

MILK-FLAVOR-ENHANCED LIPID, AND METHOD FOR ENHANCING MILK
FLAVOR IN FOOD AND BEVERAGE PRODUCTS

Technical Field

5 [0001]

The present invention relates to a milk flavor-enhanced fat and a method for enhancing a milk flavor of a food and beverage product.

10 Background Art

[0002]

A general method for enhancing a flavor derived from milk is to directly add fresh cream and butter, which are raw materials derived from milk, to a food and beverage product. For example, margarine is designed to be easily used compared with the butter by, for example, adjusting a kind of fats used, and conditions on cooling and kneading, according to the various applications and/or objects. However, in terms of the flavor derived from milk, margarine is often inferior to butter. Thus, an amount of the added butter may be increased to enhance the flavor derived from milk. However, such attempt inevitably increases the cost and may also adversely affect a physical property of the margarine.

25 [0003]

Therefore, in order to enhance the flavor derived from milk, various methods for producing a milk flavor agent have been disclosed including Non-Patent Document 1. However, almost all the methods are to hydrolyze a milk fat by a fatty acid degrading enzyme such as lipase and esterase. In addition, Patent Document 1 discloses a method for producing a butter flavor by two-stage enzymatic decomposition in order to reduce an oxidized odor and an irritating odor to produce a preferable butter flavor.

10 [0004]

Patent Document 2 discloses a method for producing a fat composition containing enriched lactones with focusing on lactones, a main constituent of milk-based flavor composition. Patent Document 3 discloses an oil feeling enhancer containing C13 to C18 lactones as an active ingredient. Patent Document 4 discloses a milk-based flavor composition containing lactones and at least one or more kinds of constituents selected from the group consisting of fatty acids and fat hydrolysate. Further, Patent Document 5 discloses a water-in-oil fat composition containing specific lactones and a lactic acid fermentation composition of an enzyme-treated product of a mixture of milk whey and cream.

25 Prior Art Documents

Patent Documents

[0005]

Patent Document 1: JP 2009-261339 A

Patent Document 2: WO 2013/105624 A

5 Patent Document 3: JP 2011-083264 A

Patent Document 4: JP 2005-015685 A

Patent Document 5: JP 2013-074904 A

Non-Patent Document

10 [0006]

Non-Patent Document 1: Journal of Japan food industry
association, Vol.29 (12), 1982

Summary of Invention

15 Problems to be Solved by Invention

[0007]

First, the inventors have reviewed the prior art
documents in detail.

The production method in Patent Document 1 discloses
20 that hydrolyzing a milk raw material by two or more kinds
of lipolytic enzymes enhances a butter flavor. However,
similar to the conventional methods, since contents of
lactones and ketones have been increased through the
hydrolysis, obtaining a well-balanced flavor has been
25 difficult. Although an initial taste and a middle taste

have been enhanced to some extent, it has been especially difficult to enhance rich aftertaste.

[0008]

The production method in Patent Document 2 discloses
5 that lactones can be enhanced by holding butter under a low water content and under a non-enzymatic mild condition. However, since a content of water by an amount to serve as a catalyst is indispensable for this reaction, and the holding period takes three days or more at the shortest,
10 this method has had poor production efficiency.

[0009]

The oil feeling enhancer of Patent Document 3 contains δ -C13 to C18 lactones as the active ingredient to enhance an oil feeling of the food and beverage product. This
15 increases palatability of food and beverage, especially, such as low-fat food and beverage product and low trans fatty acid food and beverage product, and enables to reduce an amount of use of fat in the food and beverage product. Thus, the Examples disclose that an addition of this oil
20 feeling enhancer to various fats increases oil feeling. However, the Examples neither suggest nor disclose an enhancement of a milk flavor.

A milk-based flavor composition disclosed in Patent Document 4 is a composition produced by combining
25 conventionally reported various constituents. Patent

Document 4 discloses that the use of this composition can increase palatability of a food and beverage product by giving a natural milk-like or butter-like flavor to the food and beverage product. However, this method requires combining considerably various kinds of constituents, and is not simple. Additionally, Patent Document 4 neither suggests nor discloses an effect of giving rich aftertaste when the composition is added to the food and beverage product. In addition, a milk fat originally contains a small amount of lactones. A poor storage condition may cause generating free fatty acids by oxidation and hydrolysis. Therefore, this method cannot distinguish between the milk fat and this composition.

[0010]

Patent Document 5 discloses that the water-in-oil fat composition containing the specific lactones and the lactic acid fermentation composition of the enzyme-treated product of the mixture of milk whey and cream has excellent flavor and rich taste and is especially excellent in a mouth-filling of the aftertaste. In addition, Patent Document 5 discloses that the specific lactones are prepared by adding the lactones to fat and then dissolving the lactones. The method of producing this composition requires using the specific lactones and the lactic acid fermentation composition of the enzyme-treated product of the mixture of

the milk whey and the cream in combination, and therefore, the method is complicated.

[0011]

Thus, the conventional butter flavors as disclosed in
5 the above-described prior art documents have been not able
to sufficiently reduce the free fatty acid generated by the
hydrolysis and a lower fatty acid with a carbon number of 6
or less that especially exhibits high volatility and causes
an irritating odor. A production process for a lactone-
10 containing composition was complex, and the effects to
enhance rich aftertaste and milk flavor have not been able
to be satisfied. Further, Patent Documents 2, 3, and 5
disclose only the specific lactones as the active
ingredient and neither suggest nor disclose an influence
15 caused by a coexistence with methyl ketones.

