

MUSCLE SYNTHESIS PROMOTER

CROSS-REFERENCE TO RELATED APPLICATIONS

5 [0001]

This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2015-016093, filed on January 29, 2015, the entire contents of which are incorporated herein by reference.

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BACKGROUND OF THE INVENTION

Field of the Invention

[0002]

The present invention relates to a muscle synthesis promoter.

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Background Art

[0003]

In recent years, many people (subjects) exercise in combination with oral intake of nutritious supplements (supplements) containing proteins as main ingredients, for promotion of muscle synthesis, prevention of muscle loss, and promotion of restoration of muscle mass, aiming for health promotion and improvement in exercise capacity. There is a protein powder as such nutritious supplement, and whey protein (lactoserum proteins) and casein protein made from milk have been known as the main ingredients.

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[0004]

Regarding whey protein, since the rate from oral intake to digestion and absorption (absorption rate) is fast (short time) and a large amount of branched-chain amino acid (BCAA: valine, leucine, and isoleucine) is contained, it is said that they can efficiently enhance muscles while preventing muscle fatigue. On the other hand, regarding casein protein, since they are more slowly and persistently metabolized as compared with whey protein, the rate from oral intake to digestion and absorption (absorption rate) is slow (long time), and it is said that they are unsuitable for a subject in need of instantaneous

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promotion of muscle synthesis (see Patent Document 1: Japanese Translation of PCT International Application Publication No. JP 2009-507044 T). Therefore, mainly whey protein has been used in protein powders.

5 [0005]

Meanwhile, the muscle synthesis-promoting effect has also been known for milk proteins in which a specified amount of casein protein and whey protein are contained. Specifically, intake of milk proteins after exercise has been known to
10 dose-dependently promote skeletal muscle synthesis and inhibit skeletal muscle degradation (see Non Patent Document 1: Proceedings of the 64th Conference of Japan Society of Physical Education, Health and Sport Sciences, 2013, p166). Furthermore, according to Non Patent Document 1: Proceedings
15 of the 64th Conference of Japan Society of Physical Education, Health and Sport Sciences, 2013, p166, as a food taken immediately after exercise, a milk protein-fortified milk beverage has been shown to be more effective for body building associated with exercise load, as compared with usual milk.

20 [0006]

In other words, in order to promote muscle synthesis by taking milk proteins, increasing the intake of comprehensive milk proteins is effective, such as taking a high concentration of a milk protein-fortified milk beverage or taking a large amount
25 of usual milk.

PRIOR ARTS

Patent Document

[0007]

Patent Document 1: Japanese Translation of PCT International
30 Application Publication No. JP 2009-507044 T

Non Patent Document

[0008]

Non Patent Document 1: Proceedings of the 64th Conference of Japan Society of Physical Education, Health and Sport Sciences,
35 2013, p166

[0009]

For increasing the intake of comprehensive milk proteins is effective, such as taking a high concentration of a milk protein-fortified milk beverage or taking a large amount of usual milk, a problem in which a large amount of milk protein must be taken occurs. Regarding such intake of a large amount of milk protein, sometimes the intake itself is difficult for infants or the elderly, who cannot take a large amount of milk protein as energy, and furthermore, there is also a concern about the onset of lifestyle diseases including obesity associated with excessive energy taken. Regardless of age, taking a large amount of milk protein itself is also a burden. Particularly, immediately after exercise, even though muscle synthesis should be promptly promoted, appetite is decreased by hormone secretion due to exercise, and thus taking a large amount of milk protein is a burden.

SUMMARY OF THE INVENTION

[0010]

As mentioned above, there has not been known yet a muscle synthesis promoter which does not always require intake of a large amount of milk protein and exhibits a muscle synthesis-promoting effect equivalent to or more than the muscle synthesis-promoting effect of that including, as an active ingredient, a neutral liquid composition that includes milk proteins, as mentioned in Non Patent Document 1: Proceedings of the 64th Conference of Japan Society of Physical Education, Health and Sport Sciences, 2013, p166, aiming for intake of a large amount of milk protein. Hence, to provide a novel muscle synthesis promoter which exhibits such effect is a problem to be solved.

[0011]

The present inventors have intensively studied so as to solve the problem, and found a phenomenon in which an acidic liquid composition that includes 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein at a

specific protein content ratio is easy to take, and exhibits a muscle synthesis-promoting effect even when a large amount of milk protein is not taken.

