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(54) Title: NUTRITIONAL COMPOSITION

(57) Abstract: An object of the present technology is to provide a nutritional composition having excellent emulsion stability. The present technology provides a nutritional composition containing a protein component, a lipid, and an organic acid ester of monoglyceride, wherein the organic acid ester of monoglyceride includes two or more kinds selected from acetic acid ester of monoglyceride, citric acid ester of monoglyceride, succinic acid ester of monoglyceride, diacetyl tartaric acid ester of monoglyceride, and lactic acid ester of monoglyceride. At least one kind among the organic acid esters of monoglyceride may be succinic acid ester of monoglyceride. Further, at least one kind among the organic acid ester of monoglyceride may be diacetyl tartaric acid ester of monoglyceride.

Description

Title of Invention: NUTRITIONAL COMPOSITION

Technical Field

[0001] The present technology relates to a nutritional composition, and in particular to a nutritional composition containing an organic acid ester of monoglyceride

Background Art

[0002] Patients in the acute phase, such as post-surgery, and patients with diarrheal disease often have reduced digestive and absorptive ability. Liquid diets, especially enteral nutrients, are sometimes used to supply nutrients to patients with reduced digestive and absorptive ability. As examples of liquid foods, mention may be made of semi-elemental formulas and Polymeric formula, which differ in the nitrogen source they contain. The semi-elemental formula is a liquid food in which the nitrogen source contained is a peptide (particularly a low molecular weight peptide) and/or an amino acid. On the other hand, the polymeric formula contains protein as a nitrogen source.

[0003] Enteral nutrients often contain lipids. Several proposals have been made for lipid-containing enteral nutrients. For example, PTL 1 below discloses “a nutritional composition for ketogenic diet, containing fats and oils containing fatty acids having 8 to 12 carbon atoms and soy protein hydrolysate”.

Citation List

Patent Literature

[0004] PTL 1: JP-A-2020-092691

Summary of Invention

Technical Problem

[0005] A nutritional composition such as an enteral nutrient may contain a protein component and a lipid as described above. In nutritional compositions containing a protein component and a lipid, a problem with emulsion stability may arise. Such a problem is caused for example by heat sterilization of the nutritional composition. The problem may also appear after long-term storage of the nutritional composition.

[0006] The semi-elemental formula can be absorbed without undergoing a digestion process, and thus is more easily absorbed than the Polymeric formula. However, generally the protein hydrolysate contained as a nitrogen source in the semi-elemental formula has a weaker emulsifying property than the intact protein. For this reason, problems related to emulsion stability can easily arise in semi-elemental formulas containing protein hydrolysates.

[0007] In view of the above, the purpose of the present technology is to provide a nutritional composition having excellent emulsion stability.

Solution to Problem

[0008] The present inventors have found that a specific nutritional composition has excellent emulsion stability.

[0009] That is, the present technology provides the following.

[1] A nutritional composition containing a protein component, a lipid, and an organic acid ester of monoglyceride, wherein the organic acid ester of monoglyceride includes two or more kinds selected from acetic acid ester of monoglyceride, citric acid ester of monoglyceride, succinic acid ester of monoglyceride, diacetyl tartaric acid ester of monoglyceride, and lactic acid ester of monoglyceride.

[2] The nutritional composition as set forth in [1], wherein at least one of the organic acid ester of monoglycerides is succinic acid ester of monoglyceride.

[3] The nutritional composition as set forth in [2], wherein a proportion of the succinic acid ester of monoglyceride to a total amount of the organic acid ester of monoglycerides is 80% by mass or less.

[4] The nutritional composition as set forth in any one of [1] to [3], wherein at least one of the organic acid ester of monoglycerides is diacetyl tartaric acid ester of monoglyceride.

[5] The nutritional composition as set forth in [4], wherein a proportion of the diacetyl tartaric acid ester of monoglyceride to a total amount of the organic acid ester of monoglycerides is 80% by mass or less.

[6] The nutritional composition as set forth in any one of [1] to [5], wherein a total amount of the organic acid ester of monoglycerides per 100 kcal of the composition is 0.005 g or more and 2.0 g or less.

[7] The nutritional composition as set forth in any one of [1] to [6], wherein the protein component includes a milk protein, a milk protein hydrolysate, or both a milk protein and a milk protein hydrolysate.

[8] The nutritional composition as set forth in any one of [1] to [6], wherein the protein component includes a casein hydrolysate and a whey protein hydrolysate.

[9] The nutritional composition as set forth in [8], wherein a content mass ratio of the casein hydrolysate and the whey protein hydrolysate is 1:9 to 9:1.

[10] The nutritional composition as set forth in any one of [1] to [9], wherein a content of the protein component is 1 g or more and 15 g or less per 100 kcal of the nutritional composition.

Advantageous Effects of Invention

[0010] The nutritional composition of the present technology is excellent in emulsion stability. For example, the nutritional composition of the present technology is unlikely to be separated even when subjected to a heat sterilization step. In addition, in the nutritional composition of the present technology, separation hardly occurs even after

long-term storage.

It should be noted that the effect of the present technology is not limited to the effect described in this paragraph, but may be any effect described in the description herein.

Description of Embodiments

[0011] Hereinafter, preferred embodiments of the present technology will be described. However, the present technology is not limited to the following preferred embodiments, and can be freely changed within the scope of the present technology.

[0012] The nutritional compositions of the present technology contain a protein component, a lipid, and an organic acid ester of monoglyceride. The nutritional composition contains two or more kinds selected from acetic acid ester of monoglyceride, citric acid ester of monoglyceride, succinic acid ester of monoglyceride, diacetyl tartaric acid ester of monoglyceride, and lactic acid ester of monoglyceride as the organic acid ester of monoglyceride. The emulsion stability of the nutritional composition containing a protein component and a lipid can be improved by the organic acid ester of monoglyceride. For example, the organic acid ester of monoglyceride can prevent separation in the case of heat sterilization. Furthermore, separation after long-term storage can also be prevented.

[0013] The nutritional composition of the present technology may be flowable, i.e., a flowable nutritional composition. As a result, the nutritional composition of the present technology can be administered by tube feeding, and when administered orally, it is easy to eat and swallow.

[0014] Hereinafter, the composition of the present technology will be described in more detail.

[0015] (1) Protein Component

The protein component contained in the nutritional composition of the present technology may be protein hydrolysate, protein (i.e., intact protein, or non-degraded protein), or protein hydrolysate and protein. For example, the protein component may include a milk protein, a milk protein hydrolysate, or both a milk protein and a milk protein hydrolysate.

The content of the protein component may be, for example, 1.0 g or more, preferably 2.0 g or more, more preferably 2.5 g or more, and still more preferably 3.0 g or more per 100 kcal of the nutritional composition. In addition, the content of the protein component may be, for example, 15.0 g or less, preferably 12.0 g or less, more preferably 10.0 g or less, and still more preferably 8.0 g or less per 100 kcal of the nutritional composition.

[0016] In one embodiment, the nutritional composition of the present technology contains at least a protein hydrolysate, and may include only a protein hydrolysate, for example.

A protein hydrolysate has a weaker emulsifying property than an intact protein. For

this reason, the nutritional composition containing a protein hydrolysate (particularly, a semi-elemental formula containing only a protein hydrolysate) is likely to have a problem with respect to emulsion stability. The effect of improving emulsion stability according to the present technology is more clearly exhibited in such a nutritional composition.

[0017] In other embodiments, the nutritional composition of the present technology includes at least protein, and may include only protein, for example. According to the present technology, an effect of improving emulsion stability can be exhibited even in the nutritional composition containing protein.

[0018] The protein hydrolysate may be, for example, an animal protein hydrolysate or a vegetable protein hydrolysate. Examples of the animal protein hydrolysate include a milk protein hydrolysate, an egg protein hydrolysate, a fish protein hydrolysate, and a meat protein hydrolysate. Examples of the vegetable protein hydrolysate include a soy protein hydrolysate, a pea protein hydrolysate, and a wheat protein hydrolysate. The protein hydrolysate contained in the nutritional composition of the present technology may include any one or a combination of two or more of these listed protein hydrolysates.

[0019] In a preferred embodiment, the protein hydrolysate contained in the nutritional composition of the present technology may be a milk protein hydrolysate, a soy protein hydrolysate, or a combination thereof. When these protein hydrolysates are employed, the effect of the present technology is more effectively exhibited.

[0020] In a more preferred embodiment, the protein hydrolysate contained in the nutritional composition of the present technology is a milk protein hydrolysate. The milk protein hydrolysate may include, for example, a casein hydrolysate, a whey protein hydrolysate, or a combination of these two hydrolysates.

[0021] The protein hydrolysate content in the nutritional composition of the present technology may be, for example, 1.0 g or more, preferably 2.0 g or more, more preferably 2.5 g or more, and still more preferably 3.0 g or more per 100 kcal of the nutritional composition. The protein hydrolysate content in the nutritional composition of the present technology may be, for example, 15.0 g or less, preferably 12.0 g or less, more preferably 10.0 g or less, and still more preferably 8.0 g or less per 100 kcal of the nutritional composition. By the content, the nitrogen source can be efficiently ingested. In addition, according to the present technology, even in a case where the protein hydrolysate content in the nutritional composition is high as described above, the effect of improving the emulsion stability is exhibited.

[0022] In a particularly preferred embodiment, the protein hydrolysate contained in the nutritional compositions of the present technology includes a combination of a casein hydrolysate and a whey protein hydrolysate, e.g. may include only the combination. The

content mass ratio of the casein hydrolysate and the whey protein hydrolysate in the nutritional composition is, for example, 10:90 to 90:10, preferably 50:50 to 90:10, more preferably 60:40 to 90:10, still more preferably 60:40 to 80:20, and particularly preferably 65:35 to 75:25. By such a content mass ratio, an effect of improving the utilization efficiency in a living body (i.e. bioavailability) of these hydrolysates is attained.

[0023] The content of the casein hydrolysate in the nutritional composition may be, for example, 0.2 g or more, preferably 1.0 g or more, and more preferably 1.5 g or more per 100 kcal of the nutritional composition. Further, the content of the casein hydrolysate in the nutritional composition of the present technology may be, for example, 12.0 g or less, preferably 9.0 g or less, and more preferably 7.5 g or less per 100 kcal of the nutritional composition.

The content of the whey protein hydrolysate in the nutritional composition may be, for example, 0.1 g or more, preferably 0.5 g or more, and more preferably 0.8 g or more per 100 kcal of the nutritional composition. Further, the content of the whey protein hydrolysate in the nutritional composition of the present technology may be, for example, 8.0 g or less, preferably 6.0 g or less, and more preferably 5.0 g or less per 100 kcal of the nutritional composition.

[0024] The protein hydrolysate may be prepared by a method known in the art, for example, may be a hydrolysate prepared by hydrolyzing a protein using an enzyme or an acid, and preferably a hydrolysate prepared by hydrolyzing a protein with a protease.

[0025] The number average molecular weight of the milk protein hydrolysate may be, for example, 1200 or less, preferably 900 or less, and more preferably 600 or less.

Further, the number average molecular weight of the milk protein hydrolysate may be, for example, 100 or more, preferably 200 or more, and more preferably 300 or more.

[0026] The number average molecular weight of the casein hydrolysate may be, for example, 1000 or less, preferably 700 or less, and more preferably 400 or less.

Further, the number average molecular weight of the casein hydrolysate may be, for example, 100 or more, preferably 200 or more, and more preferably 300 or more.

[0027] The number average molecular weight of the whey protein hydrolysate may be, for example, 1200 or less, preferably 900 or less, and more preferably 600 or less.

Further, the number average molecular weight of the whey protein hydrolysate may be, for example, 100 or more, preferably 200 or more, and more preferably 300 or more.

[0028] In the description herein, the number average molecular weight of protein hydrolysates is determined by the following concept of number average molecular weight.

