

DESCRIPTION

Title of Invention: VISCOUS NUTRITIONAL COMPOSITION

Technical Field

[0001]

The present invention relates to a viscous nutritional composition. More specifically, the present invention relates to a nutritional composition having a physiologically favorable viscous property which can be used for producing a liquid food.

Background Art

[0002]

Liquid foods with low viscosity are known to cause gastroesophageal reflux in feeding by percutaneous endoscopic gastrostomy tube, by which food is directly administered into the stomach. As a countermeasure for this, a method of administering a semi-solid liquid food having a viscosity of 4000 to 20,000 mPa·s (12 rpm) in a short time is often implemented. In fact, there is an increasing number of patients who experience symptomatic improvement after attempts of such a feeding method, and it has also been widely recognized that direct feeding of liquid into the stomach may not be physiologically preferable.

[0003]

On the other hand, the conventional technique of free-fall feeding is not applicable when such high-viscosity semi-solid liquid food is administered. In such cases, it is necessary to administer the composition through procedures such as injection by syringe which is burdensome and laborious. Accordingly, there was a problem that the burden imposed on nurses and caregivers was heavy.

[0004]

In view of the above, there is a need for a liquid food that can be fed by free-fall feeding, which is widely implemented, and has a more physiologically favorable viscous property than a liquid food having a very low viscosity.

[0005]

However, from the production aspect, it is also necessary to maintain a viscosity at which the production is facilitated from the step of mixing raw materials to the step of filling a container with the resulting mixture.

[0006]

With regard to a semi-solidifying agent for nutritional agents given to patients with PEG by enteral feeding, JP Patent Publication (Kokai) No. 2010-065013 A (Patent Literature 1) describes a semi-solidifying agent for nutritional agents given to patients with PEG by enteral feeding, characterized by containing kappa carrageenan in which a part of the molecule is replaced by iota carrageenan. This literature discloses, as the definition of "semi-solidified", that "Semi-solidified used herein refers to the state in which an agent is gel-like while standing but is formed into a homogeneous paste when deformed or subjected to a force". The above literature discloses that the semi-solid nutritional agent for enteral feeding described therein is characterized in that when 25 ml of the semi-solid nutritional agent for enteral feeding is put in a 50 ml syringe with an inner diameter of 30 mm and the syringe is connected to a tube with an inner diameter of 4 mm and a length of 300 mm, and the agent is pushed down by 35 mm into the tube at a rate of 5 mm/second using a jig, the stress applied is 20000 N/m² or less. Although Patent Literature 1 mentions a dietary fiber, there is no specific description regarding the detail of the dietary fiber. Further, the production of the nutritional agent described in the above Patent Literature 1 does not involve a heat disinfection treatment step. Patent Literature 1 describes, in paragraph [0008], that conventional technique relating to nutritional agents involves such a dangerous operation as heating, implying that heating is not favorable.

[0007]

JP Patent Publication (Kokai) No. 2007-295877 A (Patent Literature 2) describes a milk protein-containing gel-like nutritional composition, characterized by containing a gelling agent and a multivalent metal salt and being subjected to heat-sterilization treatment. Patent Literature 2 gives sodium carboxymethylcellulose as an example of gelling agents in paragraph [0009]. Further, it describes, in paragraph [0022], that a 4-fold-concentrated apple

juice was added, followed by heating at 80°C. The idea of the invention of Patent Literature 2 is to stabilize the gel strength of a nutritional agent at a constant level (see Claim 4 in Patent Literature 2).

[0008]

JP Patent Publication (Kokai) No. 2004-261063 A (Patent Literature 3) describes an emulsifier for a milk component-containing gel-like food, containing organic acid esters of glycerol such as citric and fatty acid esters of glycerol. This literature also describes a method for producing a milk component-containing gel-like food as exemplified by milk pudding, including the step of adding an emulsifier before the heat sterilization step and then applying heat sterilization, and then solidifying a milk component-containing gel-like food by slow cooling. Both of these Patent Literatures 2 and 3 neither describe nor suggest a synergistic effect produced by a thickening agent and an emulsifier. Further, both of these Literatures neither describe nor suggest using a water-absorbing dietary fiber.

[0009]

JP Patent Publication (Kokai) No. 2007-289164 A (Patent Literature 4) describes, as a method for producing a liquid food, a method for producing a liquid food having a certain viscosity. According to the literature, this method includes producing a preparation having a certain viscosity in which a thickening agent is homogeneously dispersed and then subjecting the solution thus prepared to retort sterilization by heating. In this literature, tamarind gum is primarily used as the thickening agent. Patent Literature 4 neither describes nor suggests a synergistic effect produced by a thickening agent and an emulsifier. This literature discloses that a dietary fiber was used as a raw material in the Preparation Example in paragraph [0025]. However, there is no specific description regarding the detail of the dietary fiber. Further, this literature neither describes nor suggests using a water-absorbing dietary fiber.

Citation List

Patent Literature

[0010]

Patent Literature 1: JP Patent Publication (Kokai) No. 2010-065013 A

Patent Literature 2: JP Patent Publication (Kokai) No. 2007-295877 A

Patent Literature 3: JP Patent Publication (Kokai) No. 2004-261063 A

Patent Literature 4: JP Patent Publication (Kokai) No. 2007-289164 A

Summary of Invention

Technical Problem

[0011]

An objective of the present invention is to provide a nutritional composition having a property that its viscosity before the heat treatment is low and its viscosity after the heat treatment is markedly increased.

Solution to Problem

[0012]

The present inventors accomplished inventing the present invention, which in part is a nutritional composition, based on the novel finding that while the viscosity of a composition was kept low before heat treatment, it was markedly increased after heat treatment by using a water-absorbing dietary fiber. Further, the present nutritional composition enables reduction in the amount of a thickening agent and the like necessary for imparting a certain viscosity by virtue of the water-absorbing action of the aforementioned dietary fiber, which reduces free water. Moreover, it is also possible to adjust the viscosity after heat treatment of the aforementioned composition by adjusting the homogenization treatment pressure. Further, the present inventors accomplished inventing the present invention, which in part is a nutritional composition, based on the novel finding that while the viscosity of a composition was kept low before heat treatment, it was markedly increased after heat treatment by using a starch not having been subjected to pregelatinization treatment in advance.

[0013]

Thus, the present invention is as follows.

[0014]

In one aspect, the present invention refers to a viscous nutritional composition comprising 0.1 to 1.0% by weight of a water-absorbing dietary fiber relative to the nutritional composition, wherein the composition has a property such that the viscosity thereof is increased by a heat treatment, wherein the viscosity of the composition prior to said heat treatment is 5 to 300 mPa·s, wherein the viscosity of the composition prior to said heat treatment is measured at 45 to 85°C and 12 rpm using a spindle type rotational viscometer, and wherein the viscosity of the composition reaches 300 to 6700 mPa·s by subjecting the composition to said heat treatment and then to storage at a temperature equal to or below normal temperature of 15 to 25°C for 1 to 90 days, wherein the viscosity of the composition that has been subjected to said heat treatment and then stored at a temperature equal to or below normal temperature of 15 to 25°C for 1 to 90 days is measured at 20°C and 12 rpm using a spindle type rotational viscometer.

In one aspect, the present invention refers to a method for producing a viscous nutritional composition, comprising the steps of:

- i) preparing a water-absorbing dietary fiber at an amount of 0.1 to 1.0% by weight relative to the nutritional composition,
- ii) applying a pressure treatment for homogenization, and
- iii) applying a heat treatment,

wherein the viscosity of the composition before the heat treatment is 5 to 300 mPa·s, wherein the viscosity of the composition before the heat treatment is measured at 45 to 85°C and 12 rpm using a spindle type rotational viscometer, and the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature of 15 to 25°C for 1 to 90 days is 300 to 6700 mPa·s, wherein the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature of 15 to 25°C for 1 to 90 days is measured at 20°C and 12 rpm using a spindle type rotational viscometer.

In one aspect, the present invention refers to a method for producing a viscous nutritional composition, comprising the steps of:

- i) preparing a water-absorbing dietary fiber at an amount of 0.1 to 1.0% by weight relative to the nutritional composition,
- ii) applying a pressure treatment for homogenization, and
- iii) applying a heat treatment,

wherein the viscosity of the composition before the heat treatment is 5 to 300 mPa·s, wherein the viscosity of the composition before the heat treatment is measured at 45 to 85°C and 12 rpm using a spindle type rotational viscometer, and the homogenization treatment pressure in the step of applying the pressure treatment for homogenization is 10 to 100 MPa, and a viscosity (20°C) of the composition after the heat treatment and storage at a temperature equal to or below normal temperature of 15 to 25°C for 1 to 90 days is 300 to 6700 mPa·s, wherein the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature of 15 to 25°C for 1 to 90 days is measured at 20°C and 12 rpm using a spindle type rotational viscometer.

Also described herein is:

1. A viscous nutritional composition comprising a water-absorbing dietary fiber, wherein the composition has a property such that viscosity thereof is increased by heat treatment.

[0015]

2. The nutritional composition according to 1, wherein the water-absorbing dietary fiber has a property such that its water absorbency is increased by heat treatment.

[0016]

3. The viscous nutritional composition according to 1 or 2, wherein the composition comprises 0.1 to 3.0% by weight of the water-absorbing dietary fiber relative to the nutritional composition and has a property such that viscosity of said composition is increased by heat treatment.

[0017]

4. The nutritional composition according to any of 1 to 3, wherein the water-absorbing dietary fiber is an insoluble dietary fiber.

[0018]

5. The nutritional composition according to any of 1 to 4, wherein the water-absorbing dietary fiber is an insoluble fiber of soybean dietary fiber and/or soybean *fusuma* bran.