[0012]

That is, an object of the present invention is to
provide fat having a reduced deteriorated flavor and milk
flavor-enhanced fat by giving rich aftertaste without a
20 complicated process. Another object of the present
invention is to provide a food having rich aftertaste and
enhanced milk flavor without deteriorated flavor by using
this milk flavor-enhanced fat.

25 Means for Solving the Problems

[0013]

The inventors have intensively studied to solve the above-described problems. As a result, surprisingly, they have found that methyl ketones, which have been recognized to have an unpleasant flavor, unexpectedly generate a significantly excellent flavor by a coexistence with δ -lactones at a specific weight ratio. That is, the milk flavor-enhanced fat of present invention has been completed by adjusting a weight ratio of a total content of the δ -lactones to a total content of the methyl ketones to a specified amount, the total content of the δ -lactones to a specified amount or more, and adding a milk fat. The δ -lactones are a sum of δ -decanolactone, δ -dodecanolactone, δ -tetradecanolactone, and δ -hexadecanolactone. The methyl ketones are a sum of 2-heptanone, 2-nonanone, 2-undecanone, 2-tridecanone, and 2-pentadecanone.

[0014]

That is, the present invention is:

(1) A milk flavor-enhanced fat including a milk fat, where a weight ratio of a total content of δ -lactones to a total content of methyl ketones is 1 to 6 and the total content of the δ -lactones is 55 ppm by weight or more, (where the methyl ketones are a sum of 2-heptanone, 2-nonanone, 2-undecanone, 2-tridecanone, and 2-pentadecanone, and the δ -lactones are a sum of δ -decanolactone, δ -

dodecanolactone, δ -tetradecanolactone, and δ -hexadecanolactone);

(2) The milk flavor-enhanced fat of (1), where the milk fat content is 20% by weight or more;

5 (3) The milk flavor-enhanced fat of (1) or (2), where free butyric acid content is 2 ppm by weight or less;

(4) The milk flavor-enhanced fat of any one of (1) to (3), where water content is less than 1% by weight;

(5) A method for producing a milk flavor-enhanced fat
10 of any one of (1) to (4); and

(6) A method for enhancing a milk flavor of food and beverage product including adding the milk flavor-enhanced fat of any one of (1) to (4).

15 Effects of Invention

[0015]

The present invention enables to provide a milk flavor-enhanced fat having reduced deteriorated flavor by giving rich aftertaste without a complicated process. The
20 present invention also enables to provide a method for enhancing the milk flavor of food and beverage product by using this milk flavor-enhanced fat.

Mode for Carrying Out the Invention

25 [0016]

A milk flavor-enhanced fat of the present invention will be explained in detail below.

The milk flavor-enhanced fat of the present invention is a fat in which a flavor derived from milk, such as milk
5 flavor and butter flavor, is enhanced. The milk flavor-enhanced fat of the present invention is a fat containing a specific amount or more of δ -lactones and milk fat, where a weight ratio of total content of δ -lactones with respect to total content of methyl ketones is specific amount.

10 [0017]

The rich aftertaste in the present invention means a taste sustaining from around three seconds after food and beverage product being kept in the mouth until several seconds after the food and beverage product is swallowed.

15 This taste is given not only in an initial taste enhanced by a flavor constituent such as δ -lactones but also a coexistence with a specific amount of the methyl ketones, which have been recognized to have an unpleasant flavor up to the present. The initial taste means a flavor taste
20 appearing instantly when the mouth is filled with the food and beverage product.

The milk flavor in the present invention means a milk flavor enhanced by the rich aftertaste compared with the case of without the use of the milk flavor-enhanced fat of
25 the present invention. This allows reducing a milk fat

content to obtain the equivalent milk flavor.

All specific evaluation methods are described in the following Examples.

[0018]

5 The milk flavor-enhanced fat of the present invention has 1 to 6, more preferably, 1.4 to 5, and further preferably 1.8 to 4.2 of a weight ratio of the total content of the δ -lactones composed of δ -decanolactone, δ -dodecanolactone, δ -tetradecanolactone, and δ -
10 hexadecanolactone with respect to a total content of the methyl ketones composed of 2-heptanone, 2-nonanone, 2-undecanone, 2-tridecanone, and 2-pentadecanone. The weight ratio of the total content of the δ -lactones with respect to the total content of the methyl ketones within this
15 range allows remarkably enhancing the rich aftertaste and the milk flavor, and therefore it is preferable.

[0019]

 Generally, the δ -lactones may be synthesized by intramolecular cyclization reaction of 5-hydroxy fatty
20 acids. In addition, the major δ -lactones are commercially available and easily obtainable.

[0020]

 The total content of the δ -lactones in the milk flavor-enhanced fat of the present invention is 55 ppm by
25 weight or more, more preferably 60 ppm by weight or more.

It is preferable that the total content of the δ -lactones in this range facilitates obtaining the effect of enhancing the sufficient rich aftertaste and milk flavor. The total content of the δ -lactones is a sum of the δ -lactones
5 composed of δ -decanolactone, δ -dodecanolactone, δ -tetradecanolactone, and δ -hexadecanolactone.

[0021]

Furthermore, assuming the δ -hexadecanolactone as 1.0, the weight ratios of the respective δ -lactones are
10 preferably as follows: δ -decanolactone content of 0.8 to 2.0, δ -dodecanolactone content of 1.6 to 3.4, and δ -tetradecanolactone content of 1.6 to 3.3. The weight ratios of the respective δ -lactones in this range especially allow obtaining the milk flavor.