As described in, for example, the literature (edited by The Society of Polymer Science, "Basic Polymer Science", pp. 116 to 119, Tokyo Kagaku Dojin Co., Ltd., 1978), the number average molecular weight indicates the average molecular weight of a polymer compound based on different indicators as follows.

In other words, since polymer compounds such as protein hydrolysates are heterogeneous mixtures and have a distribution in molecular weight, the molecular weight of protein hydrolysates must be expressed in terms of average molecular weight from the viewpoint of physicochemistry, and the number average molecular weight (hereinafter sometimes referred to as Mn) is the average of the number of molecules, and if the molecular weight of peptide chain i is Mi and the number of its molecules is Ni, it is defined by the following formula.

[0029] [Math.1]

$$Mn = \sum_{i=1}^{\infty} Mi\,Ni \Big/ \sum_{i=1}^{\infty} Ni$$

[0030] In the description herein, the number average molecular weight of protein hydrolysates is measured and calculated as follows. Using high-performance liquid chromatography, the protein hydrolysates are eluted with a Poly Hydroxyethyl Aspartamide Column (manufactured by PolyLC INC.; 4.6 × 200 mm in diameter) using 20 mM sodium chloride and 50 mM formic acid at an elution rate of 0.4 mL/min (edited by Nobuo Ui et al., "High-Performance Liquid Chromatography of Proteins and Peptides", Chemistry Special Issue No. 102, p. 241, Kagaku-Dojin Publishing Company, Inc.,1984).

Detection is performed using a UV detector (manufactured by Shimadzu Corporation), and the number average molecular weight is calculated by data analysis using a GPC analysis system (manufactured by Shimadzu Corporation). A protein and/or peptide having a known molecular weight may be appropriately used as a standard for calculating the molecular weight.

[0031] The nutritional composition of the present technology may further contain protein (i.e., intact protein). From the viewpoint of improving the digestibility and absorbability, the nutritional composition of the present technology may preferably contain only protein hydrolysate without protein. As a result, the nutritional composition of the present technology can be made into a semi-elemental formula.

The protein may be, for example, an animal protein or a vegetable protein. For example, any one or a combination of two or more of the proteins (e.g., milk proteins) that are sources of protein hydrolysates listed in "(1) Protein Component" above may be included.

[0032] The protein may be, for example, an animal protein or a vegetable protein. Examples of the animal protein include milk protein, chicken egg protein, fish protein, and meat protein. Examples of the vegetable protein include soy protein, pea protein, and wheat protein. The protein contained in the nutritional composition of the present technology may include any one or a combination of two or more of these listed proteins.

[0033] In a preferred embodiment, the protein contained in the nutritional composition of the present technology may be milk protein, soy protein, or a combination thereof. When these proteins are used, the effect of the present technology is more effectively exhibited.

[0034] In a more preferred embodiment, the protein contained in the nutritional composition of the present technology comprises milk protein. The milk protein may comprise, for example, casein, whey protein, or a combination of these two proteins.

[0035] (2) Lipid

The nutritional composition of the present technology contains a lipid. Emulsion stability problems may occur in the nutritional composition containing the lipid. One such problem is, for example, the separation of lipids, which may occur, for example, by heat sterilization or after long-term preservation. According to the present technology, emulsion stability can be improved, and for example, separation of lipids can be prevented.

[0036] In one embodiment, the lipid includes at least stearic acid, and more preferably includes stearic acid and palmitic acid. The fact that the lipid includes stearic acid, especially stearic acid and palmitic acid, contributes to improving the emulsion stability of the nutritional composition of the present technology, and, for example prevents separation during heat sterilization.

[0037] The lipid content in the nutritional composition of the present technology may be, for example, 1.0 g or more, preferably 1.5 g or more, and more preferably 2.0 g or more per 100 kcal of the nutritional composition. In addition, the lipid content in the nutritional composition of the present technology may be, for example, 8.0 g or less, preferably 7.0 g or less, more preferably 6.0 g or less, still more preferably 5.0 g or less, and particularly preferably 4.0 g or less per 100 kcal of the nutritional composition. When the nutritional composition of the present technology contains the lipid in such an amount, the effect of improving emulsion stability is easily exhibited.

[0038] (Stearic Acid)

The proportion of the stearic acid (C18:0) content to the total fatty acid content of the lipid is, for example, 7.2% by mass or more, preferably 7.4% by mass or more, and more preferably 7.6% by mass or more. The stearic acid content being equal to or greater than such a lower limit value contributes to improvement in emulsion stability of the nutritional composition according to the present technology, and contributes to

prevention of separation during heat sterilization, for example.

The proportion of the stearic acid content to the total fatty acid content of the lipid is, for example, 15.0% by mass or less, preferably 14.0% by mass or less, and more preferably 13.0% by mass or less.

[0039] In a preferred embodiment, the proportion of the stearic acid content to the total fatty acid content of the lipid is 12.0% by mass or less, more preferably 11.5% by mass or less, and still more preferably 11.0% by mass or less. When the proportion of the stearic acid content is equal to or less than such an upper limit value, the emulsion stability of the nutritional composition according to the present technology can be further improved, and for example, separation during heat sterilization can be more effectively prevented.

[0040] (Palmitic Acid)

The proportion of the palmitic acid (C16:0) content to the total fatty acid content of the lipid is, for example, 11.7% by mass or more, preferably 11.8% by mass or more, and more preferably 11.9% by mass or more. The palmitic acid content being equal to or greater than such a lower limit value contributes to improvement in emulsion stability of the nutritional composition according to the present technology, and contributes to prevention of separation during heat sterilization, for example.

The proportion of the palmitic acid content to the total fatty acid content of the lipid is, for example, 18.0% by mass or less, preferably 17.0% by mass or less, and more preferably 16.0% by mass or less.

[0041] In a particularly preferred embodiment, the proportion of the palmitic acid content to the total fatty acid content of the lipid is 15.0% by mass or less, more preferably 14.0% by mass or less, and still more preferably 13.0% by mass or less. When the proportion of the palmitic acid content is equal to or less than such an upper limit value, the emulsion stability of the nutritional composition according to the present technology can be further improved, and for example, separation during heat sterilization can be more effectively prevented.

[0042] In a particularly preferred embodiment of the present technology, the proportion of the stearic acid content to the total fatty acid content of the lipid is 7.2% by mass or more, preferably 7.4% by mass or more, and more preferably 7.6% by mass or more, and the proportion of the palmitic acid content to the total fatty acid content of the lipid is 11.7% by mass or more, preferably 11.8% by mass or more, and more preferably 11.9% by mass or more. Such proportions of the stearic acid content and the palmitic acid content are particularly suitable for improving emulsion stability in the nutritional composition containing a protein hydrolysate.

[0043] (n-6 Fatty Acids)

The lipid may further include an n-6 fatty acid. The n-6 fatty acid may include, for

example, any one or two of linoleic acid (C18:2) and arachidonic acid (C20:4). Preferably, the n-6 fatty acid includes linoleic acid. For example, it is considered that inclusion of the n-6 fatty acid at a proportion described below contributes to improvement of emulsion stability in the nutritional composition of the present technology.

[0044] The proportion of the content of the n-6 fatty acid to the total fatty acid content of the lipid is preferably 11.6% by mass or less, more preferably 11.5% by mass or less, and still more preferably 11.4% by mass or less. Setting the content of the n-6 fatty acid in this manner also contributes to improvement of emulsion stability in the nutritional composition of the present technology, and contributes to prevention of separation during heat sterilization, for example.

The proportion of the content of the n-6 fatty acid to the total fatty acid content of the lipid is, for example, 4.0% by mass or more, preferably 5.0% by mass or more, and more preferably 6.0% by mass or more.

[0045] In a particularly preferred embodiment of the present technology, the proportion of the content of the n-6 fatty acid to the total fatty acid content of the lipid is 6.5% by mass or more, preferably 7.0% by mass or more, and more preferably 8.0% by mass or more. Such a proportion of the content of the n-6 fatty acid is particularly suitable for improving emulsion stability in the nutritional composition containing a protein hydrolysate.

[0046] In a preferred embodiment, the lipid includes linoleic acid, and the proportion of the content of the linoleic acid to the total fatty acid content of the lipid is preferably 11.3% by mass or less, more preferably 11.2% by mass or less, and still more preferably 11.1% by mass or less. The proportion of the content of the linoleic acid to the total fatty acid content of the lipid is, for example, 4.0% by mass or more, preferably 5.0% by mass or more, and more preferably 6.0% by mass or more.

In a particularly preferred embodiment, the proportion of the content of the linoleic acid to the total fatty acid content of the lipid is 6.5% by mass or more, preferably 7.0% by mass or more, and more preferably 7.5% by mass or more. Such a proportion of the content of the linoleic acid is particularly suitable for improving emulsion stability in the nutritional composition containing a protein hydrolysate.

[0047] The lipid may include arachidonic acid. The proportion of the content of the arachidonic acid to the total fatty acid content of the lipid is preferably 0.6% by mass or less, more preferably 0.5% by mass or less, and still more preferably 0.4% by mass or less. Further, the proportion of the content of the arachidonic acid to the total fatty acid content of the lipid is, for example, 0.01% by mass or more, preferably 0.05% by mass or more, and more preferably 0.1% by mass or more.

[0048] The content of the n-6 fatty acid in the nutritional composition of the present

technology may be, for example, 0.05 g or more, preferably 0.1 g or more, and more preferably 0.15 g or more per 100 kcal of the nutritional composition. Further, the content of the n-6 fatty acid in the nutritional composition of the present technology may be, for example, 0.5 g or less, preferably 0.4 g or less, and more preferably 0.3 g or less per 100 kcal of the nutritional composition.

[0049] (Medium Chain Fatty Acids)

The lipid may include, for example, a medium chain fatty acid. The medium chain fatty acid may include, for example, any one, two, three, or all four of caproic acid (C6:0), caprylic acid (C8:0), capric acid (C10:0), and lauric acid (C12:0). Preferably, the medium chain fatty acid may be a combination of caprylic acid and capric acid. For example, it is considered that inclusion of the medium chain fatty acid at a proportion described below contributes to improvement of emulsion stability in the nutritional composition of the present technology.

[0050] The proportion of the content of the medium chain fatty acid (in particular, the total content of caprylic acid and capric acid) to the total fatty acid content of the lipid is, for example, 30% by mass or more, preferably 31% by mass or more, and more preferably 32% by mass or more.

The proportion of the content of the medium chain fatty acid (in particular, the total content of caprylic acid and capric acid) to the total fatty acid content of the lipid is, for example, 40% by mass or less, preferably 39% by mass or less, and more preferably 38% by mass or less.

[0051] The content of the medium chain fatty acid (in particular, the total content of caprylic acid and capric acid) in the nutritional composition of the present technology may be, for example, 0.4 g or more, preferably 0.5 g or more, and more preferably 0.6 g or more per 100 kcal of the nutritional composition. Further, the content of the medium chain fatty acid in the nutritional composition of the present technology may be, for example, 1.4 g or less, preferably 1.2 g or less, and more preferably 1.0 g or less per 100 kcal of the nutritional composition.

[0052] (n-3 Fatty AcidS)

The lipid may include, for example, an n-3 fatty acid. The n-3 fatty acid may include, for example, any one, two, three, or all four of EPA (C20:5), DPA (C22:5), DHA (C22:6), and α-linolenic acid (C18:3). Preferably, the n-3 fatty acid may include any one, two or all three of EPA, DHA, and α-linolenic acid. The n-3 fatty acid may be included in the nutritional composition, for example as fish oil, in particular purified fish oil. For example, it is considered that inclusion of the n-3 fatty acid at a proportion described below contributes to improvement of emulsion stability in the nutritional composition of the present technology.

[0053] The proportion of the content of the n-3 fatty acid to the total fatty acid content of the

lipid is, for example, 5% by mass or more, preferably 7% by mass or more, and more preferably 9% by mass or more.