[0019]

6. The nutritional composition according to any of 1 to 5, comprising one or more from the group consisting of protein, lipid, and sugar, wherein the specific gravity of the composition is 1.06 to 1.5.

[0020]

7. The nutritional composition according to any of 1 to 6, comprising one or more from the group consisting of a thickening agent and an emulsifier.

[0021]

8. The nutritional composition according to any of 1 to 7, wherein the viscosity of the composition is 5 to 300 mPa·s, wherein the viscosity of the composition is measured at 45 to 85°C and 12 rpm using a spindle type rotational viscometer.

[0022]

9. The nutritional composition according to any of 1 to 8, wherein homogenization treatment is performed by adjusting the homogenization treatment pressure to 10 to 100 MPa.

[0023]

10. The nutritional composition according to any of 1 to 9, wherein the viscosity of the composition reaches 300 to 6700 mPa·s by subjecting the composition to heat treatment and then storing the composition at a temperature equal to or below normal temperature for 1 to 90 days, wherein the viscosity of the composition that has been subjected to heat treatment and then stored at a temperature equal to or below normal temperature for 1 to 90 days is measured at 20°C and 12 rpm using a spindle type rotational viscometer.

[0024]

11. A method for producing a viscous nutritional composition, comprising the steps of:

- i) preparing 0.1 to 3.0% by weight of a water-absorbing dietary fiber relative to the nutritional composition,
- ii) applying pressure treatment for homogenization, and
- iii) applying heat treatment,

wherein the viscosity of the composition before the heat treatment is 5 to 300 mPa·s, wherein the viscosity of the composition before the heat treatment is measured at 45 to 85°C and 12 rpm using a spindle type rotational viscometer, and the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature for 1 to 90 days is 300 to 6700 mPa·s, wherein the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature for 1 to 90 days is measured at 20°C and 12 rpm using a spindle type rotational viscometer.

[0025]

12. A method for producing a viscous nutritional composition, comprising the steps of:

- i) preparing a water-absorbing dietary fiber at an amount of 0.1 to 3.0% by weight relative to the nutritional composition,
- ii) applying pressure treatment for homogenization, and
- iii) applying heat treatment,

wherein the viscosity of the composition before the heat treatment is 5 to 300 mPa·s, wherein the viscosity of the composition before the heat treatment is measured at 45 to 85°C and 12 rpm using a spindle type rotational viscometer, and the homogenization treatment pressure in the step of applying pressure treatment for homogenization is 10 to 100 MPa, and the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature for 1 to 90 days is 300 to 6700 mPa·s, wherein the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature for 1 to 90 days is measured at 20°C and 12 rpm using a spindle type rotational viscometer.

[0026]

13. A viscous nutritional composition comprising a starch not having been subjected to pregelatinization treatment in advance, wherein the composition has a property such that viscosity thereof is increased by heat treatment.

[0027]

14. The viscous nutritional composition according to 13, wherein the composition comprises 0.1 to 3.0% by weight of the starch not having been subjected to pregelatinization treatment in advance relative to the nutritional composition and has a property such that viscosity thereof is increased by heat treatment.

[0028]

15. The nutritional composition according to 13 or 14, comprising one or more from the group consisting of protein, lipid, and sugar, and wherein the specific gravity of the composition is 1.06 to 1.5.

[0029]

16. The nutritional composition according to any of 13 to 15, comprising one or more from the group consisting of a thickening agent and an emulsifier.

[0030]

17. The nutritional composition according to any of 13 to 16, wherein the viscosity of the composition is 5 to 300 mPa·s, wherein the viscosity of the composition is measured at 45 to 85°C and 12 rpm using a spindle type rotational viscometer.

[0031]

18. The nutritional composition according to any of 13 to 17, wherein homogenization treatment is performed by adjusting the homogenization treatment pressure to 10 to 100 MPa.

[0032]

19. The nutritional composition according to any of 13 to 18, wherein the viscosity of the composition reaches 300 to 6700 mPa·s by subjecting the composition to heat treatment and then storing the composition at a temperature equal to or below normal temperature for 1 to 90 days, wherein the viscosity of the composition that has been subjected to heat treatment and then stored at a temperature equal to or below normal temperature for 1 to 90 days is measured at 20°C and 12 rpm using a spindle type rotational viscometer.

[0033]

20. A method for producing a viscous nutritional composition, comprising the steps of:

- i) preparing 0.1 to 3.0% by weight of a starch not having been subjected to pregelatinization treatment in advance relative to the nutritional composition,,
- ii) applying pressure treatment for homogenization, and
- iii) applying heat treatment,

wherein the viscosity of the composition before the heat treatment is 5 to 300 mPa·s, wherein the viscosity of the composition before the heat treatment is measured at 45 to 85°C and 12 rpm using a spindle type rotational viscometer, and the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature for 1 to 90 days is 300 to 6700 mPa·s, wherein the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature for 1 to 90 days is measured at 20°C and 12 rpm using a spindle type rotational viscometer.

[0034]

21. A method for producing a viscous nutritional composition, comprising the steps of:

- i) preparing 0.1 to 3.0% by weight of a starch not having been subjected to pregelatinization treatment in advance relative to the nutritional composition,
- ii) applying pressure treatment for homogenization, and
- iii) applying heat treatment,

wherein the viscosity of the composition before the heat treatment is 5 to 300 mPa·s, wherein the viscosity of the composition before the heat treatment is measured at 45 to 85°C and 12 rpm using a spindle type rotational viscometer, and the homogenization treatment pressure in the step of applying pressure treatment for homogenization is 10 to 100 MPa, and the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature for 1 to 90 days is 300 to 6700 mPa·s, wherein the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature for 1 to 90 days is measured at 20°C and 12 rpm using a spindle type rotational viscometer.

[0035]

The present application encompasses the contents described in the specification and/or drawings of JP Patent Application No. 2011-108854 and JP Patent Application No. 2011-108857, based on which the priority of the present application is claimed.

Advantageous Effects of Invention

[0036]

The use of a water-absorbing dietary fiber enables the provision of a nutritional composition which maintains a viscosity at which the production thereof is facilitated from the step of mixing raw materials to the step of filling a container with the resulting mixture, and which, after heat treatment, has a viscosity suitable for tube feeding by free fall. Further, the use of a starch not having been subjected to pregelatinization treatment in advance enables the provision of a nutritional composition which maintains a viscosity at which the production thereof is facilitated from the step of mixing raw materials to the step of filling a container with the resulting mixture, and which, after heat treatment, has a viscosity suitable for tube feeding by free fall. In other words, the nutritional composition of the present invention can be easily produced and administered by tube. Further, compared to a composition in which the viscosity is increased primarily by a thickening agent, the viscosity of the nutritional composition of the present invention before heat treatment can be kept low, whereby the production thereof is facilitated. Further, when a water-absorbing dietary fiber is used, free

water in the nutritional composition of the present invention is reduced by virtue of the water-absorbing action of the aforementioned water-absorbing dietary fiber, whereby it is made possible to reduce the contents of a thickening agent and the like necessary for imparting a certain viscosity to less than conventional products. Further, when a starch not having been subjected to pregelatinization treatment in advance is used, the nutritional composition of the present invention achieves an appropriate viscosity even without adding a thickening agent, whereby it is made possible to reduce the contents of a thickening agent and the like necessary for imparting a certain viscosity to less than conventional products. In view of the above, also when a composition having the same degree of viscosity as a conventional product is produced, the steps from mixing raw materials before heat treatment to homogenization can be conducted more easily, and also, there are economic advantages that some of the raw materials used can be cut down. Moreover, the nutritional composition of the present invention can attain a sufficient viscosity by virtue of, for example, the composition of a starch not having been subjected to pregelatinization treatment in advance or a water-absorbing dietary fiber used, whereby the nutritional composition can also be used for a flexible container with an outlet (so-called cheer pack, etc.) to be used for oral feeding. Further, the amount of a thickening agent used in the nutritional composition of the present invention can be kept low, and in connection with this, the nutritional composition can be prepared with higher calories than conventional products without excessively increasing the viscosity of the composition before heat treatment.

Brief Description of Drawings

[0037]

[Figure 1] Figure 1 shows the changes in the viscosity of a composition containing certain amounts of a water-absorbing dietary fiber and an emulsifier after retort sterilization when the amount of a thickening agent added was changed.

[Figure 2] Figure 2 shows the changes in the viscosity of a composition after retort sterilization when homogenization pressure was changed in the presence of certain amounts of a water-absorbing dietary fiber, a thickening agent, and an emulsifier.

[Figure 3] Figure 3 shows the changes in the viscosity of a composition containing a certain amount of an emulsifier before and after retort sterilization when the amount of a water-absorbing dietary fiber added was changed.

Description of Embodiments

[0038]

The nutritional composition of the present invention is based on the novel finding that a composition having a high viscosity after heat treatment can be obtained by using a water-absorbing dietary fiber and/or a starch not having been subjected to pregelatinization treatment in advance.

[0039]

A dietary fiber refers to a substance in food that is not hydrolyzed by human digestive enzymes, and is classified into a water-soluble dietary fiber and an insoluble dietary fiber based on its affinity to water. As the source of a dietary fiber, cell wall constituents (such as cellulose, hemicellulose, insoluble pectin, lignin, and chitin), non-cell wall constituents (such as water-soluble pectin, plant gum, adhesive materials, seaweed polysaccharides, and chemically modified polysaccharides) are known (edited by Satoshi Innami et al., Dietary fiber, published by DAI-ICHI SHUPPAN Co. Ltd., 1982).