15 [0022]

Generally, the methyl ketones are assumed to be generated with a β keto acid generated through oxidation as a precursor. These methyl ketones are also commercially available and easily obtainable. However, the methyl
20 ketones such as 2-heptanone, 2-nonanone, 2-undecanone, and 2-tridecanone, which are important for the present invention, are known as a cause component of a heat-deteriorated odor generated by a heating process on processed food using milk and dairy products. Accordingly,
25 the methyl ketones are constituents recognized as an

undesirable flavor and an unpleasant flavor. In the present invention, a coexistence of methyl ketones recognized as these unpleasant flavors with δ -lactones at a specific weight ratio ensures significantly enhancing rich
5 aftertaste and milk flavor.

[0023]

In the milk flavor-enhanced fat of the present invention, the total content of the methyl ketones is preferably 55 ppm by weight or less, more preferably 45 ppm
10 by weight or less. The total content of the methyl ketones is a sum of the methyl ketones composed of 2-heptanone, 2-nonanone, 2-undecanone, 2-tridecanone, and 2-pentadecanone. The total content of the methyl ketones in this range facilitates obtaining a target flavor, and therefore it is
15 preferable.

[0024]

Furthermore, assuming the 2-tridecanone content as 1.0, the weight ratios of the respective methyl ketones are preferably as follows: 2-heptanone content of 0.4 to 1.5,
20 2-nonanone content of 0.2 to 0.7, 2-undecanone content of 0.3 to 0.7, and 2-pentadecanone content of 1.5 to 2.5. The weight ratios of the respective methyl ketones in this range especially allow obtaining milk flavor.

[0025]

25 The milk flavor-enhanced fat of the present invention

has a feature of containing milk fat. The content of the milk fat is preferably 20% by weight or more, more preferably 40% by weight or more, and further preferably 60% by weight or more. The milk fat content in the milk
5 flavor-enhanced fat in this range ensures obtaining the sufficient enhancing effect of the milk flavor, and therefore it is preferable.

[0026]

The milk fat in the present invention is produced by
10 removing almost all constituents other than the milk fat from butter or cream. Examples of the milk fat include anhydrous milk fat, clarified butter, and fractionated milk fat. The milk fat may be produced by, for example, melting an unsalted butter at 40 to 80°C, and then centrifuging the
15 molten butter (at 5000 r.p.m. for 10 minutes). In the present invention, these industrially-marketed milk fats may be used.

[0027]

It is known that a composition of the milk fat largely
20 varies depending on factors such as season, feed, and product district. However, these factors do not limit the usage as the milk fat raw material in the present invention. A distribution temperature of the milk fat is not limited, and products distributed at ordinary temperature are
25 applicable. And, frozen distributed products, which are

less likely to be deteriorated by oxidization, are preferable. A production method of the butter in the present invention is not particularly limited. And the fat in the present invention is usually a non-fermented butter
5 (sweet cream butter) produced by centrifuging raw milk to separate cream from the raw milk and subsequently churning the cream to solidify. A typical composition of the butter is a water-in-oil type emulsion containing 83% by weight of milk fat, 16% by weight of water, and nonfat milk solids.

10 [0028]

Generally, milk fat contains about 99% by weight of triglycerides and other constituents such as diglycerides, monoglycerides, lactones, methyl ketones, aldehydes, fatty acids, and sulfur-containing compound. Thus, the above-
15 described total contents of δ -lactones and methyl ketones are values including the δ -lactones and the methyl ketones originally contained in the milk fat.

[0029]

The fat in the present invention is not particularly
20 limited as long as the fat contains milk fat. Examples of fats other than milk fat include, specifically, various animal and vegetable oils such as lard, beef tallow, palm oil, palm kernel oil, coconut oil, corn oil, cottonseed oil, soybean oil, rapeseed oil, rice oil, sunflower oil, and
25 safflower oil; and processed fats produced by performing

one or more processes selected from hydrogenation, fractionation, and interesterification on these oils. These fats may also be used alone, or two kinds or more of these fats may be used in combination.

5 [0030]

A free butyric acid content of the milk flavor-enhanced fat of the present invention is preferably 2 ppm by weight or less, more preferably 1.5 ppm by weight or less, and further preferably 1.0 ppm by weight or less.
10 The free butyric acid content in this range provides less deteriorated flavor, and therefore it is preferable.

[0031]

The water content of the milk flavor-enhanced fat of the present invention is preferably less than 1% by weight, more preferably 0.8% by weight or less, and further preferably 0.5% by weight or less. The water content of the milk flavor-enhanced fat of the present invention in this range is less likely to cause the hydrolysis during the storage, and therefore it is preferable. The water
15 content is measured by Karl Fischer's method.
20

[0032]

In the milk-flavor-enhanced fat of the present invention, it is preferable that an acid value is less than 2, and a peroxide value is less than 2 meq/Kg. It is further preferable that the acid value is 1 or less and the
25

peroxide value is 1 meq/Kg or less. The acid value and the peroxide value of the milk flavor-enhanced fat during the production and the storage in the above-described ranges do not deteriorate the flavor due to the deterioration by oxidation or a similar cause, and therefore they are preferable. The acid value and the peroxide value are measured by a method compliant to Standard Methods for the Analysis of Fats, Oils and Related Materials established by Japan Oil Chemists' Society.

10 [0033]

Furthermore, additives other than the above-described components, such as, flavor components, antioxidant, emulsifier, flavor agent, colorant, and other oil-soluble additives may be added to the milk flavor-enhanced fat of the present invention in a range where the effects of the present invention are not prevented. Examples of the antioxidant include, but not limited to, tocopherol, ascorbic acid, and salts of tocopherol and ascorbic acid; and ester such as ascorbyl palmitate.