[0012]

5 Specifically, even though, in the prior art, it has been known that milk proteins dose-dependently contribute to the muscle synthesis-promoting effect, the present inventors recently unexpectedly found a phenomenon in which an acidic liquid composition that includes 0.2 to 1.2% by weight of
10 soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein at a specific protein content ratio has an instantaneous muscle synthesis-promoting action, as compared with a skimmed milk
15 solution, namely a muscle synthesis promoter including, as an active ingredient, a neutral liquid composition composed of only a large amount of milk protein mixture (e.g., see Non Patent Document 1: Proceedings of the 64th Conference of Japan Society of Physical Education, Health and Sport Sciences, 2013,
20 p166). The present inventors also unexpectedly found a phenomenon in which an acidic liquid composition that includes 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein
25 protein and whey protein at a specific protein content ratio exhibits a muscle synthesis-promoting action equivalent to that of the muscle synthesis promoter including, as an active ingredient, a neutral liquid composition composed of only a large amount of milk protein mixture, even when the
30 composition is an acidic liquid composition having a low milk protein concentration. The above phenomena were surprising. The present invention is based on these findings.

[0013]

That is, the present invention is as follows.

35 [1] A muscle synthesis promoter including, as an active ingredient, an acidic liquid composition that includes: 0.2 to

- 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20.
- 5 [2] The muscle synthesis promoter according to [1], wherein the acidic liquid composition further includes 0.5 to 5% by weight of trehalose.
- [3] The muscle synthesis promoter according to [1] or [2],
10 wherein the pH of the acidic liquid composition is 3 to 6.
- [4] The muscle synthesis promoter according to any one of [1] to [3], wherein the fibrous insoluble cellulose is fermented cellulose.
- [5] The muscle synthesis promoter according to any one of
15 [1] to [4], wherein the milk protein mixture contained in the acidic liquid composition is taken so that the total protein content is 0.06 to 0.7 g/kg body weight per meal.
- [6] The muscle synthesis promoter according to any one of [1] to [5], which is in a unit packaging form per meal, wherein
20 the unit packaging form contains 3 to 40 g (total protein content) of the milk protein mixture as an intake per meal.
- [7] The muscle synthesis promoter according to any one of [1] to [6], which is for a subject who performs exercise.
- [8] The muscle synthesis promoter according to [7], wherein
25 the exercise is muscle training.
- [9] A method for promoting muscle synthesis, which includes allowing a subject in need of promotion of muscle synthesis to take an acidic liquid composition that includes: 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of
30 HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20.
- [10] A method for promoting muscle synthesis (excluding
35 medical practice for humans), which includes allowing a subject in need of promotion of muscle synthesis to take an acidic liquid

composition that includes: 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20.

[11] Use of a muscle synthesis promoter including, as an active ingredient, an acidic liquid composition that includes: 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, for promotion of muscle synthesis, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20.

[12] Use of a muscle synthesis promoter including, as an active ingredient, an acidic liquid composition that includes: 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, for production of foods or medicines for promotion of muscle synthesis, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20.

[13] An acidic liquid composition for promotion of muscle synthesis, including: 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20.

[0014]

According to the present invention, it is possible to increase the muscle synthesis-promoting effect by preventing curdling of milk proteins in the stomach and promoting the absorption of milk proteins, and to exhibit a muscle synthesis-promoting effect equivalent to or more than the

muscle synthesis-promoting effect of that including, as an active ingredient, a neutral liquid composition that includes the same concentration of milk proteins. Therefore, according to the present invention, it is possible to exhibit a muscle synthesis-promoting effect even when a large amount of milk protein is not always taken.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 shows a time course of the skeletal muscle protein fractional synthesis rate (FSR (%/day)) when the muscle synthesis promoter of the present invention (3.4% by weight of milk protein) and a skimmed milk solution (3.4% by weight of milk protein) were orally administered.

Fig. 2 shows a time course of the skeletal muscle protein fractional synthesis rate (FSR (%/day)) when the muscle synthesis promoter of the present invention (3.4% by weight of milk protein) and a high-dose skimmed milk solution (6.8% by weight of milk protein) were orally administered.

DETAILED DESCRIPTION OF THE INVENTION

[0016]

The present invention will be described in detail below, but the present invention is not limited to the individual embodiments.

[0017]

The muscle synthesis promoter of the present invention includes an acidic liquid composition as an active ingredient, and is preferably a muscle synthesis promoter including an acidic liquid composition as an active ingredient. Specifically, the muscle synthesis promoter of the present invention is a muscle synthesis promoter including, as an active ingredient, an acidic liquid composition that includes soybean polysaccharides, HM pectin, fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein at a specific protein content ratio. More specifically, the muscle synthesis promoter of the present invention is a muscle synthesis promoter including, as an active ingredient, an acidic liquid

composition that includes 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20. According to preferred embodiments of the present invention, the muscle synthesis promoter of the present invention is used for a subject in need of instantaneous promotion of muscle synthesis.

10 [0018]

"Active ingredient" means an ingredient required for exhibiting the muscle synthesis-promoting effect. As one preferred form, "active ingredient" means an ingredient required for exhibiting the muscle synthesis-promoting effect for a subject in need of instantaneous promotion of muscle synthesis.