The proportion of the content of the n-3 fatty acid to the total fatty acid content of the lipid is, for example, 15% by mass or less, preferably 13% by mass or less, and more preferably 11% by mass or less.

[0054] Preferably, the lipid includes α-linolenic acid (C18:3), and the proportion of the content of the α-linolenic acid to the total fatty acid content of the lipid is preferably 3.5% by mass or less, and more preferably 3.25% by mass or less. Further, the proportion of the content of the α-linolenic acid to the total fatty acid content of the lipid is, for example, 1.0% by mass or more, preferably 1.5% by mass or more, more preferably 2.0% by mass or more, and still more preferably 2.5% by mass or more.

[0055] Preferably, the lipid includes EPA (C20:5), and the proportion of the content of the EPA to the total fatty acid content of the lipid is preferably 7.0% by mass or less, more preferably 6.0% by mass or less, still more preferably 5.0% by mass or less, and particularly preferably 4.8% by mass or less. Further, the proportion of the content of the EPA to the total fatty acid content of the lipid is, for example, 1.0% by mass or more, preferably 2.0% by mass or more, more preferably 3.0% by mass or more, and still more preferably 3.5% by mass or more.

[0056] Preferably, the lipid includes DHA (C22:6), and the proportion of the content of the DHA to the total fatty acid content of the lipid is preferably 5.0% by mass or less, more preferably 4.0% by mass or less, still more preferably 3.5% by mass or less, and particularly preferably 3.2% by mass or less. Further, the proportion of the content of the DHA to the total fatty acid content of the lipid is, for example, 1.0% by mass or more, preferably 1.5% by mass or more, more preferably 2.0% by mass or more, and still more preferably 2.5% by mass or more.

[0057] The content of the n-3 fatty acid in the nutritional composition of the present technology may be, for example, 0.05 g or more, preferably 0.15 g or more, and more preferably 0.2 g or more per 100 kcal of the nutritional composition. Further, the content of the n-6 fatty acid in the nutritional composition of the present technology may be, for example, 0.5 g or less, preferably 0.4 g or less, and more preferably 0.3 g or less per 100 kcal of the nutritional composition.

[0058] (Other Unsaturated Fatty Acids)

The lipid may include, for example, an unsaturated fatty acid other than the n-6 fatty acid and the n-3 fatty acid (also referred to as "other unsaturated fatty acid" in the description herein). Examples of such other unsaturated fatty acids include, but are not limited to, palmitoleic acid (C16:1), oleic acid (C18:1), and eicosenoic acid (C20:1).

[0059] In a preferred embodiment, the lipid includes oleic acid (C18:1). The proportion of the content of the oleic acid to the total fatty acid content of the lipid is preferably

17.8% by mass or less, and more preferably 17.6% by mass or less. Further, the proportion of the content of the oleic acid to the total fatty acid content of the lipid is, for example, 10.0% by mass or more, preferably 11.0% by mass or more, more preferably 12.0% by mass or more, and still more preferably 13.0% by mass or more.

[0060] (Saturated Fatty Acids)

The lipid may include a saturated fatty acid. The saturated fatty acid comprises stearic acid and palmitic acid mentioned above.

[0061] The proportion of the content of the saturated fatty acid to the total fatty acid content of the lipid is preferably 56.0% by mass or more, more preferably 56.2% by mass or more, and still more preferably 56.4% by mass or more.

The proportion of the content of the saturated fatty acid to the total fatty acid content of the lipid is preferably 70.0% by mass or less, more preferably 68.0% by mass or less, and still more preferably 65.0% by mass or less.

It is considered that inclusion of the saturated fatty acid at such a proportion contributes to improvement of emulsion stability in the nutritional composition of the present technology.

In the description herein, the content of the saturated fatty acid is the total content of caprylic acid (C8:0), capric acid (C10:0), lauric acid (C12:0), myristic acid (C14:0), pentadecanoic acid (C15:0), palmitic acid (C16:0), heptadecanoic acid (C17:0), stearic acid (C18:0), and arachidic acid (C20:0).

In one embodiment, the present technology provides a nutritional composition containing a protein hydrolysate and a lipid, in which the lipid includes at least a saturated fatty acid, and the proportion of the content of the saturated fatty acid to the total fatty acid content of the lipid is 56.0% by mass or more.

[0062] In a preferred embodiment, the proportion of the content of the saturated fatty acid to the total fatty acid content of the lipid is preferably 62.0% by mass or less, more preferably 61.0% by mass or less, and still more preferably 60.0% by mass or less.

When the proportion of the saturated fatty acid content is equal to or less than such an upper limit value, the emulsion stability of the nutritional composition according to the present technology can be further improved, and for example, separation during heat sterilization can be more effectively prevented.

[0063] (Unsaturated Fatty Acids)

The lipid may include an unsaturated fatty acid. The unsaturated fatty acid includes the n-3 fatty acid and the n-6 fatty acid described above.

[0064] The proportion of the content of the unsaturated fatty acid to the total fatty acid content of the lipid is preferably 25.0% by mass or more, more preferably 27.0% by mass or more, and still more preferably 30.0% by mass or more.

The proportion of the content of the unsaturated fatty acid to the total fatty acid

content of the lipid is preferably 42.0% by mass or less, more preferably 41.8% by mass or less, and still more preferably 41.6% by mass or less.

It is considered that inclusion of the unsaturated fatty acid at such a proportion contributes to improvement of emulsion stability in the nutritional composition of the present technology.

In the description herein, the content of the unsaturated fatty acid is the total content of palmitoleic acid (C16:1), oleic acid (C18:1), linoleic acid (C18:2 n-6), α-linolenic acid (C18:3 n-3), eicosenoic acid (C20:1), arachidonic acid (C20:4 n-6), EPA (C20:5 n-3), DPA (C22:5 n-3), and DHA (C22:6 n-3).

In one embodiment, the present technology provides a nutritional composition containing a protein hydrolysate and a lipid, in which the lipid includes at least a saturated fatty acid, and the proportion of the content of the unsaturated fatty acid to the total fatty acid content of the lipid is 42.0% by mass or less.

[0065] In a preferred embodiment, the proportion of the content of the unsaturated fatty acid to the total fatty acid content of the lipid is preferably 32.0% by mass or more, more preferably 34.0% by mass or more, and still more preferably 36.0% by mass or more.

When the proportion of the unsaturated fatty acid content is equal to or more than such a lower limit value, the emulsion stability of the nutritional composition according to the present technology can be further improved, and for example, separation during heat sterilization can be more effectively prevented.

[0066] (Method for Measuring Fatty Acid Composition)

The proportions of fatty acids mentioned above are determined by the fatty acid composition analysis method described below. The analysis method is a method in which fatty acids are extracted according to the methyl esterification method and then analyzed by capillary gas chromatography.

[0067] (Method for Adjusting Fatty Acid Composition)

The composition of the fatty acid contained in the nutritional composition of the present technology can be appropriately adjusted by adjusting the content of a fatty acid-containing material (for example, extremely hydrogenated oil, fish oil, or the like) blended in the nutritional composition. For example, in order to adjust the content of palmitic acid and/or stearic acid, the content mass of the extremely hydrogenated oil may be adjusted.

[0068] For example, the proportion of the content of the extremely hydrogenated oil to the content of the total lipid contained in the nutritional composition of the present technology may be, for example, 2% by mass or more, preferably 3% by mass or more, and more preferably 4% by mass or more. Further, the proportion of the content of the extremely hydrogenated oil to the content of the total lipid contained in the nutritional composition of the present technology may be, for example, 15% by mass or less,

preferably 13% by mass or less, more preferably 11% by mass or less, and still more preferably 10% by mass or less.

For example, the content of the extremely hydrogenated oil in the nutritional composition of the present technology may be preferably 0.04 g or more, and more preferably 0.06 g or more per 100 kcal of the nutritional composition. The content of the extremely hydrogenated oil in the nutritional composition of the present technology may be preferably 0.25 g or less, more preferably 0.20 g or less, and still more preferably 0.18 g or less per 100 kcal of the nutritional composition. The extremely hydrogenated oil may include palmitic acid and/or stearic acid.

It is considered that inclusion of the extremely hydrogenated oil at such a content proportion contributes to improvement of emulsion stability of the nutritional composition.

[0069] (3) Organic acid ester of monoglycerides

The nutritional composition of the present technology contains an organic acid ester of monoglyceride. The organic acid ester of monoglyceride may be contained in the nutritional composition as an emulsifier. The organic acid ester of monoglyceride may comprise two or more kinds selected from acetic acid ester of monoglyceride, citric acid ester of monoglyceride, succinic acid ester of monoglyceride, diacetyl tartaric acid ester of monoglyceride, and lactic acid ester of monoglyceride. In other words, the nutritional composition may comprise, as the organic acid eter of monoglyceride, two or more esters selected from the group consisting of acetic acid ester of monoglyceride, citric acid ester of monoglyceride, succinic acid ester of monoglyceride, diacetyl tartaric acid ester of monoglyceride, and lactic acid ester of monoglyceride. A combination of two or more of these organic acid esters of monoglyceride can improve emulsion stability in a nutritional composition containing a protein component and a lipid.

The nutritional composition contains one or more emulsifiers, preferably two emulsifiers. In a preferred aspect, the one or more emulsifier is one or more of acetic acid ester of monoglyceride, citric acid ester of monoglyceride, succinic acid ester of monoglyceride, diacetyl tartaric acid ester of monoglyceride, and lactic acid ester of monoglyceride. Preferably, the one or more emulsifier is succinic acid ester of monoglyceride and/or diacetyl tartaric acid ester of monoglyceride. In a preferred aspect, the nutritional composition contains two emulsifiers, wherein the two emulsifiers are succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride. In a particularly preferred aspect, the two emulsifiers, succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride, are the only emulsifiers contained in the composition, i.e. the composition does not contain other emulsifiers. In one aspect, the composition does not contain lecithin. In another aspect, the com-

position does not contain monostearic acid pentaglycerin. In another aspect, the composition does not contain enzyme-degraded lecithin. In another aspect, the composition does not contain lecithin, monostearic acid pentaglycerin and enzyme-degraded lecithin (hydrolyzed lecithin). In another aspect, the composition (only) contains the succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride and does not contain lecithin, monostearic acid pentaglycerin and enzyme-degraded lecithin (hydrolyzed lecithin).

[0070] Preferably, at least one among the organic acid esters of monoglyceride contained in the nutritional composition of the present technology is succinic acid ester of monoglyceride. The succinic acid ester of monoglyceride is particularly suitable for improving emulsion stability in a nutritional composition containing a protein component and a lipid.

[0071] The proportion of the succinic acid ester of monoglyceride to the total amount of the organic acid esters of monoglyceride is, for example, 80% by mass or less, preferably 78% by mass or less, and more preferably 76% by mass or less. Further, the proportion of the succinic acid ester of monoglyceride to the total amount of the organic acid esters of monoglyceride is, for example, 20% by mass or more, preferably 22% by mass or more, and more preferably 24% by mass or more. When the amount of the succinic acid ester of monoglyceride is within such a numerical range, it is possible to more effectively exhibit the effect of improving emulsion stability by the succinic acid ester of monoglyceride.

[0072] Preferably, at least one among the organic acid esters of monoglyceride contained in the nutritional composition of the present technology is diacetyl tartaric acid ester of monoglyceride. Diacetyl tartaric acid ester of monoglyceride is particularly suitable for improving emulsion stability in a nutritional composition containing a protein component and a lipid.

[0073] The proportion of diacetyl tartaric acid ester of monoglyceride to the total amount of the organic acid esters of monoglyceride is, for example, 80% by mass or less, preferably 78% by mass or less, and more preferably 76% by mass or less. Further, the proportion of diacetyl tartaric acid ester of monoglyceride to the total amount of the organic acid esters of monoglyceride is, for example, 20% by mass or more, preferably 22% by mass or more, and more preferably 24% by mass or more. When the amount of diacetyl tartaric acid ester of monoglyceride is within such a numerical range, it is possible to more effectively exhibit the effect of improving emulsion stability by diacetyl tartaric acid ester of monoglyceride.