20 [0034]

The milk flavor-enhanced fat of the present invention is a fat containing specific amount of δ -lactones and methyl ketones, and the production method thereof is not particularly limited. For example, it may be obtained by adding specific amount of δ -lactones and methyl ketones as

the flavor constituents. In this case, if the fat constituting the milk flavor-enhanced fat itself contains δ -lactones and/or methyl ketones, the total content needs to be designed considering these contents.

5 [0035]

Next, a food and beverage product and a production method thereof in the present invention will be described in detail.

The milk flavor-enhanced fat of the present invention
10 is applicable to the food and beverage product of which the enhancement of flavor derived from milk is preferable. As such food and beverage product, the milk flavor-enhanced fat is applicable to productions of, for example, flour-processed food, fat-processed food, and cooked and
15 processed food. More specifically, examples of the flour-processed food include baked goods such as sweet bun, Danish, and croissant; western and Japanese confectionery such as doughnut, sponge cake, waffle, bouchée, dora-yaki, and pound cake; and confectioneries such as pie, cookie,
20 and biscuit. Examples of the fat-processed food include flavor oil and chocolate; and examples of the cooked and processed food include egg product such as omelet, soup, daily dish, and pasta sauce. The milk flavor-enhanced fat is also applicable to, for example, fat-processed food,
25 water-in-oil emulsion, and oil-in-water emulsion, which are

the food and beverage products used as raw materials of these foods. More specifically, examples of the water-in-oil emulsion include, for example, margarine, fat spread, and a food and beverage product composed continuous fat phase and made from milk products as a major raw material. More specifically, examples of the oil-in-water emulsion include cream such as whipped cream, flour paste such as custard cream, cheese such as cream cheese, ice cream, beverages containing fat, source such as bechamel sauce and white sauce, and soup.

[0036]

An amount of use of the milk flavor-enhanced fat of the present invention is not particularly limited. The amount of use is appropriately determined according to strength of an enhancing effect of the flavor derived from milk required for the used food and beverage product.

The method of using the milk flavor-enhanced fat is also applicable to any process in the production of the food and beverage product. For example, the milk flavor-enhanced fat may be directly added in a finishing stage of the soup. This ensures enhancing not only the milk flavor but also the rich aftertaste like the food and beverage product being stewed for a long time. The milk flavor-enhanced fat is also applicable as a part of an oil phase in a water-in-oil emulsion for kneading and to preparation

of filling cream and sandwich cream, which are prepared by mixing the water-in-oil emulsion with a liquid sugar and other flavor materials. Furthermore, the use of the milk flavor-enhanced fat as a part of an oil phase in a water-in-oil emulsion for roll-in may enhance the milk flavor and the rich aftertaste also in the Danish produced by kneading and baking the water-in-oil emulsion. Furthermore, if it is difficult to increase the milk fat content in the food and beverage product any further due to limitations on a physical property, a price, and a similar factor, the milk flavor-enhanced fat of the present invention may be used in combination with generally-used milk flavor agent and/or other milk flavor-enhancing material.

[0037]

15 A method for analyzing trace constituents will be explained in detail below.

First, for the δ -lactones, a silica gel process is performed on acetonitrile soluble fractions as analysis samples for quantitative analysis by gas chromatograph mass spectrometry.

[0038]

Method for preparing acetonitrile-soluble fraction)

1. To 15 g of sample with adding δ -tridecalactone as an internal standard, 15 ml of acetonitrile is added, and the mixture is shaken and stirred.

2. After ten-minute centrifugation at 2000 r.p.m., a supernatant is recovered. This operation was repeated three times to recover the obtained supernatant. The solvent of the obtained supernatant is evaporated with a rotary evaporator (60°C or less) through decompression and nitrogen blowing to obtain the acetonitrile-soluble fraction.

[0039]

Silica gel process method)

10 1. A silica gel (InertSep SI FF of 200 mg/3 ml: GL Sciences Inc.) is equilibrated with 2ml of pentane by three times.

2. To 50 μ l of the acetonitrile soluble fraction, 50 μ l of pentane is added, and the acetonitrile-soluble fraction is mixed well, and then is added to the silica gel.

3. After an elution with 6 ml-pentane/diethyl ether = 95/5 and 6 ml-pentane/diethyl ether = 90/10, the acetonitrile soluble fraction is eluted with pentane/diethyl ether = 80/20.

20 4. After drying the fraction eluted with 6 ml-pentane/diethyl ether = 80/20 (v/v) under nitrogen stream, the fraction is dissolved into 200 μ l of acetone to produce analysis sample.

[0040]

25 Method for quantitative analysis of δ -lactones by gas

chromatograph mass spectrometry)

As a gas chromatograph time-of-flight mass spectrometer, Pegasus 4D (GC-TOFMS, manufactured by LECO Corporation) is used. As a GC apparatus, Agilent 6890
5 (manufactured by Agilent Technologies) is used, and as a column, StaBilwax (length: 30 m, inner diameter: 0.25 mm, liquid phase film thickness: 0.5 μ m) (manufactured by Restek Corporation) is used. Helium gas is used as a carrier gas, and the flow rate is set to 1.0 ml/minute. A
10 temperature at an injection port of the sample is set to 250°C. A temperature of the column is set to 40°C for two minutes, is increased up to 240°C by 6°C/minute, and then is maintained at 240°C for ten minutes. An extracted constituent is introduced to the capillary column by split
15 method (split ratio 1: 10).

