water is contained; and which means the total content ratio of the carbohydrate and the sugar alcohol when the carbohydrate and the sugar alcohol are used in combination) is preferably 5 to 40 wt%, more preferably 10 to 35 wt%, and particularly preferably 15 to 30 wt%. When the content ratio is 5 wt% or more, the foaming property, the flower shape-forming property, the shape-retaining property, rich feeling of flavor, and aftertaste (i.e. mouthfeel or texture after ingestion) can be improved more. When the content ratio is 40 wt% or less, the amount of water can be sufficiently secured, and hence the oil-in-water emulsion can be easily prepared.

[0017] In addition, in the present invention, the milk solid-containing substance is preferably used as the other raw material.

The milk solid-containing substance is preferably used in combination with the carbohydrate from the viewpoint of, for example,

improving the flavor of the emulsion of the present invention.

The content ratio of the milk solid-containing substance in the emulsion of the present invention (which is a value in terms of solids when water is contained) is preferably 0.5 to 10 wt%, more preferably 1 to 6 wt%, and particularly preferably 1.5 to 3 wt%. When the content ratio is 0.5 wt% or more, the flavor of the emulsion of the present invention becomes more satisfactory by virtue of the flavor derived from milk. When the content ratio is 10 wt% or less, the amounts of the other raw materials such as the carbohydrate can be sufficiently secured, and hence the oil-in-water emulsion as the object of the present invention can be easily prepared.

[0018] The total content ratio of the raw materials (such as a food for enhancing taste, cellulose, and flavoring) except for the oil and fat, sodium caseinate, emulsifier, carbohydrate, sugar alcohol, milk solid-containing substance, and water in the emulsion of the present invention is preferably 10 wt% or less, more preferably 5 wt% or less, and particularly preferably 2 wt% or less. When the content ratio is 10 wt% or less, the amounts of the other raw materials such as the carbohydrate can be sufficiently secured, and hence the oil-in-water emulsion as the object of the present invention can be easily prepared.

[0019] The term "total solids" in the emulsion of the present invention refers to all the components except for water.

The content ratio of the total solids in the emulsion of the present invention is 30 to 60 wt%, and preferably 30 to 50 wt%.

When the content ratio is less than 30 wt%, the foaming property, the flower shape-forming property, the shape-retaining property, the rich feeling of flavor, and feeling of chewing (i.e. mouthfeel) deteriorate. When the content ratio is more than 60 wt%, melt-in-the-mouth property after ingestion deteriorates.

The content ratio of water in the emulsion of the present invention is 40 to 70 wt%, and more preferably 50 to 70 wt%. The water in this case includes water in the milk solid-containing substance or the like when the milk solid-containing substance or the like contains water.

[0020] Next, a method of producing the emulsion of the present invention is described.

The method of producing the emulsion of the present invention (hereinafter sometimes referred to as "method of the present invention") includes: (A) an oil phase material-preparing step of preparing a material for forming an oil phase (hereinafter sometimes referred to as "oil phase-forming material"), which contains the oil and fat component and part of the emulsifier; (B) an aqueous phase material-preparing step of preparing a material for forming an aqueous phase (hereinafter sometimes referred to as "aqueous phase-forming material"), which contains sodium caseinate and the remaining part of the emulsifier; (C) a mixing step of mixing the oil phase-forming material obtained in Step (A) and the aqueous phase-forming material obtained in Step (B), followed by stirring to obtain a pre-emulsion; and (D) a homogenization treatment step

of subjecting the pre-emulsion obtained in Step (C) to homogenization treatment to obtain the foamable oil-in-water emulsion.

The method of producing the emulsion of the present invention may include, between Step (C) and Step (D), or after Step (D), (E) a heat pasteurization step of pasteurizing the pre-emulsion (before the homogenization treatment) or the emulsion (after the homogenization treatment) by heating.

Each step is described in detail below.

[0021] (Step (A); oil phase material-preparing step)

Step (A) is a step of preparing an oil phase-forming material containing the oil and fat component and part of the emulsifier.

The ratio of the emulsifier to be used in Step (A) in the total amount of the emulsifier to be used in the method of the present invention is preferably 40 to 95 wt%, more preferably 50 to 90 wt%, still more preferably 60 to 85 wt%, and particularly preferably 70 to 80 wt% from the viewpoint of making satisfactory the emulsified state of the emulsion to be obtained in Step (D).