[0040]

A "water-absorbing dietary fiber" that can be used in the present invention refers to a dietary fiber having water absorbing property. It is particularly preferable that water-absorbing capacity of such water absorbing dietary fiber can be enhanced through heat treatment. When a water-absorbing dietary fiber is used in the nutritional composition of the present invention, free water in the composition decreases due to the water-absorbing action of the fiber, and consequently, the concentration of a thickening agent or the like will be increased relatively in the solution part of the composition. As a result, the viscosity attributable to a thickening agent or the like will be increased. Moreover, when a dietary fiber whose water absorbency is increased by heat treatment is used, the viscosity attributable to a thickening agent, emulsifier, or the like will be further increased by heat treatment.

Further, in the nutritional composition containing a water-absorbing dietary fiber according to the present invention, other substances whose water absorbency is increased by heat treatment such as a starch not having been subjected to pregelatinization treatment in advance, polysaccharide thickeners, fibrous cellulose, and crystalline cellulose can be partly used in combination.

[0041]

In the present specification, heat treatment encompasses not only heat sterilization to be described later, but also heat treatment at 70°C or higher for several minutes or longer or heat treatment at 80°C or higher for several minutes or longer.

[0042]

The water-absorbing dietary fiber of the present invention may be subjected to heat treatment with protein, lipid, sugar, or the like. Alternatively, it is also possible to subject the water-absorbing dietary fiber of the present invention to heat treatment separately from protein, lipid, sugar, or the like, and then add the resulting water-absorbing dietary fiber to heat-sterilized protein, lipid, sugar, or the like.

[0043]

As the water-absorbing dietary fiber of the present invention, an insoluble dietary fiber is preferably used. Examples of the aforementioned insoluble dietary fiber include cellulose, hemicellulose (such as xylan, mannan, galactan, glucan, glucomannan, and xyloglucan), holocellulose, matrix polysaccharide, an insoluble fiber of a dietary fiber derived from plants (such as vegetables (such as lettuce, celery, onions, burdock, radish, green peas, dried gourd, and tomatoes), fruits (such as apples and bananas), cereals (such as barley, wheat, common wild oat, corn, and *Amaranthus*), tubers (sweet potatoes, potatoes, and konjac potato), beans (such as peas, soybeans, adzuki beans, garbanzo beans, common beans, pinto beans, and mung beans), mushrooms (such as the Jew's ear and shiitake mushroom), chestnuts, almonds, peanuts, and sesames), an insoluble fiber of a dietary fiber derived from other natural products (such as animals, seaweed, and microorganisms), the aforementioned insoluble fiber derived from natural products that has been subjected to chemical modification, partial degradation, or purification, chemically synthesized edible insoluble fiber, soybean *fusuma* bran, wheat

fusuma bran, barley *fusuma* bran, maize *fusuma* bran, oat *fusuma* bran, rye *fusuma* bran, job's tears (*C. lacryma-jobi* var. *ma-yuen*) *fusuma* bran, rice *nuka* bran, *fusuma* bran of miscellaneous cereals such as proso millet, foxtail millet, barnyard millet, and *Sorghum*, *Leguminosae fusuma* bran, *fusuma* bran of pseudocereals such as buckwheat *fusuma* bran, sesame *fusuma* bran, and *okara* (soy pulp). Preferable examples thereof include an insoluble fiber of soybean dietary fiber and soybean *fusuma* bran. Further, as the aforementioned insoluble dietary fiber, one from which hydrophobic components such as lignin have been removed, one having many side chains, and one that is amorphous can be favorably used.

[0044]

The aforementioned water-absorbing dietary fiber can be used alone or as a combination of plural types thereof, and it is also possible to use a food product containing a large amount of the aforementioned water-absorbing dietary fiber or an additive containing a large amount of the aforementioned water-absorbing dietary fiber. Further, in the present invention, other dietary fibers can be partly used as well in combination with the aforementioned water-absorbing dietary fiber. For example, at least an insoluble fiber of soybean dietary fiber and/or soybean *fusuma* bran can be contained in the water-absorbing dietary fiber to be used in the composition of the present invention. The insoluble fiber of soybean dietary fiber used in Examples of the present invention can be obtained by, for example, defatting soybean, extracting the defatted soybean with water, and drying the insoluble matters thus produced. Further, the insoluble fiber of soybean dietary fiber used in Examples of the present invention can be obtained by drying soy pulp as well.

[0045]

According to STANDARD TABLES OF FOOD COMPOSITION IN JAPAN, 5th revised and enlarged edition (Ministry of Education, Culture, Sports, Science and Technology: http://www.mext.go.jp/b_menu/shingi/gijyutu/gijyutu3/toushin/05031802.htm), the total amount of dietary fibers, the amount of a water-soluble dietary fiber, and the amount of an insoluble dietary fiber contained in soybean (dry) is 17.1 g/100 edible part, 1.8 g/100 edible part, and 15.3 g/100 edible part, respectively. Further, the total amount of dietary fibers, the amount of a water-soluble dietary fiber, and the amount of an insoluble dietary fiber contained

in soy pulp (old production method) is 9.7 g/100 edible part, 0.3 g/100 edible part, and 9.4 g/100 edible part, respectively, and the total amount of dietary fibers, the amount of a water-soluble dietary fiber, and the amount of an insoluble dietary fiber contained in soy pulp (new production method) is 11.5 g/100 edible part, 0.4 g/100 edible part, and 11.1 g/100 edible part, respectively.

[0046]

Incidentally, the water-absorbing dietary fiber of the present invention does not include a water-soluble dietary fiber such as a soybean-derived polysaccharide thickener and indigestible dextrin. A water-soluble dietary fiber may be used in combination partly in the nutritional composition of the present invention.

[0047]

Fusuma Bran refers to the residue after the production of cereal fractions by grinding cereals. For example, soybean *fusuma* bran refers to the residue after grinding soybean, and wheat *fusuma* bran, which is alternatively called wheat feed, refers to the residue after the production of flour by grinding wheat. In the case of *Poaceae*, *fusuma* bran may also be called "*nuka*" (i.e., rice bran). *Nuka* refers to a part such as pericarp, seed coat, and germ that are obtained when cereals are polished. *Fusuma* Bran and *nuka* are used synonymously with each other in the present specification. Further, *fusuma* bran is used for cereals in general, and it is not limited to specific cereals such as wheat, corn, and oat. *Fusuma* Bran that can be used in the present invention is not limited and examples thereof include chemically synthesized edible insoluble fiber, soybean *fusuma* bran, wheat *fusuma* bran, barley *fusuma* bran, corn *fusuma* bran, oat *fusuma* bran, rye *fusuma* bran, job's tears (*C. lacryma-jobi* var. *ma-yuen*) *fusuma* bran, rice *nuka* bran, *fusuma* bran of miscellaneous cereals such as proso millet, foxtail millet, barnyard millet, and *Sorghum*, *Leguminosae fusuma* bran, *fusuma* bran of pseudocereals such as buckwheat *fusuma* bran, sesame *fusuma* bran, and *okara* (soy pulp).

[0048]

According to an embodiment of the present invention, a starch not having been subjected to pregelatinization treatment in advance can be used in place of or together with a water-absorbing dietary fiber. It is known that when a starch not having been subjected to

pregelatinization treatment in advance is heated in an aqueous solution, the starch itself imparts a viscous property to the aqueous solution and its water absorbency increases. In the present specification, starch in a naturally occurring crystalline state is called β starch and starch in which sugar chains are freed by destruction of hydrogen bonds therebetween is called α starch. Starch is known to be pregelatinized by destruction of hydrogen bonds by heating, for example by a heat treatment step. Addition of a pregelatinized starch to the nutritional composition before heat treatment results in an unfavorable increase in the viscosity of the composition before heat treatment. Accordingly, the nutritional composition of the present invention preferably does not contain a pregelatinized starch before heat treatment. The amount of a starch not having been subjected to pregelatinization treatment in advance to be used in the nutritional composition of the present invention can be appropriately adjusted according to, for example, the viscosity of the nutritional composition to be produced, the types and contents of other components such as a thickening agent and an emulsifier, and homogenization treatment pressure. However, only for the sake of example, a water-absorbing dietary fiber can be used in an amount of 0.10 to 5.00% by weight (w/w%), 0.50 to 5.00% by weight (w/w%), preferably 0.10 to 3.00% by weight (w/w%), preferably 0.10 to 2.50% by weight (w/w%), preferably 0.10 to 2.20% by weight (w/w%), preferably 0.10 to 2.00% by weight (w/w%), preferably 0.10 to 1.50% by weight (w/w%), preferably 0.20 to 1.0% by weight, and more preferably 0.20 to 0.80% by weight of the nutritional composition. In the present invention, when the aforementioned lower and upper limit values are set at any of the values specified above, the amount of a starch not having been subjected to pregelatinization treatment in advance used can be described as "(lower limit value) to (upper limit value)."

[0049]

Examples of the type of a starch to be used in the present invention include wheat flour, rice flour, rye flour, corn starch, waxy corn starch, corn flour, potato starch (bareisho starch), bean starch, sweet potato starch (kansho starch), tapioca starch, potato starch (jagaimo starch), and sweet potato starch (satsumaimo starch). Further, when necessary, two or more of the

aforementioned starches can be combined, or a processed starch can be used as well so long as it is prepared with a starch not having been subjected to pregelatinization treatment.

[0050]

The water absorbency of the water-absorbing dietary fiber and starch not having been subjected to pregelatinization treatment in advance of the present invention is increased by heating. That is, these substances can also be collectively called adjuvant whose water absorbency is increased by heating. According to an embodiment of the present invention, the nutritional composition of the present invention contains an adjuvant whose water absorbency is increased by heating selected from the group consisting of a water-absorbing dietary fiber and a starch not having been subjected to pregelatinization treatment in advance.