Using Pegasus 4D (TOFMS, LECO Corporation) as a mass spectrometer, ionization is performed at an ion source temperature of 230°C and an ionization voltage of 70 eV, and the data is retrieved at intervals of 20
20 spectrums/second. An interface temperature of coupling the GC apparatus to the mass spectrometer is set to 250°C.

Quantitative values of δ -decanolactone, δ -dodecanolactone, δ -tetradecanolactone, and δ -hexadecanolactone are calculated from peak area value of δ -
25 tridecalactone added as the internal standard as the

criterion.

[0041]

Next, a method for analyzing methyl ketones and butyric acid will be described below.

5 Headspace quantitative analysis method by external standard method is performed for analysis of the methyl ketones using 2-heptanone, 2-nonanone, 2-undecanone, 2-tridecanone, and 2-pentadecanone as standard substances and for analysis of the butyric acid using butyric acid as the
10 standard substance.

[0042]

The gas chromatograph mass spectrometry is performed by the following procedure.

1. Pretreatment by a Solid Phase Micro Extraction
15 method (hereinafter referred to as "SPME") is performed. First, 2 g of sample is measured in a vial of 20 ml (manufactured by SUPELCO Corporation). The sample is sealed with a septum cap (manufactured by SUPELCO Corporation, sealed with Teflon (registered trademark)) and
20 is preheated at 60°C for 30 minutes. Next, an SPME fiber is put into a head space of the vial for 30 minutes to absorb a volatile constituent. As the SPME fiber, 1 cm length of DVB/PDMS/CAR fiber (manufactured by SUPELCO Corporation) is used.

25 2. Subsequently, an analysis with a gas chromatograph

mass spectrometer is performed. The SPME fiber containing the extracted constituent is put into a sample injection port of the spectrometer to quantitate methyl ketones and aldehydes. As the gas chromatograph mass spectrometer, the Pegasus 4D (GC-TOFMS, manufactured by LECO Corporation) is used. As a GC apparatus, the Agilent 6890 (manufactured by Agilent Technologies) is used, and as a column, StaBilwax (length: 30 m, inner diameter: 0.25 mm, liquid phase film thickness: 0.5 μ m) (manufactured by Restek Corporation) is used. Helium gas is used as a carrier gas, and the flow rate is set to 1.0 ml/minute. A temperature at the injection port of the sample is set to 250°C. A temperature of the column is set to 40°C for two minutes, is increased up to 240°C by 12°C/minute, and then is maintained at 240°C for ten minutes. The extracted constituent is introduced to the capillary column by splitless method.

Using the Pegasus 4D (TOFMS LECO Corporation) as a mass spectrometer, ionization is performed at an ion source temperature of 230°C and an ionization voltage of 70 eV, and the data is retrieved at intervals of 20 spectrums/second. An interface temperature of coupling the GC apparatus to the mass spectrometer is set to 250°C.

Examples

[0043]

Examples and Comparative Examples will be explained below for further clarification of the effects of the present invention.

5 [0044]

(Preparation of milk fat)

Butter manufactured by Yotsuba Milk Products Co., Ltd. was heated by putting the bowl in hot water at 57 to 62°C and separated oil phase was filtered to prepare a milk fat
10 (Comparative Example 1). This milk fat had 668 ppm by weight of water, 0.5 ppm by weight of free butyric acid, 0.7 of acid value, and measurement limit or less of peroxide value (measurement limit value: 0.4 meq/Kg), and had taste free from odd taste, and refreshed and natural
15 milk flavor. Comparative Example 1 described in the following table showed analysis values of this milk fat to which δ -lactones, methyl ketones, and butyric acid were not added. This milk fat was also used in Examples and Comparative Examples other than Comparative Example 1.

20 [0045]

(Preparation of interesterified fat A)

A compound oil of Palm oil and palm kernel olein was randomly interesterified with an enzyme to prepare interesterified fat A substantially containing no trans
25 fatty acid and having a melting point of 32°C. This fat

had 80 ppm by weight of water content, 0.1 ppm by weight or less of δ -lactones, methyl ketones, and free butyric acid, respectively, 0.1 or less of acid value, and measurement limit or less of peroxide value. The flavor of the interesterified fat A was, similar to the general refined vegetal oils, tasteless and odorless.

[0046]

The δ -lactones of the present invention, such as δ -decanolactone, δ -dodecanolactone, δ -tetradecanolactone, and δ -hexadecanolactone, and the methyl ketones of the present invention, such as 2-heptanone, 2-nonanone, 2-undecanone, 2-tridecanone, and 2-pentadecanone, and the butyric acid of the present invention, were obtained from products of Sigma-Aldrich Co. LLC. or Soda Aromatic Co., Ltd. to use. These components were added to fat to prepare milk flavor-enhanced fat (Examples/Comparative Examples) described in the following Table 1 and Table 2.

In the case of using liquid δ -lactones and methyl ketones, liquids as it is may be added to butter-containing fat to prepare milk flavor-enhanced fat. Solid δ -lactones and solid methyl ketones were heated and molten to be liquefied and were added to butter-containing fat, or the solid was added to butter-containing fat in a solid state and the mixture was heated and molten. For the heating and melting, avoiding excessive heating exceeding boiling point

of the added constituents is preferable in terms of sufficiently achieving the effects of the added constituents.

[0047]

5 As shown in the following Table 1 and Table 2, the fats containing δ -lactones, methyl ketones, and butyric acid as the trace constituents were variously prepared. The contents of δ -lactones, methyl ketones, and butyric acid were trace compared with the content of the fat; 10 therefore, the fats adjusted such that the entire content became 100% by weight. Accordingly, the contents of the fats described in Table 1 and Table 2 are slightly low compared with the values described in the tables by the contents of δ -lactones, methyl ketones, and butyric acid.