Preferred examples of the emulsifier to be used in Step (A) include a higher fatty acid monoglyceride having an HLB of 5 or less, a sucrose fatty acid ester having an HLB of 5 or less, and lecithin (HLB: 3 to 4).

[0022] (Step (B); aqueous phase material-preparing step)

Step (B) is a step of preparing an aqueous phase-forming material containing sodium caseinate and the remaining part of the emulsifier.

The ratio of the emulsifier to be used in Step (B) in the total amount of the emulsifier to be used in the method of the present invention is preferably 5 to 60 wt%, more preferably 10 to 50 wt%, still more preferably 15 to 40 wt%, and particularly preferably 20 to 30 wt% from the viewpoint of making satisfactory the emulsified state of the emulsion to be obtained in Step (D).

Preferred examples of the emulsifier to be used in Step (B) include a sucrose fatty acid ester having an HLB of more than 5 and 7 or less and a polyglycerin fatty acid ester having an HLB of 9 or more.

[0023] (Step (C); mixing step)

Step (C) is a step of mixing the oil phase-forming material obtained in Step (A) and the aqueous phase-forming material obtained in Step (B), followed by stirring to obtain a pre-emulsion.

As a method of mixing the oil phase-forming material and the aqueous phase-forming material, there are given: a method involving adding the aqueous phase-forming material to the oil phase-forming material; a method involving adding the oil phase-forming material to the aqueous phase-forming material; a method involving feeding the oil phase-forming material and the aqueous phase-forming material simultaneously into a vessel; and the like.

By stirring the mixture of the oil phase-forming material and the aqueous phase-forming material under a specific liquid temperature, the pre-emulsion is obtained.

The liquid temperature of the mixture at the time of the stirring

is preferably 55 to 80°C, more preferably 60 to 75°C, and particularly preferably 65 to 70°C from the viewpoint of making satisfactory the emulsified state of the emulsion to be obtained in Step (D).

A stirring time has only to allow the formation of the pre-emulsion and varies depending on a stirring speed (rpm), but is preferably 1 minute or more, more preferably 2 minutes or more, still more preferably 3 minutes or more, and particularly preferably 4 minutes or more. When the stirring time is less than 1 minute, it may be difficult to obtain the pre-emulsion. The upper limit of the stirring time is preferably 20 minutes, and more preferably 15 minutes from the viewpoint of the efficiency of the treatment.

The pre-emulsification allows oil droplets of uniform size to be formed in the aqueous phase in Step (D).

[0024] (Step (D); homogenization treatment step)

Step (D) is a step of subjecting the pre-emulsion obtained in Step (C) to homogenization treatment to obtain the foamable oil-in-water emulsion.

The homogenization treatment may be performed through the use of a homogenizer.

A homogenizing pressure in the homogenization treatment is preferably 10 MPa or more, more preferably 14 MPa or more, and particularly preferably 18 MPa or more from the viewpoint of forming oil droplets of proper size in the aqueous phase. The upper limit of the homogenizing pressure is preferably 40 MPa, and more preferably 30 MPa from the viewpoint that no further improvement of the emulsified

state of the emulsion can be expected even when the homogenizing pressure is excessively increased.

The liquid temperature of the pre-emulsion at the time of the homogenization treatment is preferably 50 to 100°C, more preferably 60 to 90°C, and particularly preferably 70 to 80°C from the viewpoint of, for example, the efficiency of the homogenization treatment.

It should be noted that Step (D) may be performed after the pre-emulsion obtained in Step (C) has been subjected to heat pasteurization treatment in Step (E) to be described below.

[0025] (Step (E); heat pasteurization step)

Step (E) is a step of pasteurizing the pre-emulsion obtained in Step (C) or the emulsion obtained in Step (D) by heating.

Step (E) is preferably performed between Step (C) and Step (D) from the viewpoint that heating before the homogenization treatment allows the homogenization treatment to be efficiently performed.

The heating temperature is preferably 65 to 140°C from the viewpoint of, for example, sufficiently performing the pasteurization. The heating time, which varies depending on the heating temperature, is preferably 3 seconds (e.g., in the case of 140°C) to 30 minutes (e.g., in the case of 65°C).

The emulsion after the heat pasteurization is, for example, cooled to 10°C or less and stored.

[0026] The emulsion of the present invention is evaluated for whipping property (e.g., a period of time required to reach an optimal

foamed state and an overrun value) and properties of the emulsion after whipping (e.g., flower shape-forming property and shape-retaining property).