[0074] Particularly preferably, the organic acid esters of monoglyceride contained in the nutritional composition of the present technology include succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride. The organic acid esters of

monoglyceride may include only, for example, succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride. The combination of the two is particularly suitable for improving emulsion stability in a nutritional composition containing a protein component and a lipid.

[0075] The total amount of the organic acid esters of monoglyceride per 100 kcal of the nutritional composition is, for example, 0.005 g or more, preferably 0.01 g or more, more preferably 0.03 g or more, still more preferably 0.1 g or more, 0.15 g or more, or 0.2 g or more, and particularly preferably 0.25 g or more or 0.3 g (e.g. 0.27 g) or more or 0.4 g or more. Further, the total amount of the organic acid esters of monoglyceride per 100 kcal of the nutritional composition may be, for example, 2.0 g or less, preferably 1.5 g or less, more preferably 1.2 g or less, still more preferably 1.1 g or less or 1.0 g or less, and particularly preferably 0.9 g or less or 0.8 g or less. The numerical range of the total amount may be defined by a value selected from the upper limit value and the lower limit value listed above, and the total amount may be, for example, 0.005 g or more and 2.0 g or less, and preferably 0.03 g or more and 1.2 g or less, or 0.1 g or more and 1.1 g or less.

In a preferred aspect, the total amount of the organic acid esters of monoglyceride per 100 kcal of the nutritional composition is, for example, about 0.4 g or more and about 0.5 g (e.g. about 0.55 g) or less. These ranges are particularly preferred when emulsifier (e.g. the organic acid esters of monoglyceride) are (only) succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride and when the ratio of succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride is the herein preferred ratio as described below, e.g. 2.5:1 to 1:1, particularly preferably 2.5:1 to 1.5:1, and still more preferably 2.2:1 to 1.5:1, most preferably 2:1. Preferably, in this context protein hydrolysates (casein hydrolysate and whey protein hydrolysate) are used as protein components.

In a further preferred aspect, the total amount of the organic acid esters of monoglyceride per 100 kcal of the nutritional composition is, for example, about 0.4 g (e.g. 0.39 g) or more and about 1.1 g or less. These ranges are particularly preferred when emulsifier (e.g. the organic acid esters of monoglyceride) are (only) succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride and when the ratio of succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride is the herein preferred ratio as described below, e.g. 2.5:1 to 1:1, particularly preferably 2.5:1 to 1.5:1, and still more preferably 2.2:1 to 1.5:1, most preferably 2:1. Preferably, in this context proteins (casein, whey protein, and soy protein)are used as protein components.

When the organic acid esters of monoglyceride are contained in the nutritional composition containing a protein component and a lipid in the total amount described

above, the emulsion stability of the nutritional composition is particularly improved.

In addition, the total amount of the organic acid esters of monoglyceride per 100 mL of the nutritional composition may be, for example, 0.005 g or more, preferably 0.01 g or more, and more preferably 0.05 g or more, 0.1 g or more, 0.2 g or more, 0.25 g or more, 0.3 g or more, 0.35 g or more, or 0.4 g or more, or 0.6 g or more. Further, the total amount of the organic acid esters of monoglyceride per 100 mL of the nutritional composition may be, for example, 2.0 g or less, preferably 1.9 g or less, and more preferably 1.8 g or less, 1.7 g or less, 1.6 g or less, or 1.5 g or less, or 1.2 g or less, or 0.8 g or less. The numerical range of the total amount may be defined by a value selected from the upper limit value and the lower limit value listed above, and the total amount may be, for example, 0.005 g or more and 2.0 g or less, and preferably 0.4 g or more and 1.5 g or less.

In a preferred aspect, the total amount of the organic acid ester of monoglycerides per 100 mL of the nutritional composition is, for example, about 0.6 g or more and about 0.8 g (e.g. 0.84 g) or less. These ranges are particularly preferred when emulsifier (e.g. the organic acid ester of monoglycerides) are (only) succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride and when the ratio of succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride is the herein preferred ratio as described below, e.g. 2.5:1 to 1:1, particularly preferably 2.5:1 to 1.5:1, and still more preferably 2.2:1 to 1.5:1, most preferably 2:1. Preferably, in this context protein hydrolysates (casein hydrolysate and whey protein hydrolysate) are used as protein components.

In a further preferred aspect, the total amount of the organic acid esters of monoglyceride per 100 ml of the nutritional composition is, for example, about 0.4 g or more and about 1.2 g or less. These ranges are particularly preferred when emulsifier (e.g. the organic acid esters of monoglyceride) are (only) succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride and when the ratio of succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride is the herein preferred ratio as described below, e.g. 2.5:1 to 1:1, particularly preferably 2.5:1 to 1.5:1, and still more preferably 2.2:1 to 1.5:1, most preferably 2:1. Preferably, in this context proteins (casein, whey protein, and soy protein)are used as protein components.

When the organic acid esters of monoglyceride are contained in the nutritional composition containing a protein component and a lipid in the total amount described above, the emulsion stability of the nutritional composition is particularly improved.

[0076] In one embodiment, the organic acid esters of monoglyceride are a combination of succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride, and the upper limit value and the lower limit value listed above for the total amount of

the organic acid esters of monoglyceride apply to the total amount of the combination per 100 kcal of the nutritional composition. That is, the numerical range of the total amount of the combination per 100 kcal of the nutritional composition may be defined by any of the upper limit values or any of the lower limit values listed above, or may be defined by any of the upper limit values and any of the lower limit values listed above. In this embodiment, the emulsion stability in a nutritional composition containing a protein component and a lipid is particularly improved.

[0077] When the nutritional composition of the present technology contains succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride, the content mass ratio of these two components [(mass of succinic acid ester of monoglyceride):(mass of diacetyl tartaric acid ester of monoglyceride)] is, for example, 5:1 to 1:5, preferably 4:1 to 1:4, and more preferably 3:1 to 1:3,and as a concrete ratio 1:3, 1:1, and 1:3 are preferable. With such a mass ratio, the effect of improving emulsion stability by the combination of these two components is more remarkably exhibited.

In a particularly preferred embodiment, the content mass ratio of these two components [(mass of succinic acid ester of monoglyceride):(mass of diacetyl tartaric acid ester of monoglyceride)] is 2.5:1 to 1:1, particularly preferably 2.5:1 to 1.5:1, and still more preferably 2.2:1 to 1.5:1.

When the two components are contained at such a ratio, a particularly excellent effect of improving emulsion stability is exhibited.

[0078] (Numerical Ranges of Contents of Succinic Acid ester of Monoglyceride and Diacetyl Tartaric Acid ester of Monoglyceride)

In one embodiment, the nutritional composition of the present technology contains a protein component, a lipid, and an organic acid ester of monoglyceride, wherein the organic acid ester of monoglyceride comprises succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride.

In this embodiment, the content of the succinic acid ester of monoglyceride per 100 kcal of the nutritional composition may be, for example, 0.0001 g or more, 0.001 g or more, or 0.01 g or more, preferably 0.02 g or more, more preferably 0.06 g or more, still more preferably 0.1 g or more or 0.14 g or more, and particularly preferably 0.17 g or more or 0.2 g or more. The content of the succinic acid ester of monoglyceride per 100 kcal of the nutritional composition may be, for example, 1.5 g or less or 1.3 g or less, preferably 1.1 g or less, more preferably 1.0 g or less, still more preferably 0.9 g or less or 0.8 g or less, and particularly preferably 0.7 g or less or 0.6 g or less.

In this embodiment, the content of the diacetyl tartaric acid ester of monoglyceride per 100 kcal of the nutritional composition may be, for example, 0.0001 g or more or 0.001 g or more, preferably 0.01 g or more, more preferably 0.03 g or more, and still more preferably 0.05 g or more. The content of the diacetyl tartaric acid ester of mono-

glyceride per 100 kcal of the nutritional composition may be, for example, 1.0 g or less or 0.8 g or less, preferably 0.6 g or less, more preferably 0.5 g or less, still more preferably 0.4 g or less, and particularly preferably 0.3 g or less.

In a particularly preferred embodiment, the organic acid ester of monoglyceride is succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride (in other words, the nutritional composition comprises, as the organic acid ester of monoglyceride, a combination of succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride), and the content of the succinic acid ester of monoglyceride per 100 kcal of the nutritional composition is 0.1 g to 0.6 g and the content of the diacetyl tartaric acid ester of monoglyceride per 100 kcal of the nutritional composition is 0.05 g to 0.3 g.

Further, in this embodiment, the content of the succinic acid ester of monoglyceride per 100 mL of the nutritional composition may be, for example, 0.0001 g or more, 0.001 g or more, or 0.01 g or more, preferably 0.05 g or more, more preferably 0.1 g or more, and still more preferably 0.15 g or more, 0.2 g or more, or 0.25 g or more. The content of the succinic acid ester of monoglyceride per 100 mL of the nutritional composition may be, for example, 1.5 g or less, preferably 1.4 g or less, more preferably 1.3 g or less, and still more preferably 1.2 g or less, 1.1 g or less, or 1.0 g or less.

In this embodiment, the content of the diacetyl tartaric acid ester of monoglyceride per 100 mL of the nutritional composition may be, for example, 0.0001 g or more, 0.001 g or more, or 0.01 g or more, preferably 0.05 g or more, more preferably 0.07 g or more, and still more preferably 0.08 g or more, 0.09 g or more, or 0.1 g or more. The content of the diacetyl tartaric acid ester of monoglyceride per 100 mL of the nutritional composition may be, for example, 1.0 g or less, preferably 0.9 g or less, more preferably 0.8 g or less, and still more preferably 0.7 g or less, 0.6 g or less, or 0.5 g or less.

In the above embodiment, the emulsion stability in a nutritional composition containing a protein component and a lipid is particularly improved.

[0079] (Total Content of Succinic Acid ester of Monoglyceride and Diacetyl Tartaric Acid ester of Monoglyceride and Ratio thereof)

In one embodiment, the nutritional composition of the present technology contains a protein component, a lipid, and an organic acid ester of monoglyceride, wherein the organic acid ester of monoglyceride is succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride.

In this embodiment, the total content of the succinic acid ester of monoglyceride and the diacetyl tartaric acid ester of monoglyceride per 100 kcal of the nutritional composition is, for example, 0.005 g or more, preferably 0.01 g or more, more preferably 0.03 g or more, still more preferably 0.1 g or more, 0.15 g or more, or 0.2 g or more, and particularly preferably 0.25 g or more. Further, the total amount of the organic acid

ester of monoglycerides per 100 kcal of the nutritional composition may be, for example, 2.0 g or less, preferably 1.5 g or less, more preferably 1.2 g or less, still more preferably 1.1 g or less or 1.0 g or less, and particularly preferably 0.9 g or less or 0.8 g or less.

In addition, the total amount of the succinic acid ester of monoglyceride and the diacetyl tartaric acid ester of monoglyceride per 100 mL of the nutritional composition may be, for example, 0.005 g or more, preferably 0.01 g or more, and more preferably 0.05 g or more, 0.1 g or more, 0.2 g or more, 0.25 g or more, 0.3 g or more, 0.35 g or more, or 0.4 g or more. Further, the total amount of the succinic acid ester of monoglyceride and the diacetyl tartaric acid ester of monoglyceride per 100 mL of the nutritional composition may be, for example, 2.0 g or less, preferably 1.9 g or less, and more preferably 1.8 g or less, 1.7 g or less, 1.6 g or less, or 1.5 g or less. The numerical range of the total amount may be defined by a value selected from the upper limit value and the lower limit value listed above, and the total amount may be, for example, 0.005 g or more and 2.0 g or less, and preferably 0.4 g or more and 1.5 g or less.