15 As described in the following tables, the above-described milk fat and interesterified fat A were used as fats. Accordingly, all Examples and Comparative Examples showed 0.5% by weight or less of water, 1 or less of acid value, and 1 meq/Kg or less of peroxide value if the trace 20 constituents were contained.

[0048]

Table 1 Composition of milk flavor-enhanced fat (Examples)

No.	Examples							
	1	2	3	4	5	6	7	8
Fat (%)								
Milk fat	100	100	100	100	100	100	65	45
Interesterified fat A	0	0	0	0	0	0	35	55
Trace constituent content (ppm)								
δ -lactones)								
δ -decanolactone	17.0	17.0	17.0	17.0	14.0	12.0	14.0	14.0
δ -dodecanolactone	30.0	30.0	30.0	30.0	24.0	21.0	24.0	24.0
δ -tetradecanolactone	25.0	25.0	25.0	25.0	20.0	17.0	20.0	20.0
δ -hexadecanolactone	10.0	10.0	10.0	10.0	8.0	7.0	8.0	8.0
Methyl ketones)								
2-heptanone	7.2	4.3	12.2	3.6	13.0	5.0	3.3	3.3
2-nonanone	2.6	1.6	4.4	1.3	4.7	1.8	2.4	2.4
2-undecanone	3.1	1.9	5.3	1.6	5.6	2.2	2.1	2.1
2-tridecanone	5.8	3.5	9.9	2.9	10.4	4.0	4.5	4.5
2-pentadecanone	10.9	6.5	18.5	5.4	19.6	7.6	9.1	9.1
Butyric acid	0.5	0.5	0.5	0.5	0.5	0.5	0.3	0.2

• The units are: % by weight for fat, and ppm by weight for δ -lactones, methyl ketones, and butyric acid, which are the trace constituents (the same applies to the following tables).

[0049]

Table 2 Composition of milk flavor-enhanced fat (Examples/Comparative Examples)

No.	Examples			Comparative Examples			
	9	10	11	1	2	3	4
Fat (%)							
Milk fat	25	100	100	100	100	100	100
Interesterified fat A	75	0	0	0	0	0	0
Trace constituent content (ppm)							
δ -lactones)							
δ -decanolactone	14.0	17.0	17.0	11.4	17.0	17.0	11.4
δ -dodecanolactone	24.0	30.0	30.0	18.0	30.0	30.0	18.0
δ -tetradecanolactone	20.0	25.0	25.0	14.2	25.0	25.0	14.2
δ -hexadecanolactone	8.0	10.0	10.0	5.4	10.0	10.0	5.4
Methyl ketones)							
2-heptanone	3.3	7.2	7.2	0.7	0.7	28.8	4.2
2-nonanone	2.4	2.6	2.6	0.3	0.3	10.4	1.5
2-undecanone	2.1	3.1	3.1	0.5	0.5	12.4	1.8
2-tridecanone	4.5	5.8	5.8	0.9	0.9	23.2	3.4
2-pentadecanone	9.1	10.9	10.9	2.0	2.0	43.6	6.4
Butyric acid	0.1	1.3	1.8	0.5	0.5	0.5	0.5

[0050]

the food and beverage products containing the milk flavor-enhanced fat were carried out as follows. Ten panelists preliminary rinsed an inside of oral cavities with distilled water. The panelists put 1 g of each tasting sample at intervals of three minutes or more. The panelists evaluated the milk flavor-enhanced fats and the food and beverage products on deteriorated flavor, rich aftertaste, and milk flavor in accordance with the following criteria.

10 The evaluation method was carried out after completely melting the milk flavor-enhanced fats to perform the evaluation in the melt state at 40°C.

15 In this respect, relative evaluations were conducted on deteriorated flavors with a point of the milk fat (Comparative Example 1) as 3.0 and on rich aftertaste and milk flavor with respective points of the milk fat (Comparative Example 1) and the food and beverage product containing the milk fat (Comparative Example 1) as 1.0. Averages were summarized in the following Table 3 and Table 20 4.

 The flavor evaluation criteria (point method) judged the milk flavor-enhanced fats and the food and beverage products with average points of two points or more as pass in all items.

25 Deteriorated flavor:

3: Neither the deteriorated odor nor the deteriorated flavor is felt, or the deteriorated odor or the deteriorated flavor is not felt.

2: Although the deteriorated odor and/or the deteriorated flavor are/is slightly felt, the deteriorated odor and/or the deteriorated flavor are/is in the acceptable range.

1: The deteriorated odor and/or the deteriorated flavor are/is strongly felt.

10 Rich aftertaste:

3: Rich aftertaste is strongly felt compared with the milk fat (Comparative Example 1) or the food and beverage product containing the milk fat (Comparative Example 1).

15 2: Rich aftertaste is felt compared with the milk fat (Comparative Example 1) or the food and beverage product containing the milk fat (Comparative Example 1).

1: Rich aftertaste equivalent to the milk fat (Comparative Example 1) or the food and beverage product containing the milk fat (Comparative Example 1), or rich aftertaste is not felt.

Milk Flavor (Overall Evaluation):

3: Milk flavor is strong compared with the milk fat (Comparative Example 1) or the food and beverage product containing the milk fat (Comparative Example 1).

2: Milk flavor is felt compared with the milk fat (Comparative Example 1) or the food and beverage product containing the milk fat (Comparative Example 1).

1: Milk flavor is weak equivalent to the milk fat (Comparative Example 1) or the food and beverage product containing the milk fat (Comparative Example 1).