The period of time required to reach an optimal foamed state refers to (i.e. means) a period of time from the start of stirring to the time point at which the optimal foamed state is reached in the case where the emulsion of the present invention is foamed by stirring. The period of time varies depending on, for example, the temperature of the emulsion and the kind of stirring means. However, by measuring the period of time for each of a plurality of kinds of emulsions under the same conditions (such as the temperature of the emulsion and the kind of stirring means), it is possible to evaluate how good or bad the whipping properties of the plurality of kinds of emulsions are as compared to each other.

The optimal foamed state refers to a state in which the emulsion has reached its maximum volume by foaming.

[0027] The overrun value refers to a value calculated using the following formula:

$$(B-A)\times 100/A$$

where "A" represents the weight of the emulsion when the emulsion in its optimal foamed state is contained in a vessel at the same volume as that of the capacity of the vessel, and "B" represents the weight of the emulsion when the emulsion before foaming is contained in the vessel at the same volume as that of the capacity of the vessel.

It should be noted that the overrun value as defined in the present invention refers to an overrun value measured under normal temperature and normal pressure (20°C and 1 atm) under a state in which the temperature of the emulsion has been cooled to 5°C. The overrun value slightly varies depending on the temperature of the emulsion and an atmosphere (i.e. temperature and pressure).

[0028] The flower shape-forming property refers to a property of not losing shape or chipping away when the emulsion after whipping is formed into a desired shape (e.g., a shape resembling a flower).

The shape-retaining property refers to a property of retaining the shape of the emulsion before storage (e.g., flower-shaped emulsion) without losing shape or chipping away even after storage when the emulsion after whipping that has been formed into a desired shape (a shape resembling a flower) is stored under predetermined storage conditions such as refrigeration or freezing and then the storage is ended by thawing or the like.

Examples

[0029] Hereinafter, the present invention is described in detail by way of Examples. The present invention is not limited to Examples. Overrun values in Examples below were each measured under an atmosphere of 20°C and 1 atm for an emulsion cooled to 5°C.

(Example 1)

In 13 parts by weight of a plant oil and fat (i.e. hydrogenated palm kernel oil, melting point: 40°C) were dissolved 0.25 part by

weight of a higher fatty acid monoglyceride having an HLB of 4, 0.23 part by weight of a higher fatty acid monoglyceride having an HLB of 2.9, 0.23 part by weight of a sucrose fatty acid ester having an HLB of 1, and 0.08 part by weight of lecithin having an HLB of 3, to thereby prepare an oil phase-forming material.

In addition, the following ingredients were dissolved in 52.62 parts by weight of water to prepare an aqueous phase-forming material: 12 parts by weight of sugar, 10 parts by weight of starch syrup (solids: 75.6 wt%), 7 parts by weight of powdered starch syrup, 2 parts by weight of skim milk powder, 0.08 part by weight of common salt, 1.7 parts by weight of sodium caseinate, 0.17 part by weight of a sucrose fatty acid ester having an HLB of 6, 0.08 part by weight of a polyglycerin fatty acid ester having an HLB of 14.5, 0.28 part by weight of cellulose, 0.081 part by weight of a polysaccharide thickener, and 0.2 part by weight of a flavoring.

[0030] Next, the oil phase-forming material and the aqueous phase-forming material were mixed at 65 to 70°C to provide a mixture. The mixture was stirred at 70°C for 5 minutes using a propeller stirrer (product name: HOMO MIXER MARK II, manufactured by PRIMIX Corporation, stirring speed: 5,500 rpm) to provide a pre-emulsion.

The pre-emulsion was pasteurized by heating at 130°C for 4 seconds with a direct heat pasteurizer.

After that, the pre-emulsion was subjected to homogenization treatment with a homogenizer (product name: Homogenizer H70, manufactured by SANWA MACHINE CO., INC.) under a temperature of

70 to 80°C at a homogenizing pressure of 20 MPa to provide the emulsion of the present invention. The emulsion was immediately cooled to 10°C or less.

The emulsion after the cooling was analyzed and found to contain an oil and fat component at a ratio of 13 wt% and total solids at a ratio of 44.2 wt%.

Further, when the emulsion was foamed by stirring with a tabletop whipper (product name: Hobart mixer, manufactured by Hobart), the emulsion reached its optimal foamed state after 17 minutes from the start of the stirring. Its overrun value was 240%.