[0019]

"Promotion of muscle synthesis" means that muscle synthesis is promoted by taking milk proteins and absorbing them as a nutrient in the body. Therefore, the muscle synthesis promoter of the present invention is used for this or a state caused by this. Examples of the objects of promotion of muscle synthesis include increase in muscle mass, promotion of muscle growth, repair of muscle tissues, muscle enhancement, improvement in muscle strength, health promotion effect associated with promotion of muscle synthesis, and improvement in exercise capacity, and preferably, repair of muscle tissues, improvement in muscle strength, health promotion effect associated with promotion of muscle synthesis, and improvement in exercise capacity. The promotion of muscle synthesis also includes anabolism of muscle proteins from amino acids. "Instantaneous promotion of muscle synthesis" means promotion of muscle synthesis associated with immediate absorption of milk proteins.

35 [0020]

"A subjects in need of promotion of muscle synthesis"

means a subject in need of promotion of the synthesis of muscle proteins for repair of muscular tissues and promotion of muscle growth, and for example, a subject who performs exercise for promotion of muscle synthesis, prevention of muscle loss, and
5 promotion of restoration of muscle mass, aiming for health promotion or improvement in exercise capacity. In terms of the fact that muscle synthesis is promoted by applying a certain load on muscle strength, the exercise is preferably muscle strength training (resistance exercise), and more preferably
10 long-term muscle strength training, for example, muscle strength training that is continued for continuous 30 minutes to 5 hours at a frequency of 1 to 7 days in a week. Examples of the muscle strength training include dumbbell exercise, squat exercise, and machine training.

15 [0021]

Examples of the subjects who require promotion of muscle synthesis of the present invention include athletes, athletic lovers (athletes), persons who require exercise for improvement in lifestyle diseases, persons who require exercise
20 for health promotion such as the elderly, or patients who have diseases that require promotion of muscle synthesis, for example, muscle damage (e.g., sarcopenia) and require promotion of muscle synthesis by exercise. The subjects may be animals other than humans (livestock such as horses or
25 cattle, pets such as dogs or cats, or appreciation animals kept in zoos, etc.).

[0022]

The timing when the muscle synthesis promoter of the present invention is taken by (administered to) a subject in
30 need of promotion of muscle synthesis may be before exercise, after exercise, or during exercise. The timing of intake is preferably after exercise, and more preferably immediately after exercise. In terms of the fact that skeletal muscle degradation (catabolism) caused by exercise can be inhibited and anabolism
35 from amino acids to proteins can be promoted, the timing of intake is immediately after exercise, preferably within 3 hours

after the end of exercise, more preferably within 2 hours after the end of exercise, still more preferably within 1 hour after the end of exercise, and particularly preferably within 30 minutes after the end of exercise (see Levenhagen et al. Am J physiol Endocrinol Metab (2001), 280, E982-E993).
[0023]

In the muscle synthesis-promoting effect, the muscle synthesis-promoting effect equivalent to that of a neutral liquid composition that includes the same concentration of milk proteins means a rate at the same level as the protein absorption rate when a neutral liquid composition that includes the same concentration of milk proteins (e.g., milk, skimmed milk, concentrated milk, skimmed concentrated milk, and the like) is orally taken (administered), and an effect at the same level as the muscle synthesis-promoting action associated with the absorption. In the muscle synthesis-promoting effect, the instantaneous muscle synthesis-promoting effect action equivalent to that of a neutral liquid composition that includes the same concentration of milk proteins means a rate at the same level as the protein absorption rate when a neutral liquid composition that includes the same concentration of milk proteins (e.g., milk, skimmed milk, concentrated milk, skimmed concentrated milk, and the like) is orally taken (administered), and an effect at the same level as the muscle synthesis-promoting action associated with the absorption. The muscle synthesis-promoting effect can be confirmed by, for example, after a rat swimming test, measuring the skeletal muscle protein fractional synthesis rate (FSR) of the triceps brachii muscle in the test group within 1 hour after the test substance is administered. In other words, when the FSR in the test group is equivalent to or more than the FSR in the control group in which a neutral liquid composition that includes the same concentration of milk proteins, which is said to have an instantaneous muscle synthesis-promoting action, is orally taken, the muscle synthesis-promoting action can be determined as significant. In this case, the instantaneous

muscle synthesis-promoting effect can be confirmed by measuring the muscle synthesis rate preferably shortly after intake of the muscle synthesis promoter of the present invention, more preferably within 30 minutes to 3 hours after intake, still more preferably within 30 minutes to 2 hours after intake, yet more preferably within 30 minutes to 1 hour after intake, and particularly preferably 30 minutes after intake.