[0051]

Table 3 Flavor evaluation of milk flavor-enhanced fat (Examples)

No.	Examples							
	1	2	3	4	5	6	7	8
Total content in milk flavor-enhanced fats (ppm) >								
Butyric acid	0.5	0.5	0.5	0.5	0.5	0.5	0.3	0.2
δ -lactones	82.0	82.0	82.0	82.0	66.0	57.0	66.0	66.0
Methyl ketones	29.6	17.8	50.3	14.8	53.3	20.6	21.4	21.4
Weight ratio of δ -lactones/methyl ketones	2.8	4.6	1.6	5.5	1.2	2.8	3.1	3.1
Flavor evaluations)								
Deteriorated flavor	3.0	3.0	2.2	3.0	2.1	3.0	3.0	3.0
Rich aftertaste	2.8	2.5	2.5	2.1 *	2.3	2.2	2.5	2.3
Milk flavor	2.8	2.6	2.3	2.2	2.1	2.2	2.5	2.3

10 [0052]

Table 4 Flavor evaluation of milk flavor-enhanced fat (Examples/Comparative Examples)

No.	Examples			Comparative Examples			
	9	10	11	1	2	3	4
Total content in milk flavor-enhanced fats (ppm) >							
Butyric acid	0.1	1.3	1.8	0.5	0.5	0.5	0.5
δ -lactones	66.0	82.0	82.0	49.0	82.0	82.0	49.0
Methyl ketones	21.4	29.6	29.6	4.4	4.4	118.4	17.3
Weight ratio of δ -lactones/methyl ketones	3.1	2.8	2.8	11.1	18.6	0.7	2.8
Flavor evaluations)							
Deteriorated flavor	3.0	2.3	2.0	3.0	3.0	1.0	3.0
Rich aftertaste	2.0	2.8	2.8	1.0	1.0	-	1.2
Milk flavor	2.0	2.4	2.1	1.0	1.2	-	1.1

• The "-" in the table means that flavor evaluation has not been carried out.

15 [0053]

Next, a food and beverage product containing the milk flavor-enhanced fat is explained.

In accordance with the following "Method for Preparing Water-in-Oil Emulsion," water-in-oil emulsions for filling
5 shown in Table 5 were prepared.

"Method for Preparing Water-in-Oil Emulsion"

1. In accordance with Table 5, fats were molten and an emulsifier dissolved into the fats was added to prepare an oil phase.

10 2. A raw material classified into a water-phase raw material was added to and dissolved into water to prepare a water phase.

3. The water phase was added to the oil phase being stirred and mixed. The obtained mixed liquid is referred
15 to as preparation liquid.

4. For filling/kneading, the preparation liquid was poured into a case through a combinator and a pin machine to obtain the water-in-oil emulsion. For roll-in emulsion, the preparation liquid was passed through the combinator, a
20 resting tube, and a molding machine to prepare a sheet-shaped water-in-oil emulsion.

5. The prepared water-in-oil emulsions were stored in a refrigerator at 3 to 7°C for 3 to 7 days.

[0054]

Table 5 Formulation of water-in-oil emulsion for filling

	Example 12	Comparative Example 5
Interesterified fat B	21.0 (%)	21.0
Interesterified fat A	37.0	37.0
Milk flavor-enhanced fat (Example 1)	3.0	
Milk fat (Comparative Example 1)		3.0
Soybean oil	20.0	20.0
Skimmed milk powder	3.0	3.0
Salt	1.0	1.0
Water	14.2	14.2
Emulsifier	0.8	0.8
Proportion of milk flavor-enhanced fat in oil phase (%)	3.7	0.0
Proportion of milk fat in oil phase (%)	3.7	3.7

• The unit is % by weight.

• As the interesterified fat B, fat produced by performing an interesterification on a compound oil of coconut oil, palm stearin, and fully hydrogenated high-erucic rapeseed oil that did not actually contain a trans acid, with a sodium methylate as a catalyst were used. This fat had 70 ppm by weight of water, 0.1 or less of acid value, and measurement limit or less of peroxide value. Similar to the general refined vegetable oils, the flavor was tasteless and odorless.

• As the emulsifier, glycerin fatty acid ester, polyglycerin fatty acid ester, sorbitan fatty acid ester, and lecithin were used.

[0055]

As the flavor evaluation of the food and beverage products containing the milk flavor-enhanced fat, similar to the flavor evaluation of the milk flavor-enhanced fats, the relative evaluation was conducted. In the relative

evaluation, ten panelists conducted the evaluations on rich
aftertaste and milk flavor in accordance with the above-
described criteria. Since the milk flavor-enhanced fat
(Example 1) and the milk fat (Comparative Example 1) in
5 which neither the deteriorated odor nor the deteriorated
flavor was felt were used, the deteriorated flavor was not
felt from the following all food and beverage products.

[0056]

10 Temperatures of the obtained water-in-oil emulsions
for filling were controlled at room temperature for one
night for the flavor evaluation.

Table 6 Flavor evaluation of water-in-oil emulsion for
filling

	Example 12	Comparative Example 5
Rich aftertaste	2.5	1.0
Milk flavor	2.3	1.0

15

As a result, although the milk fat content in the oil
phase was the same and proportion of the milk flavor-
enhanced fat 3.7% by weight, rich aftertaste and milk
flavor of the water-in-oil emulsion for filling in Example
12 were felt strong compared with the water-in-oil emulsion
20 for filling in Comparative Example 5, and it was preferable.

[0057]

In accordance with the above-described "Method for

Preparing Water-in-Oil Emulsion," water-in-oil emulsions for roll-in shown in Table 7 were prepared.