[0051]

The amounts of a water-absorbing dietary fiber and/or a starch not having been subjected to pregelatinization treatment in advance to be used in the nutritional composition of the present invention can be appropriately adjusted according to, for example, the viscosity of the nutritional composition to be produced, the type of the water-absorbing dietary fiber or starch not having been subjected to pregelatinization treatment in advance, the types and contents of other components such as food protein, a thickening agent, and an emulsifier, and homogenization treatment pressure. Only for the sake of example, a water-absorbing dietary fiber and/or a starch not having been subjected to pregelatinization treatment in advance can be used in an amount of 0.10 to 3.00% by weight (w/w%), preferably 0.10 to 2.50% by weight (w/w%), preferably 0.10 to 2.20% by weight (w/w%), preferably 0.10 to 2.00% by weight (w/w%), preferably 0.10 to 1.50% by weight (w/w%), preferably 0.20 to 1.0% by weight, and more preferably 0.20 to 0.80% by weight of the nutritional composition. In the present invention, when the aforementioned lower and upper limit values are set at any of the values specified above, the amount of a water-absorbing dietary fiber used can be described as "(lower limit value) to (upper limit value)".

[0052]

Further, the larger the water-absorbing dietary fiber particle, the better the water absorbency (edited by Satoshi Innami et al., Dietary fiber, published by DAI-ICHI SHUPPAN

Co. Ltd., 1982). The size of the dietary fiber that can be preferably used in the present invention can be appropriately adjusted according to, for example, the viscosity of the nutritional composition to be produced, the type and content of the water-absorbing dietary fiber, food protein, the types and contents of other components such as a thickening agent and an emulsifier, and homogenization treatment pressure. However, only for the sake of example, the size of a dry water-absorbing dietary fiber before absorbing water can be a size such that the fiber passes through a 20 mesh but not a 100 mesh, more preferably a size such that the fiber passes through a 60 mesh but not a 100 mesh. The same applies to a starch not having been subjected to pregelatinization treatment in advance.

[0053]

Soybean dietary fiber contains cellulose, hemicellulose, and the like, and depending on the degree of polymerization and three dimensional structure, soybean dietary fiber exists as a water-soluble dietary fiber or an insoluble dietary fiber. Since a water-soluble dietary fiber has a thickening property on its own, it is utilized as a thickening and stabilizing agent in practical applications. Meanwhile, an insoluble dietary fiber composed mainly of cellulose and hemicellulose hardly exhibits a thickening property on its own. Among insoluble dietary fibers of soybean dietary fiber, those having large three dimensional structures are excellent in water absorbency and have a property such that its water absorbency is increased by heating. Soybean *fusuma* bran is known to be a material rich in an insoluble dietary fiber of soybean dietary fiber.

[0054]

Examples of a thickening agent (also called a gelling agent, a stabilizer, a thickening and stabilizing agent, and a starch adhesive) that can be used in the present invention include locust bean gum, κ -carrageenan, ι -carrageenan, λ -carrageenan, carrageenan, gelatin, low methoxyl pectin, high methoxyl pectin, pectin, tara gum, agar, low-strength agar, gellan gum, guar gum, xanthan gum, tamarind gum, propylene glycol, ethyl hydroxy ethyl cellulose, and carboxy methyl cellulose. Preferable examples thereof include a thickening agent composed mainly of polysaccharides. The aforementioned thickening agent can be used alone or as a combination of plural types thereof. Further, other thickening agents can be partly used in

combination with the aforementioned thickening agent. For example, carrageenan and/or low-strength agar can be contained in the thickening agent used in the composition of the present invention. The amount of a thickening agent to be used in the nutritional composition of the present invention can be appropriately adjusted according to, for example, the viscosity of the nutritional composition to be produced, the type of a thickening agent, the types and contents of other components such as a water-absorbing dietary fiber and/or a starch not having been subjected to pregelatinization treatment in advance, and an emulsifier, and homogenization treatment pressure. When a thickening agent is used in the present invention, only for the sake of example, the lower limit thereof can be 0.01% by weight, 0.02% by weight, or 0.05% by weight of the nutritional composition. Further, the upper limit thereof can be 2.0% by weight, 1.0% by weight, or 0.5% by weight of the nutritional composition. In the present invention, when the aforementioned lower and upper limit values are set at any of the values specified above, the amount of a thickening agent used can be described as "(lower limit value) to (upper limit value)". A thickening agent does not have to be used in the present invention.

[0055]

Carrageenan refers to salts of sulfuric acid esters of polysaccharides composed of galactose and anhydrogalactose, and is obtained by extracting the whole body of the algae *Hypnea charoides*, *Eucheuma muricatum*, *Iridaea*, *Gigartina tenella*, and *chondrus ocellatus* with water or an alkaline aqueous solution, and then performing purification (purified carrageenan). Carrageenan may also be pronounced or expressed as carra-gee-nan, cara-ghe-nan, cara-ghe-nin, and Carrageenan. Carrageenan can also be used in the form of *Eucheuma* powder or processed *Eucheuma* algae, which is obtained by drying the whole body of the algae *Eucheuma muricatum* or subjecting the whole body of the algae *Eucheuma muricatum* to alkaline treatment, and then neutralizing and drying the algae. Depending on the ratio between galactose and anhydrogalactose and the number of sulfuric acid ester, carrageenan exists mainly in the following types: κ -carrageenan, ι -carrageenan, and λ -carrageenan. Further, there are κ -carrageenan in which part of the molecule is replaced by ι -carrageenan, and degraded carrageenan having non-dietary usage. The κ - and ι -type carrageenan has a

gelling property, and in an aqueous solution, the degree of viscosity is κ -carrageenan < ι -carrageenan. When these aqueous solutions are cooled, κ -carrageenan forms a hard but fragile gel, while ι -carrageenan forms a viscoelastic gel. Further, κ - and ι -type carrageenan forms a strong gel by reacting with salt and milk protein (Toru Hidaka et al., Food Additive Encyclopedia, FOOD CHEMICAL NEWSPAPER, Inc., published in 1997, p. 74 and Handbook of Natural Materials, 14th edition, SHOKUHIN TO KAGAKU (Food Science), published in 1998, p. 110 to 111).

[0056]

Low-strength agar refers to agar that is adjusted to have a jelly strength (Nikkansui method) of 10 to 250 g/cm² at an agar concentration of 1.5% by cleaving the molecules of agar components by subjecting agar to heat treatment. Low-strength agar has a lower jelly strength than agar. Low-strength agar can be produced by, for example, the method described in JP Patent No. 3414954. It should be noted that jelly strength (Nikkansui method) refers to the maximum weight (g) that can be supported for 20 seconds per cm² of the surface of a gel obtained by preparing a 1.5% agar solution and solidifying this by leaving it at 20°C for 15 hours.

[0057]

Examples of the emulsifier that can be used in the present invention include fatty acid esters of glycerol (such as pentaglycerol monolaurate, hexaglycerol monolaurate, decaglycerol monolaurate, tetraglycerol monostearate, decaglycerol monostearate, decaglycerol distearate, diglycerol monooleate, decaglycerol monooleate, and erucic acid esters of decaglycerol), organic acid (such as acetic acid, lactic acid, citric acid, succinic acid, and diacetyl tartaric acid) monoglyceride, fatty acid esters of polyglycerol, fatty acid esters of propylene glycol, condensed ricinoleic acid esters of polyglycerol, fatty acid esters of sorbitan, fatty acid esters of sucrose (such as erucic acid esters of sucrose, stearic acid esters of sucrose, and myristic acid esters of sucrose), (*Brassica*, egg yolk, fractionated, milk, and the like) lecithin, and enzymatically degraded lecithin (such as enzymatically degraded *Brassica* lecithin). Preferable examples thereof include organic acid monoglyceride. The aforementioned emulsifier can be used alone or as a combination of plural types thereof, and it is also possible

to use a hydrophilic emulsifier in combination with other emulsifiers. Further, in the present invention, the aforementioned emulsifier can partly contain an emulsifier other than those listed above, for example, in an amount less than that of the aforementioned emulsifier. For example, at least succinic acid monoglyceride and/or diacetyl tartaric acid monoglyceride can be contained in the emulsifier to be used in the composition of the present invention, and at least organic acid monoglyceride can be contained in the emulsifier to be used in the composition of the present invention. The amount of an emulsifier to be added can be appropriately adjusted according to, for example, the viscosity of the nutritional composition to be produced, the type of emulsifier, the contents of other ingredients such as a water-absorbing dietary fiber and a thickening agent, and homogenization treatment pressure. Only for the sake of example, the lower limit value can be 0.02% by weight, 0.05% by weight, 0.10% by weight, 0.55% by weight, 0.60% by weight, and 0.70% by weight of the nutritional composition. Further, only for the sake of example, the upper limit value can be 2.0% by weight, 1.5% by weight, and 1.0% by weight of the nutritional composition. In the present invention, when the aforementioned lower and upper limit values are set at any of the values specified above, the amount of an emulsifier used can be described as "(lower limit value) to (upper limit value)".

[0058]

Monoglyceride refers to glycerol with fatty acid bound to one of its hydroxyl groups. Organic acid monoglyceride refers to the aforementioned monoglyceride with organic acid bound to the hydroxyl group thereof by ester linkage.

[0059]

Diacetyl tartaric acid monoglyceride refers to the aforementioned monoglyceride with a compound in which the hydroxyl group of tartaric acid is acetylated bound to the hydroxyl group thereof by ester linkage. Diacetyl tartaric acid monoglyceride is alternatively called TMG or diacetyl tartaric (acid) ester of monoglyceride (DATEM). Diacetyl tartaric acid monoglyceride may be used for O/W type emulsification.

[0060]

Succinic acid monoglyceride refers to the aforementioned monoglyceride with succinic acid bound to the hydroxyl group thereof by ester linkage. Further, succinic acid monoglyceride is alternatively called succinic acid esters of monoglyceride (SMG). Succinic acid monoglyceride may be used for O/W type emulsification.