In this embodiment, the content ratio of the succinic acid ester of monoglyceride and the diacetyl tartaric acid ester of monoglyceride per 100 kcal of the nutritional composition [(succinic acid ester of monoglyceride content):(diacetyl tartaric acid ester of monoglyceride content)] is preferably 3:1 to 1:3, and more preferably 3:1 to 1:2.

In the above embodiment, the emulsion stability in a nutritional composition containing a protein component and a lipid is particularly improved.

[0080] (4) Other Components

The nutritional composition of the present technology may further contain other components. As examples of the other components, the nutritional composition comprises mineral salts, carbonhydrates, amino acids, vitamins, and other nutritional components. The nutritional composition of the present technology may contain one or more of these other components.

In addition, as the other components, one or more additives selected from an emulsifier, a thickener, and a gelling agent may be contained.

These other components may be appropriately selected depending on, for example, the subject to which the nutritional composition is administered or the purpose of administration thereof.

[0081] The salts may include one or more of calcium salts, magnesium salts, sodium salts, and potassium salts.

[0082] As the calcium salt, any one or a combination of two or more of calcium chloride, calcium hydroxide, tricalcium phosphate, calcium carbonate, calcium citrate, calcium sulfate, and calcium oxide may be included in the nutritional composition of the present technology. In other words, the nutritional composition of the present

technology may comprise any one or a combination of two or more of calcium salts selected from the group consisting of calcium chloride, calcium hydroxide, tricalcium phosphate, calcium carbonate, calcium citrate, calcium sulfate, and calcium oxide. The total content of the calcium salts may be preferably 0.05 g or more, more preferably 0.10 g or more, and still more preferably 0.12 g or more per 100 kcal of the nutritional composition. Further, the total content of the calcium salts may be preferably 0.7 g or less, more preferably 0.5 g or less, and still more preferably 0.4 g or less per 100 kcal of the nutritional composition.

[0083] As the magnesium salt, one or a combination of two or more of trimagnesium phosphate, magnesium carbonate, and magnesium chloride may be included in the nutritional composition of the present technology. In other words, the nutritional composition of the present technology may comprise any one or a combination of two or more of calcium salts selected from the group consisting of trimagnesium phosphate, magnesium carbonate, and magnesium chloride. The total content of the magnesium salts may be preferably 0.06 g or more, more preferably 0.10 g or more, and still more preferably 0.13 g or more per 100 kcal of the nutritional composition. Further, the total content of the magnesium salts may be preferably 0.6 g or less, more preferably 0.4 g or less, and still more preferably 0.3 g or less per 100 kcal of the nutritional composition.

[0084] For example, the nutritional composition may include one, two, or all three of sodium pyrophosphate, trisodium citrate, and sodium ferrous citrate as the sodium salts. The total content of the sodium salts may be, for example, 0.06 g or more, and preferably 0.13 g or more per 100 kcal of the nutritional composition. The total content of the sodium salts may be, for example, 0.4 g or less, and preferably 0.3 g or less per 100 kcal of the nutritional composition.

[0085] For example, the nutritional composition may include any one, two, or three of potassium chloride, potassium carbonate, and dipotassium hydrogen phosphate as the potassium salts. The total content of the potassium salts may be, for example, 0.06 g or more, and preferably 0.13 g or more per 100 kcal of the nutritional composition. The total content of the potassium salts may be, for example, 0.4 g or less, and preferably 0.3 g or less per 100 kcal of the nutritional composition.

[0086] In addition, the nutritional composition may further contain a copper salt and/or a zinc salt. Examples of the copper salt include copper gluconate. Examples of the zinc salt include zinc gluconate. The content of any of these salts may be, for example, 0.04 g or less, and particularly 0.02 g or less per 100 kcal of the nutritional composition.

[0087] The carbonhydrates may include saccharides used in foods, such as monosaccharides, disaccharides, oligosaccharides, and polysaccharides. Among them, polysaccharides are preferable. The polysaccharide is, for example, dextrin. That is, the nu-

tritional composition may contain, for example, dextrin.

[0088] The content of the saccharides (particularly dextrin) may be, for example, 3 g or more, preferably 5 g or more, and more preferably 7 g or more per 100 kcal of the nutritional composition. The content of the saccharides (particularly dextrin) may be, for example, 22 g or less, preferably 20 g or less, and more preferably 18 g or less per 100kcal of the nutritional composition.

[0089] The amino acids may include, for example, branched chain amino acids (BCAA), i.e., any one, two, or all three of valine, leucine, and isoleucine. Preferably, the nutritional composition contains leucine.

The content of the amino acids (in particular, the total content of branched chain amino acids) may be, for example, 0.2 g or more, preferably 0.4 g or more, and more preferably 0.6 g or more per 100 kcal of the nutritional composition. Further, the content of the amino acids (in particular, the total content of branched chain amino acids) may be, for example, 6.0 g or less, preferably 4.0 g or less, and more preferably 3.0 g or less per 100 kcal of the nutritional composition.

The content of the leucine may be, for example, 0.1 g or more, preferably 0.2 g or more, and more preferably 0.3 g or more per 100 kcal of the nutritional composition. The content of the leucine may be, for example, 3.0 g or less, preferably 2.0 g or less, and more preferably 1.5 g or less per 100 kcal of the nutritional composition.

[0090] The vitamins may include, for example, one or more of vitamin A, vitamin D, vitamin E, and vitamin K, which may be classified as fat-soluble vitamins, vitamin B group (vitamin B_1, vitamin B_2, vitamin B_6, vitamin B_{12}, niacin, pantothenic acid, folic acid, and biotin), which may be classified as water-soluble vitamins, and vitamin C.

The content of vitamin A may be, for example, 20 μgRAE or more, preferably 40μgRAE or more, and more preferably 60 μgRAE or more per 100 kcal of the nutritional composition. Also, the content of vitamin A may be, for example, 400 μgRAE or less, preferably 300 μgRAE or less, and more preferably 200 μgRAE or less per 100 kcal of the nutritional composition.

The content of vitamin D may be, for example, 0.2 μg or more, preferably 0.5 μg or more, and more preferably 0.7 μg or more per 100 kcal of the nutritional composition. Also, the content of vitamin D may be, for example, 5.0 μg or less, preferably 4.0 μg or less, and more preferably 3.0 μg or less per 100 kcal of the nutritional composition.

The content of vitamin E may be, for example, 0.2 mg or more, preferably 0.5 mg or more, and more preferably 0.7 mg or more per 100 kcal of the nutritional composition. Also, the content of vitamin E may be, for example, 5.0 mg or less, preferably 4.0 mg or less, and more preferably 3.0 mg or less per 100 kcal of the nutritional composition.

The content of vitamin K may be, for example, 2.0 μg or more, preferably 4.0 μg or more, and more preferably 5.0 μg or more per 100 kcal of the nutritional composition.

Also, the content of vitamin K may be, for example, 25 μg or less, preferably 20 μg or less, and more preferably 15 μg or less per 100 kcal of the nutritional composition.

The content of vitamin B_1 may be, for example, 0.05 mg or more, preferably 0.15 mg or more, and more preferably 0.2 mg or more per 100 kcal of the nutritional composition. Also, the content of vitamin B_1 may be, for example, 1.6 mg or less, preferably 1.2 mg or less, and more preferably 0.8 mg or less per 100 kcal of the nutritional composition.

The content of vitamin B_2 may be, for example, 0.05 mg or more, preferably 0.15 mg or more, and more preferably 0.2 mg or more per 100 kcal of the nutritional composition. Also, the content of vitamin B_2 may be, for example, 1.8 mg or less, preferably 1.4 mg or less, and more preferably 1.0 mg or less per 100 kcal of the nutritional composition.

The content of vitamin B_6 may be, for example, 0.1 mg or more, preferably 0.2 mg or more, and more preferably 0.3 mg or more per 100 kcal of the nutritional composition. Also, the content of vitamin B_6 may be, for example, 1.8 mg or less, preferably 1.4 mg or less, and more preferably 1.2 mg or less per 100 kcal of the nutritional composition.

The content of vitamin B_{12} may be, for example, 0.2 μg or more, preferably 0.3 μg or more, and more preferably 0.4 μg or more per 100 kcal of the nutritional composition. Also, the content of vitamin B_{12} may be, for example, 3.0 μg or less, preferably 2.5 μg or less, and more preferably 2.0 μg or less per 100 kcal of the nutritional composition.

The niacin equivalent may be, for example, 2 mgNE or more, preferably 3 mgNE or more, and more preferably 3.5 mgNE or more per 100 kcal of the nutritional composition. Also, the niacin equivalent may be, for example, 15 mgNE or less, preferably 12 mgNE or less, and more preferably 10 mgNE or less per 100 kcal of the nutritional composition.

The content of pantothenic acid may be, for example, 0.2 mg or more, preferably 0.6 mg or more, and more preferably 1.0 mg or more per 100 kcal of the nutritional composition. Also, the content of pantothenic acid may be, for example, 6.0 mg or less, preferably 5.0 mg or less, and more preferably 4.0 mg or less per 100 kcal of the nutritional composition.

The content of folic acid may be, for example, 10 μg or more, preferably 20 μg or more, and more preferably 30 μg or more per 100 kcal of the nutritional composition. Also, the content of folic acid may be, for example, 250 μg or less, preferably 200 μg or less, and more preferably 150 μg or less per 100 kcal of the nutritional composition.

The content of biotin may be, for example, 2.0 μg or more, preferably 3.0 μg or more, and more preferably 4.0 μg or more per 100 kcal of the nutritional composition. Also, the content of biotin may be, for example, 25 μg or less, preferably 20 μg or less, and more preferably 15 μg or less per 100 kcal of the nutritional composition.

The content of vitamin C may be, for example, 5 mg or more, preferably 10 mg or more, and more preferably 15 mg or more per 100 kcal of the nutritional composition. Also, the content of vitamin C may be, for example, 100 mg or less, preferably 80 mg or less, and more preferably 60 mg or less per 100 kcal of the nutritional composition.

[0091] Examples of the other nutrient components include trace minerals (or, microminerals or trace elements) and carnitine. The trace mineral may be, for example, mineral enriched yeast. Examples of minerals included in the trace minerals include iron, zinc, copper, manganese, iodine, selenium, chromium, and molybdenum.

[0092] The nutritional compositions of the present technology may contain components such as, for example, water, sweeteners, fruit juices, vegetable juices, flavors, food colorings, and acidulants. The type and content proportion of these components may be appropriately selected by those skilled in the art according to the desired physical properties, shape, taste, or appearance.

[0093] (5) Physical Properties of Nutritional Composition

The nutritional composition of the present technology may have fluidity, for example, may be in a liquid or paste form, or may be in a gel form having fluidity.

[0094] The nutritional composition of the present technology may be in a state of emulsion, and is preferably an oil-in-water type emulsion (O/W type).

[0095] The water content in the nutritional composition of the present technology may be, for example, 20 g or more, preferably 30 g or more, and more preferably 40 g or more per 100 kcal of the nutritional composition. Further, the water content may be, for example, 200 g or less, preferably 180 g or less, and more preferably 160 g or less with respect to 100 kcal of the nutritional composition.

[0096] Since the nutritional composition of the present technology have fluidity, for example, the elderly can easily ingest the nutritional composition, and the nutritional composition can be administered to a subject by tube feeding. Various physical properties of the nutritional composition of the present technology may be set as follows, for example.

[0097] The nutritional composition of the present technology may have a pH value of, for example, 6.0 to 8.0, preferably 6.3 to 7.7, and more preferably 6.5 to 7.5 at 20°C.

[0098] The specific gravity at 20°C of the nutritional composition of the present technology may be, for example, 1.0 to 1.5, preferably 1.01 to 1.4, and more preferably 1.02 to 1.2.