In addition, when the emulsion that had been whipped was squeezed using a whipping bag, its flower shape-forming property was satisfactory. The formed product obtained by the squeezing (flower-shaped emulsion) was refrigerated in a refrigerator at 5°C for 72 hours. As a result, the formed product after the refrigeration showed no change in shape, and was satisfactory in flavor (such as rich feeling) and mouthfeel (such as aftertaste) with no changes therein.

[0031] (Example 2)

The emulsion obtained in Example 1 (i.e. the emulsion before the stirring with the tabletop whipper) was continuously treated at the speed of revolutions of 490 rpm with a Mondo mixer (manufactured by Mondomix) together with air treated with a sterile filter to provide an emulsion that had been whipped.

The emulsion that had been whipped was analyzed and found to

contain an oil and fat component at a ratio of 13 wt% and total solids at a ratio of 44.2 wt%. Its overrun value was 240%.

In addition, the emulsion that had been whipped was refrigerated in a refrigerator at 5°C for 72 hours. As a result, as compared to the emulsion before the refrigeration, the emulsion after the refrigeration showed no change in shape, and was satisfactory in flavor (such as rich feeling) and mouthfeel (such as aftertaste) with no changes therein.

[0032] (Example 3)

The emulsion that had been whipped obtained in Example 2 was frozen until the temperature inside the emulsion reached -18°C. The emulsion was kept in the frozen state at -18°C for 3 weeks and then thawed by being kept in a refrigerator at 5°C for 48 hours. The emulsion after the thawing was analyzed and found to contain an oil and fat component at a ratio of 13 wt% and total solids at a ratio of 43.2 wt%. Its overrun value was 240%. As compared to the emulsion that had been whipped in Example 2, the emulsion after the thawing showed no change in shape, and was satisfactory in flavor (such as rich feeling) and mouthfeel (such as aftertaste) with no changes therein. In the emulsion after the thawing, water separation was not observed.

[0033] (Comparative Example 1)

An emulsion was obtained in the same manner as in Example 1 except that 1.7 parts by weight of water were used in place of 1.7 parts by weight of sodium caseinate.

The emulsion was analyzed and found to contain an oil and fat component at a ratio of 13 wt% and total solids at a ratio of 41.5 wt%.

In addition, when the emulsion was stirred with a whipper, even after a lapse of 17 minutes from the start of the stirring, foaming was insufficient and the emulsion did not reach a state suited for whipping. In other words, the emulsion did not reach its optimal foamed state and had no flower shape-forming property.

Industrial Applicability

[0034] The emulsion of the present invention is low in fat and low in calories, contains milk fat at a low ratio and hence can have its production cost kept low, and is satisfactory in foaming property, flower shape-forming property, shape-retaining property, rich feeling of flavor, and aftertaste (i.e. free of heaviness in the mouthfeel). Hence, the emulsion of the present invention can be eaten with high palatability by, for example, consumers who are both health-minded and budget-minded.

In addition, even after refrigerated storage or frozen storage, the shape-retaining property and flavor of the flower-shaped emulsion after whipping of the present invention are satisfactorily kept at comparable levels to those before the storage. Hence, the emulsion of the present invention can be suitably used as a material for a frozen food or the like.

The emulsion of the present invention can be used in the food

field such as cream that has been whipped and desserts utilizing the cream.

Claims

1. A foamable oil-in-water emulsion having a content ratio of an oil and fat component of 8 to 22 wt% and a content ratio of total solids of 30 to 60 wt%,

the foamable oil-in-water emulsion comprising sodium caseinate and an emulsifier, and having an overrun value in an optimal foamed state of 200% or more.

2. The foamable oil-in-water emulsion according to claim 1, wherein a content ratio of the sodium caseinate is 0.8 to 4.0 wt%.

3. The foamable oil-in-water emulsion according to claim 1 or 2, wherein the foamable oil-in-water mulsion, when frozen after whipping and then thawed, maintains the same shape as that immediately after the whipping.

4. A method of producing the foamable oil-in-water emulsion according to any one of claims 1 to 3, comprising:

an oil phase material-preparing step of preparing a material for forming an oil phase, which contains the oil and fat component and part of the emulsifier;

an aqueous phase material-preparing step of preparing a material for forming an aqueous phase, which contains the sodium caseinate and the remaining part of the emulsifier;

a mixing step of mixing the material for forming an oil phase and the material for forming an aqueous phase, followed by stirring to obtain a pre-emulsion; and

a homogenization treatment step of subjecting the pre-emulsion

to homogenization treatment to obtain the foamable oil-in-water emulsion.