[0061]

In the present invention, examples of fatty acid constituting organic acid monoglyceride include, but are not limited to, saturated fatty acid and unsaturated fatty acid such as caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, and oleic acid.

[0062]

In the present invention, food protein can be used as all or a part of protein. Examples of food protein that can be used in the present invention include milk-derived protein (such as casein, casein sodium, Milk Protein Concentrate (MPC), α -casein, β -casein, and κ -casein and degradation products thereof), soy-derived protein (such as glycinin and β -conglycinin), wheat-derived protein (such as gluten, gliadin, and glutelin), meat-derived protein (such as muscle constituting protein, myosin, and actin), fish meat (such as muscle fiber protein, actomyosin, myosin, and actin), chicken egg-derived protein (such as egg white albumin and egg yolk lipoprotein), and pig skin-derived protein (such as gelatin). Preferable examples thereof include casein sodium. In the present invention, food protein can be used alone or as a combination of plural types thereof. Further, in the present invention, other food proteins can also be partly used in combination with the protein. For example, at least casein sodium can be contained in the food protein to be used in the composition of the present invention. The amount of food protein to be used in the nutritional composition of the present invention can be appropriately adjusted according to, for example, the viscosity of the nutritional composition to be produced, pH, ionic strength, temperature, the type of food protein, the types and contents of other components such as a dietary fiber, a thickening agent, and an emulsifier, and homogenization treatment pressure. However, only for the sake of example, food protein can be used in an amount of 1.0 to 12.0% by weight (w/w%), preferably 2.0 to 10.0% by weight, and more preferably 3.0 to 8.0% by weight of the nutritional composition.

[0063]

The nutritional composition of the present invention can contain sugars. Examples of sugars that can be used in the present invention include polysaccharides such as a starch, dextrin, cellulose, glucomannan, and glucan, chitins, fructooligosaccharide, galactooligosaccharide, mannan oligosaccharide, low molecular weight polysaccharides, low molecular weight dextrin, low molecular weight cellulose, and low molecular weight glucomannan. For example, those that have a DE value of 12 to 50, 15 to 40, and 20 to 40 can be used. Further, sugars can be derived from any source such as plants, animals, and microorganisms, or can be chemically synthesized. For example, sugars derived from, for example, plants (such as potatoes, rice, sweet potatoes, corn, wheat, beans (such as *vicia faba*, mung beans, and adzuki beans, and cassava), animals (such as Crustaceans, insects, and shell fish), and microorganisms (such as mushrooms and fungi) can be directly used, or sugars obtained by subjecting the above sugars to partial or entire degradation or modification by a means of enzymatic reaction, microbial reaction, heat, and chemical reaction may also be used. The amounts and types of sugars to be used in the nutritional composition of the present invention can be appropriately adjusted and selected according to, for example, the viscosity of the nutritional composition to be produced and the types and contents of other ingredients such as an emulsifier, a thickening agent, protein, and lipid.

[0064]

Dextrin refers to a product obtained by subjecting a starch to, for example, degradation by heat, acid, enzyme, and the like, and if necessary, performing purification. Dextrin is alternatively called or expressed as British gum, starch gum, or dextrine. Various types of dextrans exist depending on the production method, degree of degradation, and the like. Examples of the various types of dextrans include maltodextrin, indigestible dextrin (water-soluble dietary fiber), cyclodextrin, soluble starch, and branched corn syrup. Dextrin can be evaluated based on dextrose equivalent (DE). Those skilled in the art can determine DE by a conventional method. For example, the dextrose equivalent of maltodextrin is assumed to be 3 to 20. The dextrose equivalent (DE) of dextrin used in the present invention is normally 12

to 50, preferably 15 to 40, and more preferably 20 to 40. The above dextrin can be used in combination with dextrin having a DE outside the above-specified values.

[0065]

In the nutritional composition of the present invention, in addition to the aforementioned water-absorbing dietary fiber and/or a starch not having been subjected to pregelatinization treatment in advance, a thickening agent, an emulsifier, food protein, and sugars, water, protein, carbohydrate, lipid, vitamins, minerals, organic acid, organic base, fruit juice, flavors, pH adjusters, and the like can be used. Examples of the protein include animal and plant-derived proteins and degradation products thereof such as milk-derived protein, enzyme degradation products of protein, whole milk powder, nonfat dry milk powder, casein, degradation products of casein, whey powder, whey protein, whey protein concentrates, degradation products of whey protein, hydrolyzed products of whey protein, α -casein, β -casein, κ -casein, β -lactoglobulin, α -lactalbumin, lactoferrin, soybean protein, chicken egg protein, and meat protein; and various types of milk-derived components such as butter, milk serum mineral, cream, whey, non-protein nitrogen, sialic acid, phospholipid, and laccase. The nutritional composition of the present invention can contain peptide and amino acid such as casein phosphopeptide and lysine. Examples of the carbohydrate include sugars, processed starches (dextrin as well as soluble starch, British starch, oxidized starch, starch ester, starch ether, and the like), and a dietary fiber. Examples of the lipid include animal-derived fat such as lard and fish oil, and fractionated oil, hydrogenated oil, and ester-exchanged oil thereof; and plant-derived oil such as palm oil, safflower oil, corn oil, rapeseed oil, and coconut oil, and fractionated oil, hydrogenated oil, and ester-exchanged oil thereof. Examples of the vitamins include vitamin A, carotenes, vitamin B group, vitamin C, vitamin D group, vitamin E, vitamin K group, vitamin P, vitamin Q, niacin, nicotinic acid, pantothenic acid, biotin, inositol, choline, and folic acid. Examples of the minerals include calcium, potassium, magnesium, sodium, copper, iron, manganese, zinc, and serine. Examples of the organic acid include malic acid, citric acid, lactic acid, tartaric acid, and erythorbic acid. A combination of two or more of these components can be used, and a synthesized product and/or food containing large amounts of these components can be used as well.

[0066]

The heat quantity(calorie) of the nutritional composition of the present invention can be adjusted by appropriately adding protein, lipid, and carbohydrate. The nutritional composition of the present invention can contain, for example, protein in an amount of 3 to 10 g/100g, preferably 4 to 8 g/100 g, and more preferably 5 to 7 g/100 g in terms of protein equivalent. The nutritional composition of the present invention can contain, for example, lipid in an amount equivalent to 2 to 10 g/100 g, preferably 3 to 8 g/100 g, and more preferably 3 to 6 g/100 g. The nutritional composition of the present invention can contain, for example, carbohydrate in an amount equivalent to 13 to 30 g/100 g, preferably 15 to 27 g/100 g, and more preferably 20 to 25 g/100 g. The nutritional composition of the present invention can contain the aforementioned amounts of protein, lipid, and carbohydrate while retaining certain fluidization characteristics as described above.

[0067]

The specific gravity of the nutritional composition of the present invention can be adjusted according to the usage. The specific gravity of the nutritional composition of the present invention can be set at, for example, 1.06 or more, 1.07 or more, 1.08 or more, 1.09 or more, 1.1 or more, less than 1.5, less than 1.4, less than 1.3, and less than 1.2, for example, 1.06 to 1.5, 1.07 to 1.5, 1.08 to 1.4, 1.09 to 1.3, 1.1 to 1.2, 1.1 to 1.15, 1.12 to 1.15, 1.13 to 1.15, preferably 1.135 to 1.145. Those skilled in the art can determine the specific gravity of the composition by appropriately adjusting each component. Although the specific gravity may vary depending on the temperature, for the sake of convenience, the specific gravity refers to a value obtained at 20°C in the present specification. The specific gravity of the composition can be calculated from the weight and volume of each component or by a conventional method, for example by using a density and specific gravity meter.

[0068]

In the present specification, a nutritional composition refers to a composition that appropriately contains protein, lipid, carbohydrate, and the like and has a specific gravity of 1.06 or more, for example 1.06 to 1.5, for example 1.07 to 1.5, for example

1.08 to 1.4, for example 1.09 to 1.3, for example 1.1 to 1.2, for example 1.1 to 1.15, for example 1.12 to 1.15, for example 1.13 to 1.15, and 1.135 to 1.145.

[0069]

After mixing some or all of the aforementioned raw materials, homogenization is performed as needed. Homogenization refers to homogenizing the mixed components by thorough mixing and mechanically miniaturizing fat globules and coarse particles of other components to prevent floatation and aggregation of fat and the like, while making the nutritional composition into a uniform emulsion. By increasing homogenization treatment pressure in homogenization process, viscosity after heat treatment can be reduced and generation of sediment (settling particles) can be reduced. That is, the viscosity of the nutritional composition and the generation of sediment can be controlled by adjusting the homogenization treatment pressure. Homogenization treatment is normally performed by shearing an adjusted solution using a conventional homogenizer under certain pressure. In the present invention, homogenization treatment can be preferably performed at a homogenization pressure of 10, 25, 40, 60, 100 MPa, and the like; however, treatment pressure is not limited to those exemplified above. That is, the viscosity (spindle type rotational viscometer, 20°C, 12 rpm) of the composition after heat treatment and storage at a temperature equal to or below normal temperature for a certain period of time, for example 7 days, can also be adjusted to 300 to 6700 mPa·s, for example 400 to 6700 mPa·s by applying homogenization treatment at a homogenization treatment pressure of 10 to 100 MPa in addition to using the thickening agent and the emulsifier.