[0099] The viscosity at 20°C of the nutritional composition of the present technology may be, for example, 1 mPa·s to 30000 mPa·s, preferably 5 mPa·s to 1800 mPa·s, and more preferably 10 mPa·s to 100 mPa·s. In an embodiment of the present technology, the viscosity at 20°C of the nutritional composition of the present technology may be, for example, 200

mPa·s or less, preferably 100 mPa·s or less, and more preferably 50 mPa·s or less. Such a viscosity allows the nutritional composition to be easily used as an enteral nutrient.

[0100] In an embodiment of the present technology, the amount of energy(or the caloric density) per 1 mL of the nutritional composition of the present technology may be, for example, 0.5 kcal or more, 0.6 kcal or more, 0.7 kcal or more, 0.8 kcal or more, or 0.9 kcal or more. This high amount of energy per 1 mL of composition allows for efficient energy intake. In this embodiment, the amount of energy per 1 mL of the nutritional composition of the present technology may be, for example, 3 kcal or less, 2 kcal or less, or 1.8 kcal or less. For example, the nutritional composition of the present technology may have an amount of energy per 1 mL of 1.5 kcal.

[0101] (6) Food and Drink Composition

The nutritional composition of the present technology may be used as a food and drink composition. The food and drink composition in the present technology may have, for example, a liquid or paste form.

[0102] In addition, the food and drink composition of the present technology may be used as an enteral nutrient, and may be constituted as, for example, an artificial concentrated liquid diet. The food and drink composition of the present technology may be constituted as, for example, a semi-elemental formula, a polymeric formula, or a component nutrition agent, but is preferably a semi-elemental formula. The semi-elemental formula does not contain intact protein.

[0103] The food and drink composition of the present technology can be provided or sold as a food and drink with an indication for use, such as for supplying nutrients to patients in an acute phase or for supplying nutrients to patients immediately after onset of a disease. In addition, the food and drink composition of the present technology can be provided and/or sold by being indicated with, for example, “a person in an acute phase” or “a person suffering from diarrhea” as a subject to be ingested. The term “indication” includes all acts to make a user aware of the use of the composition of the present technology. Any expression that can recall and/or analogize the use falls under the term “indication” of the present technology, regardless of the purpose of the indication, the content of the indication, the object and/or the medium to be indicated.

[0104] Further, it is preferable that the “indication” is performed by an expression in which a user can directly recognize the use. Specifically, it includes the act of transferring, delivering, exhibiting for the purpose of transferring or delivering, or importing goods pertaining to food and drink, or packages of such goods with the aforementioned intended use stated on them; the act of exhibiting or distributing advertisements, price lists, or transaction documents relating to such goods with the aforementioned intended use stated on them, or providing information containing such information with the

aforementioned intended use stated on them by electromagnetic (Internet, etc.) means, etc.

[0105] On the other hand, it is preferable that the contents of the indication be an indication approved by the government, etc. (e.g., an indication that is approved based on various systems established by the government and in a manner based on such approval, etc.). In addition, it is preferable to attach such contents of the indication to a package, a container, a catalog, a pamphlet, a promotional material at a sales site such as a point-of purchase (POP) sign, or other documents.

[0106] Examples of the "indication" also include indications as health foods, functional foods, enteral nutrition foods, food for special dietary uses, health-promoting foods, foods for specified health use, foods with nutrient function claims, foods with functional claims, quasi-drugs, and the like.

[0107] (7) Pharmaceutical Composition

The nutritional composition of the present technology may be used as a pharmaceutical composition. The pharmaceutical composition in the present technology may have, for example, a liquid or paste form.

[0108] The pharmaceutical composition of the present technology may be used as an enteral nutrient, and may be constituted as, for example, an artificial concentrated liquid food. The pharmaceutical composition of the present technology may be constituted as, for example, a semi-elemental formula, a Polymeric formula, or a component nutrition agent, but is preferably a semi-elemental formula. The semi-elemental formula does not contain intact protein.

[0109] When the composition according to the present technology is used as a pharmaceutical composition, the pharmaceutical composition may be administered by either oral administration or parenteral administration, and can be appropriately formulated into a desired dosage form depending on the administration method. For example, for oral administration, it may be formulated into a desired dosage form (liquid or paste). For parenteral administration, the composition of the present technology may be administered via, for example, gastric fistula, and may be administered, for example, enterally.

[0110] In addition, at the time of formulation, the pharmaceutical composition according to the present technology may contain components of additives (for example, a pH adjusting agent, a coloring agent, and a flavoring agent) which are usually used for formulation. In addition, as long as the effect of the present technology is not impaired, the pharmaceutical composition according to the present technology may include a known component or a component to be found in the future for improving a condition for acute phase patients.

In addition, formulation can be carried out by a known method as appropriate

depending on the dosage form. In formulation, a formulation carrier may be blended as appropriate to prepare a formulation.

[0111] (8) Method for Producing Nutritional Composition

The method for producing a nutritional composition of the present technology includes a mixing step of mixing a protein component, a lipid, and organic acid ester of monoglycerides. The mixing may be carried out by mixing the components in a liquid medium, in particular water. A mixture is obtained by the mixing. The mixing may be carried out such that the mixture has an emulsified state, for example to form an oil-in-water type emulsion. For example, protein components (e.g., casein hydrolysate and/or whey protein hydrolysate), carbonhydrates, and mineral salts are dissolved in water at 55°C to 65°C. After the dissolution, fats and oils and an emulsifier are added thereto, and the mixture is stirred and mixed, and then homogenized with 50 MPa. In this way, the nutritional composition of the present technology may be produced.

[0112] The protein component, the lipid, and the organic acid ester of monoglycerides are as described above in (1), (2), and (3), respectively. The blending amount of these components may be set according to the content of each component in the nutritional composition to be produced. In the mixing step, the other components described in (4) above may also be mixed.

[0113] The production method may include a sterilization step of sterilizing the nutritional composition obtained by the mixing in the mixing step. The sterilization may be performed by any technique known in the art, for example, retort sterilization, sterilization by indirect contact (plate type, tubular type, or scraping type), sterilization by direct contact (steam injection type or steam infusion type), and the like.

[0114] The production method may further include a filling step of filling a container with the composition obtained in the mixing step before or after the sterilization step. When the filling step is performed after the sterilization step, the filling step may be performed aseptically. The container can be, for example, a paper pack, plastic bag, plastic bottle, plastic cup, aluminum pouch, metallic can, or glass container. By the filling step, the container is filled with the nutritional composition. The nutritional compositions of the present technology may be sold in a state of being filled in the container.

Thus, in another aspect, the present technology also provides a method for manufacturing a nutritional composition comprising a protein component, a lipid, and an organic acid ester of monoglyceride. Specifically, in some preferable embodiments, the method is configured as follows;

(1) A method for manufacturing a nutritional composition, which comprises a mixing step of obtaining a mixture by mixing a protein component, a lipid, and an organic acid ester of monoglyceride, wherein the organic acid ester of monoglyceride comprises

two or more kinds selected from acetic acid ester of monoglyceride, citric acid ester of monoglyceride, succinic acid ester of monoglyceride, diacetyl tartaric acid ester of monoglyceride, and lactic acid monoglyceride; preferably the organic acid ester of monoglyceride comprises at least one of succinic acid ester of monoglyceride or diacetyl tartaric acid ester of monoglyceride; more preferably the organic acid ester of monoglyceride comprises succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride.

(2) The method according to (1), the method further comprises a sterilization step of sterilizing the mixture obtained by the mixing in the mixing step, wherein the sterilizing is performed by heat sterilization, such as retort sterilization, sterilization by indirect contact, or sterilization by direct contact.

(3) The method according to (2), wherein the sterilizing is performed at 120 to 150 °C for 0.5 to 15 minutes, preferably at 130 °C for 10 minutes, by retort sterilization treatment, or the sterilizing is performed at 130 to 160 °C for 1 to 90 seconds by direct or indirect sterilization treatment.

(4) The method according to any one of (1) to (3), the method further comprises a filling step of filling a container with the composition obtained in the mixing step before or after the sterilization step, and optionally comprises a storage step of preserving the composition for long-term.

Furthermore, the nutritional composition obtained by the method is also other aspect of the invention, which is a nutritional composition manufactured by the above mentioned method according to any one of (1) to (3), preferably the nutritional composition is a sterilized composition.

[0115] (9) Method of Using Nutritional Composition

The subject of administration of the nutritional composition of the present technology may be an animal, particularly a mammal, more particularly a primate, even more particularly a human or a non-human primate, and particularly preferably a human. When the subject to which the composition of the present technology is administered is a human, the age of the human may be, for example, 0 to 120 years old.

Particularly preferably, the nutritional compositions of the present technology are administered to patients in the acute phase, such as after surgery, or to patients with diarrhea. The nutritional composition of the present technology contains a protein hydrolysate, wherein the protein hydrolysate does not need to be digested for absorption. Therefore, the nutritional compositions are suitable for providing nutrition to such patients.

[0116] The nutritional compositions of the present technology may be ingested or served, for example, orally or by tube feeding. In the latter case, the nutritional compositions of the present technology are administered to a human, for example, via gastric fistula.

The compositions of the present technology are preferably flowable, such that the nutritional compositions are suitable for tube administration to tube-fed patients.

[0117] In one embodiment of the present technology, the nutritional composition of the present technology may be administered such that an amount of energy of, for example, 500 kcal to 2000 kcal, preferably 600 kcal to 1500 kcal, and preferably 800 kcal to 1200 kcal per day is given to an administration subject by the nutritional composition of the present technology. For example, an amount of energy of 200 kcal to 500 kcal per administration may be provided to a subject by the composition of the present technology, and the administration may be performed 1 to 10 times, 2 to 8 times, or 2 to 5 times per day.

The nutritional composition of the present technology may be administered on a regular basis, such as daily or at intervals such as every other day or every two days. The compositions of the present technology may be administered over a period of, for example, one week or more, two weeks or more, three weeks or more. The upper limit of the administration period of the nutritional composition of the present technology may not be set, and may be, for example, three years or less, two years or less, one year or less, or the like, but may be administered without determining the end time of the administration period.

[0118] Hereinafter, the present technology will be described in more detail with reference to examples, but the present technology is not limited to these examples.

Examples

[0119] <Experiment 1>

A nutritional composition was prepared with the following raw material composition per 100 mL of the nutritional composition. That is, casein hydrolysate (manufactured by Morinaga Milk Industry Co., Ltd., casein hydrolysate content 88%, number average molecular weight 330) 4.5 g, whey protein hydrolysate (manufactured by Morinaga Milk Industry Co., Ltd., whey protein hydrolysate content 75%, number average molecular weight 450) 2.3 g, dextrin (manufactured by Matsutani Chemical Industry Co., Ltd., standard 67° Bx) 35 g, trisodium citrate, potassium carbonate, dipotassium hydrogenphosphate, calcium chloride, and trimagnesium phosphate were added to a water at 60°C and mixed and dissolved. Mixed fats and oils (vegetable fats and oils, medium-chain fatty acids, and purified fish oils) 3.3 g, and an emulsifier (two or three of lecithin, succinic acid ester of monoglyceride, diacetyl tartaric acid ester of monoglyceride, monostearic acid pentaglycerin, and enzyme-degraded lecithin) were further added thereto, followed by stirring and mixing. The emulsifier was composed of a component composition as shown in Table 1 below. As the configuration of the emulsifier, four patterns of Examples 1 to 4 shown in the same table were prepared.