Table 7 Formulation of water-in-oil emulsion for roll-in

	Example 13	Comparative Example 6
Milk flavor-enhanced fat (Example 1)	10.0 (%)	
Milk fat (Comparative Example 1)		10.0
Interesterified fat C	20.0	20.0
Interesterified fat A	38.0	38.0
Rapeseed oil	15.0	15.0
Salt	1.0	1.0
Water	15.3	15.3
Emulsifier	0.7	0.7
Proportion of milk flavor-enhanced fat in oil phase (%)	12.0	0.0

5 • The unit is % by weight.

• As the interesterified fat C, fats produced by performing an interesterification on a compound oil of palm stearin, palm oil, and fully hydrogenated high-erucic rapeseed oil that did not substantially contain trans fatty acid with a sodium methylate as a catalyst were used. This fat had 70 ppm by weight of water content, 0.1 or less of acid value, and measurement limit or less of peroxide value. Similar to the general refined vegetable oils, the flavor was tasteless and odorless.

15 • As the emulsifier, glycerin fatty acid ester and lecithin were used.

[0058]

Croissants were baked using the water-in-oil emulsions for roll-in prepared in Example 13 and Comparative Example 6 in accordance with the following "Method for Preparing

Croissant."

"Method for Preparing Croissant"

1. A flour dough ingredient described in Table 8 was kneaded and fermented inside a proof box at 28°C and a
5 humidity of 75% for 60 minutes. After that, the flour dough ingredient was placed in a freezer at -18°C for 30 minutes and retarded in the freezer at -7°C for 60 minutes.

2. The prepared water-in-oil emulsion composition for roll-in was interfolded (60 parts by weight with respect to
10 100 parts bread flour), and three-folding was performed on the flour dough ingredient twice with a reverse sheeter. After that, the flour dough ingredient was retarded in the freezer at -7°C for 60 minutes and the three-folding was performed once with the reverse sheeter. After that, the
15 flour dough ingredient was retarded in the freezer at -7°C for 45 minutes.

3. The flour dough ingredient was extended up to a dough thickness of 4 mm by the reverse sheeter so as to be formed to be 55 g, and was fermented in the proof box at
20 32°C and the humidity of 75% for 60 minutes.

4. The flour dough ingredient was baked in an oven at 210°C for 17 minutes to prepare a croissant.

[0059]

Table 8 Formulation of flour dough for Croissant

Bread flour	100.0
Sugar	8.0
Salt	1.9
Skimmed milk powder	3.0
Whole egg	8.0
Shortening	5.0
Yeast	3.0
Yeast nutrient	0.1
Water	51.0

- The unit is parts by weight.

[0060]

The flavor evaluation was carried out after the
 5 obtained croissants were cooled under room temperature for
 one hour.

Table 9 Flavor evaluation of Croissant

	Example 14	Comparative Example 7
Water-in-oil emulsion for roll-in	Example 13	Comparative Example 6
Rich aftertaste	2.7	1.0
Milk flavor	2.5	1.0

10 As a result, rich aftertaste and milk flavor of the
 croissant of Example 14 were felt strong compared with the
 croissant of Comparative Example 7, and it was preferable.

[0061]

Results and Considerations

15 As apparent from the above-described results, in the
 case where the weight ratio of the total content of δ -
 lactones to the total content of methyl ketones is the
 specified amount; the total content of δ -lactones is

contained by the specified amount or more; and milk fat is contained, the deteriorated flavor is reduced and rich aftertaste is given without the complex processes such as long-time reaction and enzyme reaction. Thus, it enables
5 to provide milk flavor-enhanced fats (Examples) enhancing milk flavor.

However, in the case where the weight ratio of the total content of δ -lactones to the total content of methyl ketones was not the specified amount; the total content of
10 δ -lactones was not the specified amount; or milk fat was not contained, the rich aftertaste was insufficient and milk flavor was weak.

As δ -lactones and methyl ketones that may be preferably used for the present invention, constituents
15 originally contained in milk fat are preferable rather than the addition of novel constituent. The δ -lactones and methyl ketones have been found by variously examining a balance between the constituents and/or the respective constituents. Accordingly, compared with the addition of
20 only a specific constituent, the milk flavor may be especially obtained with the respective δ -lactones and methyl ketones being the specific weight ratios as described above.

Furthermore, the application of these milk flavor-
25 enhanced fats (Examples), not only to food and beverage

products assuming direct food such as filling, but also to various food and beverage products, for example, bakery product such as croissant, ensures giving rich aftertaste and enhancing milk flavor.

CLAIMS

1. A milk flavor-enhanced fat comprising 20% by weight or more of milk fat, wherein a weight ratio of a total content of δ -lactones to a total content of methyl ketones is 1 to 6, the total content of the δ -lactones is 60 ppm by weight or more, the total content of methyl ketones is 45 ppm by weight or less, and wherein free butyric acid content is 2 ppm by weight or less, (wherein the methyl ketones are a sum of 2-heptanone, 2-nonanone, 2-undecanone, 2-tridecanone, and 2-pentadecanone, and the δ -lactones are a sum of δ -decanolactone, δ -dodecanolactone, δ -tetradecanolactone, and δ -hexadecanolactone).

2. The milk flavor-enhanced fat according to claim 1, wherein water content is less than 1% by weight.

3. A method for producing a milk flavor-enhanced fat according to claim 1 or 2.

4. A method for enhancing a milk flavor of a food and beverage product comprising adding the milk flavor-enhanced fat according to claim 1 or 2.