[0070]

Homogenization treatment after mixing the raw materials can be performed at any appropriate temperature. Homogenization treatment can be performed, for example, at room temperature of around 20°C. Homogenization treatment can also be performed at a temperature higher than this, for example at 20 to 85°C, for example at 45 to 80°C, preferably at 45 to 70°C, more preferably at around 50°C to 60°C. Homogenization treatment is preferably performed at around 50°C to 60°C. By doing so, the viscosity (spindle type rotational viscometer, temperature of homogenization treatment, 12 rpm) of a

composition in the homogenization step can be suppressed to preferably approximately 5 to 300 mPa·s.

[0071]

In the production of the nutritional composition of the present invention, heat treatment or heat sterilization is performed. For heat sterilization conditions, sterilization conditions generally applied to food product can be used, and heat sterilization can be performed using a conventional device. For example, sterilization at 62 to 65°C for 30 minutes, 72°C or higher for 15 seconds or more, 72°C or higher for 15 minutes or more, or 120 to 150°C for 1 to 5 seconds, or disinfection at 121 to 124°C for 5 to 20 minutes, at 105 to 140°C, retort (autoclave) sterilization, high pressure steam disinfection, and the like can be used; however, heat sterilization is not limited to those exemplified above. Heat sterilization can be performed preferably under pressure. By applying heat sterilization treatment, the nutritional composition can be sterilized, while the viscosity of the composition can be increased. In the present specification, disinfection and sterilization can be used synonymously. Further, retort sterilization can be used as one aspect of heat sterilization.

[0072]

The viscosity of the nutritional composition of the present invention before mixing a water-absorbing dietary fiber and/or a starch not having been subjected to pregelatinization treatment in advance, a thickening agent, an emulsifier, food protein, and the like in the composition and applying heat treatment is preferably 5 to 810 mPa·s, preferably 5 to 300 mPa·s, preferably 10 to 200 mPa·s, and more preferably 20 to 100 mPa·s, and the nutritional composition can maintain a viscosity at which the production thereof is facilitated from the step of mixing raw materials to the step of filling a container with the resulting mixture. The aforementioned viscosity is the value obtained by measuring the viscosity under the conditions of 12 rpm at 45 to 85°C, preferably 45 to 70°C, and more preferably 50 to 60°C using a spindle type rotational viscometer. Further, the viscosity (spindle type rotational viscometer, 12 rpm) of a mixture before heat treatment at 20°C is 5 to 810 mPa·s, preferably 5 to 400 mPa·s, preferably 50 to 300 mPa·s, and more preferably 100 to 300 mPa·s. When the viscosity of a mixture before heat treatment is less than 5 mPa·s, there might be a

possibility of inconvenience such as sedimentation of the components of the mixture. On the other hand, when the viscosity (spindle type rotational viscometer, 45 to 85°C, 12 rpm) of a mixture before heat treatment is more than 300 mPa·s, inconvenience is caused such that handling of solutions in homogenization step becomes difficult.

[0073]

In the present specification, when the viscosity before heat treatment is expressed as 5 to 300 mPa·s, it is intended to indicate a range from not lower than the lower limit to less than the upper limit. That is, "5 to 300 mPa·s" means 5 mPa·s or more to less than 300 mPa·s.

[0074]

The viscosity (spindle type rotational viscometer, 20°C, 12 rpm) of the nutritional composition of the present invention gradually increases by storing the composition at a temperature equal to or below room temperature following heat treatment, and after the elapse of a certain period of time, the viscosity is almost stabilized. The storage period of the composition can be appropriately selected according to the desired viscosity, for example, several hours to half a day, 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 7 days, 10 days, 14 days, 20 days, 30 days, 40 days, 50 days, 60 days, 70 days, 80 days, and 90 days. That is, the storage period of the composition of the present invention after heat treatment can be, for example, 1 to 90 days, preferably 5 to 60 days, more preferably 7 to 30 days, and even more preferably 7 days. The viscosity (spindle type rotational viscometer, 20°C, 12 rpm) of a nutritional composition according to a preferable embodiment of the present invention is almost stabilized approximately 7 days after (approximately one week after) storage at a temperature equal to or below normal temperature following heat treatment. Those skilled in the art can appropriately determine the time required for stabilization of a heat-treated composition by a conventional technique.

[0075]

Further, preferably, the viscosity (spindle type rotational viscometer, 20°C, 12 rpm) of the nutritional composition of the present invention that has been subjected to heat treatment and then stored at normal temperature (15 to 25°C) or below for a certain period of time, for example 7 days, can be 300 mPa·s or more, 400 mPa·s or more, 500 mPa·s or more,

600 mPa·s or more, 700 mPa·s or more, 800 mPa·s or more, 900 mPa·s or more, 1000 mPa·s or more, 1200 mPa·s or more, less than 6700 mPa·s, less than 6000 mPa·s, less than 5000 mPa·s, less than 4000 mPa·s, less than 3000 mPa·s, less than 2000 mPa·s, and less than 1500 mPa·s. The viscosity of the nutritional composition of the present invention that has been subjected to heat treatment and then stored at a temperature equal to or below normal temperature for a certain period of time can be, for example, 300 to 6700 mPa·s, preferably 400 to 6700 mPa·s, preferably 400 to 2000 mPa·s, and more preferably 500 to 1500 mPa·s. The heat-treated nutritional composition of the present invention is preferably stored at 0°C to normal temperature or below. By adjusting the viscosity to the aforementioned values, conventional free-fall tube feeding can be employed for feeding a liquid nutritional composition to those who consume it. As a result, gastroesophageal reflux, which is a problem associated with tube feeding of a low-viscosity nutritional composition, and cumbersome operation such as injection by syringe, which is a problem associated with feeding of a semi-solid nutritional composition with high viscosity (for example 7000 to 20000 mPa·s), are solved, whereby simple feeding is made possible. Alternatively, a composition having the same degree of viscosity (spindle type rotational viscometer, 20°C, 12 rpm) as a semi-solid liquid food of 4000 mPa·s or more can be obtained by appropriately adjusting the types of an emulsifier, the contents of other ingredients such as a thickening agent, homogenization treatment pressure, and the like. This nutritional composition can be provided in a variety of containers used for liquid foods or for oral or tube feeding. As an example thereof, a flexible container with an outlet used for liquid foods or for oral or tube feeding (so-called soft bag, nutrition bag, etc.) can be used. Further, a nutritional composition to be used for a flexible container with an outlet used for oral feeding (so-called cheer pack) can also be obtained by appropriately adjusting the viscosity. By subjecting a composition to heat treatment and storing the composition at a temperature equal to or below normal temperature for a certain period of time, for example 7 days, the viscosity of the composition (measured with a spindle type rotational viscometer, 20°C, 12 rpm at any time) will be 1.5 to 20 times, preferably 2 to 12 times, and more preferably 3 to 10 times as high as that before heat treatment.

[0076]

In the present specification, when the viscosity of the nutritional composition of the present invention that has been subjected to heat treatment and then stored for a certain period of time at a temperature equal to or below normal temperature is expressed as 300 to 6700 mPa·s, it is intended to indicate a range from not lower than the lower limit to less than the upper limit. That is, "300 to 6700 mPa·s" means 300 mPa·s or more to less than 6700 mPa·s.

[0077]

The viscosity of the nutritional composition of the present invention can be measured by a conventional method. As an example, the viscosity can be measured with a spindle type rotational viscometer (20 to 85°C and 12 rpm).

[0078]

The measurement of the viscosity (20°C, 12 rpm) of the nutritional composition of the present invention can be performed in accordance with, for example, "Standard for labeling approval of foods for special dietary uses: Test method for foods for the elderly 3, Viscosity ("How to handle the labeling approval for foods for the elderly", (February 23, 1994, Notice No. 15 by the chief of the Office of Health Policy on Newly Developed Foods, Food Sanitation Division, Environmental Health Bureau, the Ministry of Health, Labour and Welfare of Japan)) ". Specifically, using a spindle type rotational viscometer, the reading is taken two minutes after rotating a rotor. Subsequently, the value thus obtained is multiplied by a coefficient corresponding to this value, and the resulting value is expressed as mPa·s. The measurement is performed at $20 \pm 2^\circ\text{C}$.

[0079]

Further, as other examples, the viscosity can be measured properly or continuously during the production step using an inline viscometer such as a torsional vibration viscometer, an ultrasonic viscometer, and a rotating viscometer.

[0080]

The nutritional composition of the present invention achieves an increasing effect on the viscosity of the composition after heat treatment and storage at a temperature equal to or below normal temperature for a certain period of time, for example 1 to 90 days, for example 7 days due to the effect of a water-absorbing dietary fiber and/or a starch not having been

subjected to pregelatinization treatment in advance. In light of the above, the viscosity of the nutritional composition of the present invention before heat treatment can be kept lower than that of a composition in which the viscosity is increased primarily by a thickening agent. That is, the present invention provides a nutritional composition that can be easily produced and fed by tube. Meanwhile, as will be demonstrated in, for example, Comparative Example 1 in Example 3 to be described later, the viscosity of a nutritional composition produced by adding an emulsifier without containing a water-absorbing dietary fiber and a starch not having been subjected to pregelatinization treatment in advance, did not increase even after heat treatment and further storage at a temperature equal to or below normal temperature for 7 days, in comparison with the viscosity (spindle type rotational viscometer, 20°C, 12 rpm) before heat treatment.

[0081]

Here, the effect of a water-absorbing dietary fiber and/or a starch not having been subjected to pregelatinization treatment in advance means that, in the production of a nutritional composition having a viscosity (spindle type rotational viscometer, 20°C, 12 rpm) of 300 to 6700 mPa·s after heat treatment and then storage at a temperature equal to or below normal temperature for a certain period of time, for example 1 to 90 days, for example 7 days, regardless of the fact that the viscosity of the composition before heat treatment is markedly lower than the viscosity of a composition in which the viscosity is increased primarily by a thickening agent, the viscosity of the composition can be brought to equal to or more than the viscosity of the nutritional formulation in which the viscosity is increased primarily by a thickening agent by heat treatment and further storage at a temperature equal to or below normal temperature for a certain period of time, for example 1 to 90 days, for example 7 days.