[0120]

[Table 1]

Table 1: Emulsifier composition (amount per 100 mL)

		Example 1	Example 2	Example 3	Example 4
Emulsifier	Lecithin	–	0.20 g	0.20 g	0.20 g
	Succinic acid ester of monoglyceride	0.10 g	0.10 g	0.10 g	0.10 g
	Diacetyl tartaric acid ester of monoglyceride	0.30 g	0.30 g	–	–
	Monostearic acid pentaglycerin	–	–	0.30 g	–
	Enzymatic hydrolysis of lecithin	–	–	–	0.30 g
Emulsion stability	Emulsified liquid	AA	A	A	A
	Retort sterilization	AA	A	B	B

[0121] After the stirring and mixing, the mixture was subjected to homogenization treatment using a high-pressure homogenizer (manufactured by APV Co., Ltd.) at 50 MPa. After the homogenization treatment, each 100 mL of the obtained emulsified liquid (also referred to as a modified milk liquid) was filled in a retort pouch (manufactured by Toyo Seikan Co., Ltd.), sealed, and subjected to retort sterilization treatment at 130°C for 3 minutes using a retort sterilizer (manufactured by Hisaka Works, Ltd.) to produce a liquid nutritional composition. Hereinafter, the liquid nutritional compositions produced using the emulsifiers of Examples 1 to 4 are also referred to as "the nutritional composition of Example 1" to "the nutritional composition of Example 4", respectively.

[0122] The energy of these nutritional compositions produced was 150 kcal (per 100 mL of nutritional composition), the protein component content was 3.8 g (per 100 kcal of nutritional composition), the lipid content was 2.7 g (per 100 kcal of nutritional composition), the carbonhydrate content was 15.2 g (per 100 kcal of nutritional composition), and the moisture content was 52 g (per 100 kcal of nutritional composition).

[0123] The nutritional compositions of Examples 1 to 4 were evaluated for emulsion stability. The evaluation was performed by visually confirming the state of the emulsified liquid after the homogenization treatment and before the retort sterilization and the state of the nutritional composition after one day from the retort sterilization. The evaluation criteria are as follows. The evaluation results are shown in Table 1 above.

AAA: Emulsified very well and had a more homogeneous appearance than AA.

AA: Separation of lipid components could not be observed and the nutritional composition was emulsified well.

A: Lipid components were slightly separated and floated to the top of the nutritional composition, but were mostly emulsified.

B: A large amount of lipid components were separated.

[0124] As shown in Table 1 above, the nutritional composition of Example 1 was well emulsified in the state of the modified milk liquid before retort sterilization. The nutritional composition of Example 1 was well emulsified even in the state after retort sterilization.

In addition, regarding the nutritional compositions of Examples 2 to 4, slight separation of the lipid component was observed in the state of the modified milk liquid before retort sterilization, but they were substantially emulsified. However, after retort sterilization, the nutritional composition of Example 2 was still substantially emulsified, but a large amount of separation of the lipid components was observed for the nutritional compositions of Examples 3 and 4.

From the comparison of Example 2 with Examples 3 and 4, it can be seen that the emulsion stability in the nutritional composition containing a protein component and a lipid can be improved by combining two kinds of organic acid ester of monoglycerides.

In addition, from the comparison between Example 1 and Example 2, it can be seen that even more excellent emulsion stability can be obtained when lecithin is not contained as an emulsifier than when lecithin is contained as an emulsifier. It is also believed that containing only an organic acid ester of monoglyceride as an emulsifier is desirable for emulsion stability in the nutritional composition containing a protein component and a lipid.

[0125] <Experiment 2>

An emulsified liquid was obtained by the same production method as in Experiment 1 except that the composition of the emulsifier shown in Table 2 below was adopted. The emulsified liquid was subjected to sterilization treatment at 151°C for 4 seconds using a direct steam injection sterilizer (manufactured by MicroThermics Inc.), and then filled in sterilized PET bottles (manufactured by Toyo Seikan Co., Ltd.) by 200 mL in an aseptic environment to produce a liquid nutritional composition. The liquid nutritional compositions produced using the emulsifiers of Examples 5 and 6 are also referred to as “the nutritional composition of Example 5” and “the nutritional composition of Example 6”, respectively.

Table 2 below also shows the total amount of the succinic acid ester of monoglyceride and the diacetyl tartaric acid ester of monoglyceride (per 100 mL of the nutritional composition and per 100 kcal of the nutritional composition) and the proportion (% by mass) of each of the succinic acid ester of monoglyceride and the diacetyl tartaric acid ester of monoglyceride to the total amount. The same applies to Tables 3 to 6 which will be described later.

[0126]

[Table 2]

Table 2: Emulsifier composition

			Example 5	Example 6
Emulsifier	Amount per 100 mL of Nutritional composition	Succinic acid ester of monoglyceride (M1)	0.30 g	0.10 g
		Diacetyl tartaric acid ester of monoglyceride (M2)	0.10 g	0.30 g
		Total amount (M1 + M2)	0.40 g	0.40 g
	Energy per 100 mL of Nutritional composition		150 kcal	150 kcal
	Amount per 100 kcal of Nutritional composition	Succinic acid ester of monoglyceride (M1')	0.20 g	0.067 g
		Diacetyl tartaric acid ester of monoglyceride (M2')	0.067 g	0.20 g
		Total amount (M1' + M2')	0.27 g	0.27 g
	Proportion (% by mass)	Succinic acid ester of monoglyceride	75%	25%
		Diacetyl tartaric acid ester of monoglyceride	25%	75%
Emulsion stability	After sterilization by direct steam injection, 37°C, 1 month storage		AA	AA

[0127] The nutritional compositions of Examples 5 and 6 were evaluated for emulsion stability. The evaluation was performed by visually confirming the state of the nutritional composition after storage for one month in a constant temperature incubator at 37°C after the injection sterilization treatment. The evaluation criteria were the same as those described in Experiment 1.

[0128] As shown in Table 2 above, all of the nutritional compositions of Examples 5 and 6 were well emulsified even after storage for one month after injection sterilization. From these results, it can be seen that good emulsion stability is obtained when the blending mass ratio of succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride is 3:1 to 1:3.

[0129] <Experiment 3>

An emulsified liquid was obtained by the same production method as in Experiment 1 except that the composition of the emulsifier shown in Table 3 below was adopted. The emulsified liquid was filled into 100 mL of a retort pouch in the same manner as in Experiment 1, sealed, and subjected to retort sterilization treatment at 130°C for 3 minutes using a retort sterilizer to produce a liquid nutritional composition. Hereinafter, the liquid nutritional compositions produced using the emulsifiers of Examples 7 to 11 are also referred to as “the nutritional composition of Example 7” to “the nutritional composition of Example 11”, respectively.

[0130]

[Table 3]

Table 3: Emulsifier composition

			Example 7	Example 8	Example 9	Example 10	Example 11
Emulsifier	Amount per 100 mL of Nutritional composition	Succinic acid ester of monoglyceride (M1)	0.45 g	0.40 g	0.35 g	0.30 g	0.20 g
		Diacetyl tartaric acid ester of monoglyceride (M2)	0.15 g	0.20 g	0.25 g	0.30 g	0.40 g
		Total amount (M1 + M2)	0.60 g	0.60 g	0.60 g	0.60 g	0.60 g
	Energy per 100 mL of Nutritional composition		152 kcal	152 kcal	152 kcal	152 kcal	152 kcal
	Amount per 100 kcal of Nutritional composition	Succinic acid ester of monoglyceride (M1')	0.30 g	0.26 g	0.23 g	0.20 g	0.13 g
		Diacetyl tartaric acid ester of monoglyceride (M2')	0.099 g	0.13 g	0.16 g	0.20 g	0.26 g
		Total amount (M1' + M2')	0.40 g	0.40 g	0.40 g	0.40 g	0.40 g
	Proportion (% by mass)	Succinic acid ester of monoglyceride	75%	67%	58%	50%	33%
		Diacetyl tartaric acid ester of monoglyceride	25%	33%	42%	50%	67%
Emulsion stability	After retort sterilization, 37°C, 1 month storage		AA	AAA	AA	AA	AA

[0131] The nutritional compositions of Examples 7 to 11 were evaluated for emulsion stability. The evaluation was performed by visually confirming the state of the nutritional composition after storage for one month in a constant temperature incubator at 37°C after the retort sterilization. The evaluation criteria were as described in Experiment 1. The evaluation results are shown in Table 3 above.

[0132] As shown in Table 3 above, all of the nutritional compositions of Examples 7 to 11 were well emulsified even when stored for one month after the retort sterilization treatment. From these results, it can be seen that good emulsion stability is obtained when the blending mass ratio of succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride is 3:1 to 1:2.

In addition, in Experiment 2, the total amount of the organic acid ester of monoglycerides is 0.27 g/100 kcal (nutritional composition), but in Experiment 3, the total amount of the organic acid ester of monoglycerides is 0.40 g/100 kcal (nutritional composition). Therefore, it can be seen that good emulsion stability can be obtained even when the total amount of these two kinds of organic acid ester of monoglycerides is changed. That is, for example, the total amount may be from 0.27 g/100 kcal to 0.40 g/100 kcal.

[0133] <Experiment 4>

An emulsified liquid was obtained by the same production method as in Experiment 1 except that the composition of the emulsifier shown in Table 4 below was adopted. The emulsified liquid was filled into 100 mL of a retort pouch in the same manner as in Experiment 1, sealed, and subjected to retort sterilization treatment at 130°C for 3 minutes using a retort sterilizer to produce a liquid nutritional composition.

Hereinafter, the liquid nutritional compositions produced using the emulsifiers of Examples 12 and 13 are also referred to as "the nutritional composition of Example 12" and "the nutritional composition of Example 13", respectively.

[0134] [Table 4]

Table 4: Emulsifier composition

			Example 12	Example 13
Emulsifier	Amount per 100 mL of Nutritional composition	Succinic acid ester of monoglyceride (M1)	0.30 g	0.45 g
		Diacetyl tartaric acid ester of monoglyceride (M2)	0.10 g	0.15 g
		Total amount (M1 + M2)	0.40 g	0.60 g
	Energy per 100 mL of Nutritional composition		150 kcal	152 kcal
	Amount per 100 kcal of Nutritional composition	Succinic acid ester of monoglyceride (M1')	0.20 g	0.30 g
		Diacetyl tartaric acid ester of monoglyceride (M2')	0.067 g	0.10 g
		Total amount (M1' + M2')	0.27 g	0.40 g
	Proportion (% by mass)	Succinic acid ester of monoglyceride	75%	75%
		Diacetyl tartaric acid ester of monoglyceride	25%	25%
Emulsion stability	After retort sterilization, 37°C, 1 month storage		AA	AA

[0135] The nutritional compositions of Examples 12 and 13 were evaluated for emulsion stability. The evaluation was performed by visually confirming the state of the nutritional composition after storage for one month in a constant temperature incubator at 37°C after the retort sterilization. The evaluation criteria were as described in Experiment 1. The evaluation results are shown in Table 4 above.

[0136] As shown in Table 4 above, all of the nutritional compositions of Examples 12 and 13 were well emulsified even when stored for one month after the retort sterilization treatment. From these results, it can be seen that when the blending mass ratio of succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride is 3:1, good emulsion stability can be obtained even when the total amount thereof is changed. For example, it was also confirmed that the total amount may be from 0.27 g/100 kcal to 0.40 g/100 kcal.

[0137] <Experiment 5>

An emulsified liquid was obtained by the same production method as in Experiment 1 except that the composition of the emulsifier shown in Table 5 below was adopted. The emulsified liquid was filled into 100 mL of a retort pouch in the same manner as in Experiment 1, sealed, and subjected to retort sterilization treatment at 130°C for 3 minutes using a retort sterilizer to produce a liquid nutritional composition. Hereinafter, the liquid nutritional compositions produced using the emulsifiers of

Examples 14 to 19 are also referred to as “the nutritional composition of Example 14” to “the nutritional composition of Example 19”, respectively.