[0082]

By appropriately adjusting the formulation ratio of a water-absorbing dietary fiber and/or a starch not having been subjected to pregelatinization treatment in advance, a thickening agent, and an emulsifier to be contained in the nutritional composition of the present invention and subjecting the composition to heat treatment and then to storage at a

temperature equal to or below normal temperature for a certain period of time, for example 1 to 90 days, for example 7 days, a nutritional composition having a certain viscosity can be obtained. Since the viscosity of the composition is affected by factors such as the contents and types of protein and fat contained in the nutritional composition and particle diameter of fat globules before sterilization, the formulation ratio of a water-absorbing dietary fiber and/or a starch not having been subjected to pregelatinization treatment in advance, a thickening agent, and an emulsifier can be appropriately adjusted.

[0083]

The nutritional composition of the present invention attains a sufficient viscosity by, for example, adjusting the amount of a water-absorbing dietary fiber and/or a starch not having been subjected to pregelatinization treatment in advance to be used, and it is also possible to provide the nutritional composition in a flexible container with an outlet used for oral feeding. A flexible container with an outlet used for oral feeding refers to a so-called cheer pack, i.e., a flexible bag-like container provided with an outlet such as a flexible bag-like container with a tubular spout fixed thereto. Alternatively, a flexible container with an outlet used for oral feeding is called an aluminum pouch with an outlet, a spout of a flexible container, a flexible bag-like container with a capped opening, a pouch container with an outlet a plug, and the like.

[0084]

(Examples)

Example 1: The effect of the amount of a thickening agent added on the viscosity of a composition

After adding, to nutritional compositions, certain amounts of a water-absorbing dietary fiber and an emulsifier, and also a thickening agent at varied formulation ratios, the effect exerted on the viscosity of the nutritional compositions was examined. Raw materials were stirred and mixed in accordance with the recipe in Table 1 to formulate various nutritional compositions (Production Examples 1 to 3). The resulting nutritional compositions were subjected to homogenization treatment under the conditions of 50 to 60°C and a homogenization treatment pressure of 20 MPa, followed by homogenization treatment under the conditions of 50 to 60°C and a homogenization treatment pressure of 30 MPa. For

specific gravity, an actual measurement value obtained using a viscosity and specific gravity meter at 20°C was recorded. After the viscosity of these nutritional compositions was measured [prior to retort sterilization], they were filled and sealed in containers and then subjected to retort sterilization under the conditions of 121 to 123.5°C for 5 to 20 minutes. The nutritional compositions after retort sterilization were stored at 15°C for one week, and the viscosity was measured again [post retort sterilization]. It should be noted that the viscosity was measured using a spindle type rotational viscometer under the conditions of 12 rpm and 20°C. Further, the milk-derived protein used was a combination of 1.9% by weight of MPC, 3.8% by weight of casein sodium, and 1.5% of degradation products of milk protein, the water-absorbing dietary fiber used was an insoluble fiber of soybean dietary fiber, the emulsifier used was diacetyl tartaric (acid) ester of monoglyceride (DATEM), and the thickening agent used was carrageenan. Further, the composition of Production Examples 1 to 3 is shown in Table 1-2.

[Table 1]

	Production Example 1	Production Example 2	Production Example 3
Raw material	Formulation ratio (w/w%)	Formulation ratio (w/w%)	Formulation ratio (w/w%)
Milk-derived protein	7.2	7.2	7.2
Prepared fat	4.23	4.23	4.23
Sucrose	1.6	1.6	1.6
Dextrin	22.5	22.5	22.5
Indigestible dextrin	1.08	1.08	1.08
Insoluble soybean dietary fiber	1.08	1.08	1.08
Mineral mixture	1.3	1.3	1.3
pH Adjuster	0.16	0.16	0.16
Vitamin mixture	0.18	0.18	0.18
Fragrance	0.18	0.18	0.18
Diacetyl tartaric (acid) ester of monoglyceride (DATEM)	0.64	0.64	0.64
Carrageenan	0	0.03	0.06
Water	59.85	59.82	59.79
Total	100.0	100.0	100.0
Specific weight	1.14	1.14	1.14

[Table 1-2]

Composition	Production Examples 1-3
Protein	6.3g/100g
Lipid	4.4g/100g
Carbohydrate	24.6g/100g
Detail Sugar	22.7g/100g
Dietary fiber	1.9g/100g

[0085]

(Results)

The results are shown in Figure 1. Even in absence of a thickening agent (Production Example 1), in the presence of a certain amount of a water-absorbing dietary fiber, the viscosity after retort sterilization of the composition to which an emulsifier was added

increased to approximately 4.4 times higher than that prior to retort sterilization. Further, in the presence of a certain amount of a water-absorbing dietary fiber, the viscosity after retort sterilization of the compositions to which an emulsifier and a thickening agent were added increased approximately 8.4 to 13.4 times higher than that prior to retort sterilization, with the composition containing a thickening agent at a higher formulation ratio showing a higher viscosity value after retort sterilization. Meanwhile, there was no major difference in the viscosity before retort sterilization depending on the formulation ratio of a thickening agent.

[0086]

From the above results, it was found that by using a water-absorbing dietary fiber in the nutritional composition of the present invention, the viscosity of the composition after retort sterilization could be dramatically increased even in the absence of a thickening agent or in the presence of only a small amount of a thickening agent.

[0087]

Example 2: The effect of homogenization treatment pressure on the viscosity of a composition

After adding certain amounts of a water-absorbing dietary fiber and an emulsifier to nutritional compositions and performing homogenization treatment at varied levels of homogenization treatment pressure, the effect exerted on the viscosity of the nutritional compositions was examined. Raw materials were stirred and mixed in accordance with the recipe in Table 2 to formulate nutritional compositions (Production Example 4). The resulting nutritional compositions were subjected to homogenization treatment under the conditions of 50 to 60°C and a homogenization treatment pressure of 20, 40, or 60 MPa. For specific gravity, an actual measurement value obtained using a viscosity and specific gravity meter at 20°C was recorded. Subsequently, the resulting nutritional compositions were filled and sealed in containers and subjected to retort sterilization under the conditions of 121 to 123.5°C for 5 to 20 minutes. After storing the nutritional compositions having been subjected to retort sterilization at 15°C for one week, the viscosity was measured again [after retort sterilization]. It should be noted that the viscosity was measured using a spindle type rotational viscometer under the conditions of 12 rpm and 20°C. Further, the milk-derived protein used was a combination of 1.9% by weight of MPC, 3.8% by weight

of casein sodium, and 1.5% of degradation products of milk protein, and the thickening agent used was carrageenan. Further, the composition of Production Example 4 is shown in Table 2-2.

[Table 2]

	Production Example 4
Raw material	Formulation ratio (w/w%)
Milk-derived protein	7.2
Prepared fat	4.23
Sucrose	1.6
Dextrin	22.5
Indigestible dextrin	1.73
Insoluble soybean dietary fiber	0.43
Mineral mixture	1.3
pH Adjuster	0.16
Vitamin mixture	0.18
Fragrance	0.18
Diacetyl tartaric (acid) ester of monoglyceride (DATEM)	0.64
Carrageenan	0.053
Water	59.80
Total	100.0
Specific weight	1.14

[Table 2-2]

Composition	Production Example 4
Protein	6.3g/100g
Lipid	4.4g/100g
Carbohydrate	24.6g/100g
Detail Sugar	22.7g/100g
Dietary fiber	1.9g/100g

[0088]

(Results)

Results are shown in Figure 2. The viscosity of the composition after retort sterilization decreased with an increase in homogenization treatment pressure. From this, it was found that the viscosity of a composition after retort sterilization can be adjusted by adjusting homogenization treatment pressure.

[0089]

Example 3: The effect of the amount of a water-absorbing dietary fiber added on the viscosity of a composition

After adding, to nutritional compositions, a certain amount of an emulsifier, and a water-absorbing dietary fiber at varied formulation ratios, without using a thickening agent, the effect exerted on the viscosity of nutritional compositions was examined. Raw materials were stirred and mixed in accordance with the recipe in Table 3 to formulate various nutritional compositions (Production Example 1, Examples 1 to 4, and Comparative Example 1). The resulting nutritional compositions were subjected to homogenization treatment under the conditions of 50 to 60°C and a homogenization treatment pressure of 20 MPa, followed by homogenization treatment under the conditions of 50 to 60°C and a homogenization treatment pressure of 30 MPa. For specific gravity, an actual measurement value obtained using a viscosity and specific gravity meter at 20°C was recorded. After the viscosity of these nutritional compositions was measured [prior to retort sterilization], they were filled and sealed in containers and then subjected to retort sterilization under the conditions of 121 to 123.5°C for 5 to 20 minutes. The nutritional compositions after retort sterilization were stored at 15°C for one week, and the viscosity was measured again [post retort sterilization]. It should be noted that the viscosity was measured using a spindle type rotational viscometer under the conditions of 12 rpm and 20°C or 50°C. Further, the milk-derived protein used was a combination of 1.9% by weight of MPC, 3.8% by weight of casein sodium, and 1.5% of degradation products of milk protein, the water-absorbing dietary fiber used was an insoluble fiber of soybean dietary fiber, and the emulsifier used was diacetyl tartaric (acid) ester of monoglyceride (DATEM). Further, the composition of Examples 1 to 4 and Comparative Example 1 is shown in Table 3-2.