[0138] [Table 5]

Table 5: Emulsifier composition

			Example 14	Example 15	Example 16	Example 17	Example 18	Example 19
Emulsifier	Amount per 100 mL of Nutritional composition	Succinic acid ester of monoglyceride (M1)	0.32 g	0.40 g	0.48 g	0.56 g	0.60 g	0.80 g
		Diacetyl tartaric acid ester of monoglyceride (M2)	0.16 g	0.20 g	0.24 g	0.28 g	0.30 g	0.40 g
		Total amount (M1 + M2)	0.48 g	0.60 g	0.72 g	0.84 g	0.90 g	1.2 g
	Energy per 100 mL of Nutritional composition		151 kcal	152 kal	153 kcal	154 kcal	155 kcal	157 kcal
	Amount per 100 kcal of Nutritional composition	Succinic acid ester of monoglyceride (M1')	0.21 g	0.26 g	0.31 g	0.36 g	0.39 g	0.51 g
		Diacetyl tartaric acid ester of monoglyceride (M2')	0.11 g	0.13 g	0.16 g	0.18 g	0.19 g	0.25 g
		Total amount (M1' + M2')	0.32 g	0.40 g	0.47 g	0.55 g	0.58 g	0.76 g
	Proportion (% by mass)	Succinic acid ester of monoglyceride	67%	67%	67%	67%	67%	67%
		Diacetyl tartaric acid ester of monoglyceride	33%	33%	33%	33%	33%	33%
Emulsion stability	After retort sterilization, 37°C, 1 month storage		AA	AAA	AAA	AAA	AA	AA

[0139] The nutritional compositions of Examples 14 to 19 were evaluated for emulsion stability. The evaluation was performed by visually confirming the state of the nutritional composition after storage for one month in a constant temperature incubator at 37°C after the retort sterilization. The evaluation criteria were as described in Experiment 1. The evaluation results are shown in Table 5 above.

[0140] As shown in Table 5 above, all of the nutritional compositions of Examples 14 to 19 were well emulsified even when stored for one month after the retort sterilization treatment. Furthermore, the nutritional compositions of Examples 15 to 17 were emulsified even better than the nutritional compositions of Examples 14, 18, and 19.

From these results, it can be seen that when the blending mass ratio of succinic acid ester of monoglyceride and diacetyl tartaric acid ester of monoglyceride is 2:1, good emulsion stability can be obtained even when the total amount thereof is changed. For example, it was confirmed that the total amount may be from 0.32 g/100 kcal to 0.76 g/100 kcal.

In addition, from these results, it can also be seen that particularly good emulsion stability is obtained when the total amount of the succinic acid ester of monoglyceride and the diacetyl tartaric acid ester of monoglyceride is from 0.40 g/100 kcal to 0.55 g/100 kcal.

[0141] <Experiment 6>

In Experiment 1 above, protein hydrolysates (casein hydrolysate and whey protein hydrolysate) were used as protein components. In Experiment 6, the emulsion stability in the case of using proteins (casein, whey protein, and soy protein) as protein components was verified.

A nutritional composition was prepared with the following raw material composition per 100 mL of the nutritional composition. That is, micellar casein concentrate (manufactured by MILEI GmbH, casein content 71%, whey protein content 8%) 2.5 g, sodium caseinate (manufactured by TATUA, casein content 91%) 2.0 g, soy protein powder (manufactured by Fuji Oil Co., Ltd., soy protein content 86%) 0.23 g, dextrin (manufactured by Matsutani Chemical Industry Co., Ltd., standard 67° Bx) 21 g, citric acid, trisodium citrate, sodium chloride, potassium carbonate, dipotassium hydrogenphosphate, and magnesium carbonate were added to a water at 60°C and mixed and dissolved. 2.9 g of vegetable fat and oil and an emulsifier according to the mix proportion shown in Table 1 were further added thereto, and the mixture was stirred and mixed. Thereafter, the mixture was subjected to homogenization treatment using a high-pressure homogenizer (manufactured by APV Co., Ltd.) at 50 MPa. After the homogenization treatment, each 100 mL of the obtained emulsified liquid (also referred to as a modified milk liquid) was filled in a retort pouch (manufactured by Toyo Seikan Co., Ltd.), sealed, and subjected to retort sterilization treatment at 130°C for 3 minutes using a retort sterilizer (manufactured by Hisaka Works, Ltd.) to produce a liquid nutritional composition. Hereinafter, the liquid nutritional compositions produced using the emulsifiers of Examples 20 to 30 are also referred to as “the nutritional composition of Example 20” to “the nutritional composition of Example 30”, respectively.

The energy (per 100 mL of nutritional composition) of these nutritional compositions produced was as shown in Table 6, the protein component content was 4.0 g (per 100 kcal of nutritional composition), the lipid content was 3.3 g to 4.5 g (per 100 kcal of nutritional composition), the carbonhydrate content was 13.7 g (per 100 kcal of nutritional composition), and the moisture content was 85 g to 86 g (per 100 kcal of nutritional composition).

[0142]

[Table 6]

Table 6: Emulsifier composition

			Example 20	Example 21	Example 22	Example 23	Example 24	Example 25	Example 26	Example 27	Example 28	Example 29	Example 30
Emulsifier	Amount per 100 mL of Nutritional composition	Succinic acid ester of monoglyceride (M1)	0.0067 g	0.0133 g	0.027 g	0.040 g	0.067 g	0.13 g	0.27 g	0.40 g	0.53 g	0.67 g	0.80 g
		Diacetyl tartaric acid ester of monoglyceride (M2)	0.0033 g	0.0067 g	0.013 g	0.020 g	0.033 g	0.067 g	0.13 g	0.20 g	0.27 g	0.33 g	0.40 g
		Total amount (M1 + M2)	0.010 g	0.020 g	0.040 g	0.060 g	0.10 g	0.20 g	0.40 g	0.60 g	0.80 g	1.0 g	1.2 g
	Energy per 100 mL of Nutritional composition		100 kcal	100 kcal	100 kcal	100 kcal	101 kcal	101 kcal	103 kcal	105 kcal	107 kcal	109 kcal	110 kcal
	Amount per 100 kcal of Nutritional composition	Succinic acid ester of monoglyceride (M1')	0.0067 g	0.013 g	0.027 g	0.040 g	0.066 g	0.13 g	0.26 g	0.38 g	0.50 g	0.61 g	0.72 g
		Diacetyl tartaric acid ester of monoglyceride (M2')	0.0033 g	0.0067 g	0.013 g	0.020 g	0.033 g	0.066 g	0.13 g	0.19 g	0.25 g	0.31 g	0.36 g
		Total amount (M1' + M2')	0.010 g	0.020 g	0.040 g	0.060 g	0.10 g	0.20 g	0.39 g	0.57 g	0.75 g	0.92 g	1.1 g
	Proportion (% by mass)	Succinic acid ester of monoglyceride	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%
		Diacetyl tartaric acid ester of monoglyceride	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%
Emulsion stability	After retort sterilization, 37°C, 1 month storage		A	A	AA	AA	AA	AA	AAA	AAA	AAA	AAA	AAA

[0143] The nutritional compositions of Examples 20 to 30 were evaluated for emulsion stability. The evaluation was performed by visually confirming the state of the nu-

tritional composition after storage for one month in a constant temperature incubator at 37°C after the retort sterilization. The evaluation criteria were as described in Experiment 1. The evaluation results are shown in Table 6 above.

[0144] As shown in Table 6 above, the nutritional compositions of Examples 22 to 30 were well emulsified even when stored for one month after the retort sterilization treatment. Further, the nutritional compositions of Examples 26 to 30 were more favorably emulsified as compared with the nutritional compositions of the other examples.

From these results, it can be seen that the effect of improving emulsion stability according to the present technology is exhibited even when proteins are used instead of the protein hydrolysate.

It can also be seen that an excellent effect of improving emulsion stability is exhibited when the total amount of the organic acid ester of monoglycerides is 0.040 g to 1.1 g/100 kcal. It can also be seen that a particularly excellent effect of improving emulsion stability is exhibited when the total amount of the organic acid ester of monoglycerides is 0.39 g to 1.1g /100 kcal.

Claims

[Claim 1] A nutritional composition comprising a protein component, a lipid, and an organic acid ester of monoglyceride, wherein the organic acid ester of monoglyceride comprises two or more kinds selected from acetic acid ester of monoglyceride, citric acid ester of monoglyceride, succinic acid ester of monoglyceride, diacetyl tartaric acid ester of monoglyceride, and lactic acid ester of monoglyceride.

[Claim 2] The nutritional composition according to claim 1, wherein at least one kind among the organic acid esters of monoglyceride is succinic acid ester of monoglyceride.

[Claim 3] The nutritional composition according to claim 2, wherein a proportion of the succinic acid ester of monoglyceride to a total amount of the organic acid ester of monoglycerides is 80% by mass or less.

[Claim 4] The nutritional composition according to any one of claims 1 to 3, wherein at least one kind among the organic acid esters of monoglyceride is diacetyl tartaric acid ester of monoglyceride.

[Claim 5] The nutritional composition according to claim 4, wherein a proportion of the diacetyl tartaric acid ester of monoglyceride to a total amount of the organic acid ester of monoglycerides is 80% by mass or less.

[Claim 6] The nutritional composition according to any one of claims 1 to 5, wherein a total amount of the organic acid esters of monoglyceride per 100 kcal of the composition is 0.005 g or more and 2.0 g or less.

[Claim 7] The nutritional composition according to any one of claims 1 to 6, wherein the protein component comprises a milk protein, a milk protein hydrolysate, or both a milk protein and a milk protein hydrolysate.

[Claim 8] The nutritional composition according to any one of claims 1 to 6, wherein the protein component comprises a casein hydrolysate and a whey protein hydrolysate.

[Claim 9] The nutritional composition according to claim 8, wherein a mass content ratio of the casein hydrolysate and the whey protein hydrolysate is 1:9 to 9:1.

[Claim 10] The nutritional composition according to any one of claims 1 to 9, wherein a content of the protein component is 1 g or more and 15 g or less per 100 kcal of the nutritional composition.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/047528

A. CLASSIFICATION OF SUBJECT MATTER

A23L 33/12(2016.01)i; ***A23L 33/19***(2016.01)i; ***A61K 31/20***(2006.01)i; ***A61K 31/22***(2006.01)i; ***A61K 35/20***(2006.01)i; ***A61K 38/01***(2006.01)i; ***A61P 3/02***(2006.01)i
FI: A23L33/12; A23L33/19; A61P3/02; A61K38/01; A61K31/22; A61K35/20; A61K31/20

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)

A23L33/12; A23L33/19; A61K31/20; A61K31/22; A61K35/20; A61K38/01; A61P3/02

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2023
Registered utility model specifications of Japan 1996-2023
Published registered utility model applications of Japan 1994-2023

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2001-54367 A (MORINAGA MILK IND. CO., LTD.) 27 February 2001 (2001-02-27) claim 1, paragraphs [0017] and [0061]	1, 2, 6-10
A		3-5
X	JP 2010-83774 A (TERUMO CORP.) 15 April 2010 (2010-04-15) claims 1 to 3, paragraph [0021], Tables 1 and 4	1, 2, 4, 6, 7, 10
A		3, 5, 8, 9
X	JP 2004-16187 A (MIYOSHI OIL & FAT CO., LTD.) 22 January 2004 (2004-01-22) claim 1, paragraph [0021], example 1, Table 1	1-7, 10
A		8, 9
A	JP 10-210951 A (MORINAGA MILK IND. CO., LTD.) 11 August 1998 (1998-08-11) claims 1-5, paragraph [0078]	1-10

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
06 March 2023	**20 March 2023**
Name and mailing address of the ISA/JP **Japan Patent Office** **3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo** **100-8915, Japan**	Authorized officer **MURAMATSU, Hiroki 4O 4169** Telephone No. **+81-3-3581-1101 Ext. 3461**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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JP 2001-54367 A	27 February 2001	(Family: none)	
JP 2010-83774 A	15 April 2010	(Family: none)	
JP 2004-16187 A	22 January 2004	(Family: none)	
JP 10-210951 A	11 August 1998	(Family: none)	