[Table 3-1]

	Example 1	Example 2	Example 3	Example 4	Comparative Example 1
Raw material	Formulation ratio (w/w%)	Formulation ratio (w/w%)	Formulation ratio (w/w%)	Formulation ratio (w/w%)	Formulation ratio (w/w%)
Milk-derived protein	7.2	7.2	7.2	7.2	7.2
Prepared fat	4.23	4.23	4.23	4.23	4.23
Sucrose	1.6	1.6	1.6	1.6	1.6
Dextrin	22.5	22.5	22.5	22.5	22.5
Indigestible dextrin	0	0.37	0.73	1.1	0
Insoluble soybean dietary fiber	2.2	1.83	1.47	1.1	0
Mineral mixture	1.3	1.3	1.3	1.3	1.3
pH Adjuster	0.16	0.16	0.16	0.16	0.16
Vitamin mixture	0.18	0.18	0.18	0.18	0.18
Fragrance	0.18	0.18	0.18	0.18	0.18
Diacetyl tartaric (acid) ester of monoglyceride (DATEM)	0.64	0.64	0.64	0.64	0.64
Thickening agent	0	0	0	0	0
Water	59.81	59.81	59.81	59.81	62.01
Total	100.0	100.0	100.0	100.0	100.0
Specific weight	1.1365	1.1365	1.1365	1.1365	1.1365

[Table 3-2]

Composition	Examples 1-4	Comparative Example 1
Protein	6.3g/100g	6.3g/100g
Lipid	4.4g/100g	4.4g/100g
Carbohydrate	24.6g/100g	22.7g/100g
Detail Sugar	22.7g/100g	22.7g/100g
Dietary fiber	1.9g/100g	0g/100g

[0090]

(Results)

Results are shown in Figure 3. The viscosity of the nutritional composition of Example 1 was 804 mPa·s (20°C) before retort sterilization, whereas it was markedly increased to 6610 mPa·s (20°C) after retort sterilization. The viscosity of Comparative Example 1 without insoluble soybean dietary fiber was 65 mPa·s (20°C) before retort sterilization, and after retort sterilization, it was only slightly changed to 52 mPa·s (20°C). That is, even in the absence of a thickening agent, the viscosity after retort sterilization of a composition to which a water-absorbing dietary fiber was added was approximately 5.9 to 8.2 times as high as that before retort sterilization. Further, the higher the formulation ratio of a water-absorbing dietary fiber, the higher the viscosity value of the composition after retort sterilization. As shown above, by using a water-absorbing dietary fiber in the nutritional composition of the present invention, a composition having such a high viscosity as 6610 mPa·s (20°C) after retort sterilization was obtained even without using a thickening agent at all. It is to be noted that the viscosity (50°C) of Examples 1 and 2 before retort sterilization was 300 mPa·s (50°C) and 160 mPa·s (50°C), respectively.

[0091]

Example 4: Starch not having been pregelatinized in advance

The effect of a starch not having been pregelatinized in advance on the viscosity of a nutritional composition was tested by adding a certain amount of a starch not having been pregelatinized in advance to the composition. Raw materials were stirred and mixed in accordance with the recipe in Table 4-1 to formulate various nutritional compositions (Formulations 3 and 4), and the resulting nutritional compositions were subjected to homogenization treatment under the conditions of 50 to 60°C and a homogenization treatment pressure of 20 MPa, followed by homogenization treatment at 50 to 60°C and 30 MPa. For specific gravity, an actual measurement value obtained using a viscosity and specific gravity meter at 20°C was recorded. After the viscosity of these nutritional compositions was measured [prior to retort sterilization], they were filled and sealed in containers and then subjected to retort sterilization under the conditions of 121 to 123.5°C for 5 to 20 minutes. The nutritional compositions after retort sterilization were stored at 15°C

for three days, and the viscosity was measured again [post retort sterilization]. It should be noted that the viscosity was measured using a spindle type rotational viscometer under the conditions of 12 rpm, 20°C or 50°C. Further, the starch not having been pregelatinized in advance used in the present Example was waxy corn starch (trade name "Suehiro 200", the product of OJI CORNSTARCH Co., Ltd.), the milk-derived protein used in the present Example was a combination of 1.9% by weight of MPC, 3.7% by weight of casein sodium, and 1.5% of degradation products of milk protein, and the emulsifier used in the present Example was diacetyl tartaric (acid) ester of monoglyceride (DATEM). A thickening agent was not used. Further, the composition of Formulations 3 and 4 is shown in Table 4-2.

[Table 4-1]

	Formulation 3	Formulation 4
Raw material	Formulation ratio (w/w%)	Formulation ratio (w/w%)
Milk-derived protein	7.1	7.1
Dextrin	22.2	22.1
Waxy corn starch	1.5	2.0
Sucrose	1.6	1.6
Mineral mixture	1.3	1.3
pH Adjuster	0.16	0.16
Prepared fat	4.17	4.15
Vitamin mixture	0.18	0.18
Fragrance	0.18	0.18
Emulsifier	Diacetyl tartaric (acid) ester of monoglyceride (DATEM)	Diacetyl tartaric (acid) ester of monoglyceride (DATEM)
	0.63	0.63
Thickening agent	None	None
Water	61.08	60.77

Viscosity prior to retort sterilization mPa·s	60(20°C)	66(20°C)
Viscosity post retort sterilization mPa·s	560(20°C)	1600(20°C)

[Table 4-2]

Composition		Formulation 3	Formulation 4
Protein		6.3g/100g	6.3g/100g
Lipid		4.4g/100g	4.4g/100g
Carbohydrate		24.2g/100g	24.5g/100g
Detail	Sugar	24.2g/100g	24.5g/100g
	Dietary fiber	0g/100g	0g/100g

[0092]

The results of measurement of viscosity before and after heat sterilization are shown in Table 4-1. After heat sterilization, the viscosity of Formulations 3 and 4 were dramatically increased compared to those before heat sterilization. Particularly, the viscosity of Formulation 4 post heat sterilization increased to approximately 24 times higher than the viscosity prior to heat sterilization.

[0093]

From the above results, it was found that the viscosity of the composition after retort sterilization could be dramatically increased even in absence of a thickening agent or in the presence of only a small amount of a thickening agent by using a starch not having been pregelatinized in advance in the nutritional composition of the present invention.

[0094]

All the publications, patents, and patent applications cited in the present specification are incorporated herein by reference in their entirety.

CLAIMS

[Claim 1]

A viscous nutritional composition comprising 0.1 to 1.0% by weight of a water-absorbing dietary fiber relative to the nutritional composition, wherein the composition has a property such that the viscosity thereof is increased by a heat treatment, wherein the viscosity of the composition prior to said heat treatment is 5 to 300 mPa·s, wherein the viscosity of the composition prior to said heat treatment is measured at 45 to 85°C and 12 rpm using a spindle type rotational viscometer, and wherein the viscosity of the composition reaches 300 to 6700 mPa·s by subjecting the composition to said heat treatment and then to storage at a temperature equal to or below normal temperature of 15 to 25°C for 1 to 90 days, wherein the viscosity of the composition that has been subjected to said heat treatment and then stored at a temperature equal to or below normal temperature of 15 to 25°C for 1 to 90 days is measured at 20°C and 12 rpm using a spindle type rotational viscometer.

[Claim 2]

The nutritional composition according to claim 1, wherein the water-absorbing dietary fiber has a property such that water absorbency thereof is increased by heat treatment.

[Claim 3]

The nutritional composition according to claim 1, wherein the water-absorbing dietary fiber is an insoluble dietary fiber.

[Claim 4]

The nutritional composition according to claim 1, wherein the water-absorbing dietary fiber is an insoluble fiber of soybean dietary fiber and/or soybean *fusuma* bran.

[Claim 5]

The nutritional composition according to claim 1, comprising one or more from the group consisting of protein, lipid, and sugar, wherein the specific gravity of the composition is 1.06 to 1.5.

[Claim 6]

The nutritional composition according to claim 1, comprising one or more from the group consisting of a thickening agent and an emulsifier.

[Claim 7]

The nutritional composition according to claim 1, wherein a homogenization treatment is performed prior to said heat treatment by adjusting the homogenization treatment pressure to 10 to 100 MPa.

[Claim 8]

A method for producing a viscous nutritional composition, comprising the steps of:

- i) preparing a water-absorbing dietary fiber at an amount of 0.1 to 1.0% by weight relative to the nutritional composition,
- ii) applying a pressure treatment for homogenization, and
- iii) applying a heat treatment,

wherein the viscosity of the composition before the heat treatment is 5 to 300 mPa·s, wherein the viscosity of the composition before the heat treatment is measured at 45 to 85°C and 12 rpm using a spindle type rotational viscometer, and the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature of 15 to 25°C for 1 to 90 days is 300 to 6700 mPa·s, wherein the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature of 15 to 25°C for 1 to 90 days is measured at 20°C and 12 rpm using a spindle type rotational viscometer.

[Claim 9]

A method for producing a viscous nutritional composition, comprising the steps of:

- i) preparing a water-absorbing dietary fiber at an amount of 0.1 to 1.0% by weight relative to the nutritional composition,
- ii) applying a pressure treatment for homogenization, and
- iii) applying a heat treatment,

wherein the viscosity of the composition before the heat treatment is 5 to 300 mPa·s, wherein the viscosity of the composition before the heat treatment is measured at 45 to 85°C and 12 rpm using a spindle type rotational viscometer, and the homogenization treatment pressure in the step of applying the pressure treatment for homogenization is 10 to 100 MPa, and a viscosity (20°C) of the composition after the heat treatment and storage at a temperature equal to or below normal temperature of 15 to 25°C for 1 to 90 days is 300 to 6700 mPa·s, wherein the viscosity of the composition after the heat treatment and storage at a temperature equal to or below normal temperature of 15 to 25°C for 1 to 90 days is measured at 20°C and 12 rpm using a spindle type rotational viscometer.