[0024]

“Protein content” means the amount of proteins as a polymer of amino acids contained in various proteins including milk proteins, whey protein, or casein protein. “Protein content ratio” means a ratio of the amount of proteins as a polymer of amino acids contained in various proteins including milk proteins, whey protein, or casein protein. The protein content may be calculated, for example, based on publicly known information such as a food composition table, or by measurement using a commonly used method such as the Kjeldahl method or the Lowry method. In fact, in the case of the Kjeldahl method, the protein content can be calculated by measuring nitrogen contained in various proteins and by multiplying the value by a nitrogen protein conversion factor (usually 6.25).

[0025]

The acidic liquid composition used in the present invention means an acidified liquid composition that includes 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein at a specific protein content ratio. The acidic liquid composition used in the present invention may not be complete liquid, and may partially contain a solid and/or a gel.

[0026]

The milk protein mixture contained in the acidic liquid composition used in the present invention is not particularly limited as long as it contains whey protein and casein protein at a specific protein content ratio, and may be prepared by mixing whey protein and casein protein that were separately separated

or purified at a specific protein content ratio, or may be prepared by mixing raw materials (materials) or foods, etc. that have already contained whey protein and casein protein that were not separately separated or purified at a specific protein content ratio. At this time, the milk protein mixture used in the present invention does not require a separation step or a purification step of whey protein or casein protein, and, in terms of the fact that the production cost of these proteins is inexpensive, the milk protein mixture is preferably prepared by using, as main ingredients, raw materials or foods, etc. that have already contained whey protein and casein protein at a specific protein content ratio, and, as needed, by mixing whey protein and casein protein that were separately purified at a specific protein content ratio.

[0027]

For the whey protein that was separated or purified separately from casein protein, for example, it is possible to use an undiluted solution of whey (sweet whey, acid whey, and the like), its concentrate, its dried product (whey powder, etc.), its frozen product, its hydrolysate, etc., and a reduced solution thereof. It is also possible to use desalted whey, a whey protein concentrate (WPC), a whey protein isolate (WPI), α -lactalbumin (α -La), β -lactoglobulin (β -Lg), immunoglobulin, lactoferrin, etc., and a reduced solution thereof. For the casein protein that was separated or purified separately from whey protein, for example, it is possible to use an isolate of casein (natural cheese such as fresh cheese, sodium caseinate, calcium caseinate, and the like), its concentrate, its dried product, its frozen product, its hydrolysate, etc., and a reduced solution thereof. It is also possible to use a purified product such as α -casein, β -casein, and k-casein, and a reduced solution thereof. For raw materials or foods that have already contained whey protein and casein protein at a specific protein content ratio, for example, it is possible to use raw milk, sterilized milk (milk, etc.), skimmed milk, homogenized milk, processed milk, dairy products (concentrated milk, powdered milk, condensed milk,

fermented milk (yogurt, etc.), lactic acid bacteria beverages, processed cheeses, ice creams, and creams), a milk protein concentrate (MPC), its concentrate, its dried product, its frozen product, its hydrolysate, etc., and a reduced solution thereof.

5 Of these, in terms of the fact that an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein is easily prepared, a milk protein concentrate (MPC), which is a milk raw material that contains abundant casein protein, is preferably used as the milk protein

10 mixture. In the milk protein concentrate, the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 4. At this time, as these, commercially available products may be obtained for use, or these may be prepared for use.

15 [0028]

The milk protein mixture contained in the acidic liquid composition used in the present invention is composed of whey protein and casein protein at a specific protein content ratio, and specifically, the protein content ratio of casein protein to

20 whey protein (casein protein/whey protein) is 2 to 20, preferably 2 to 10, more preferably 2 to 6, and still more preferably 2 to 4. In the present invention, the protein content ratio of casein protein to whey protein means a protein content ratio in a milk protein mixture contained in an acidic liquid

25 composition included in the muscle synthesis promoter. The milk protein mixture used in the present invention greatly differs from the prior art, in terms of the fact that the protein content ratio of casein protein to whey protein (casein protein/whey protein) is intentionally adjusted (designed) and

30 that the milk protein mixture is prepared in an acidic liquid composition.

[0029]

The acidic liquid composition used in the present invention is in a form in which separation and precipitation are

35 inhibited and redispersion is satisfactory, and which is easy to take (administer) at a low viscosity, even when the composition

is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, even though generally casein protein in milk proteins are likely to acid-coagulate and separation and precipitation derived from the acid coagulation occur. As long as the form is in within this form, the detailed properties (pH, viscosity, and the like) can be optionally designed.

[0030]

Examples of the pH of the acidic liquid composition used in the present invention include 3 to 6, 3.1 to 5.8, 3.2 to 5.6, 3.3 to 5.4, 3.4 to 5.2, 3.5 to 5, 3.6 to 4.8, 3.7 to 4.6, and 3.8 to 4.4. The pH of the acidic liquid composition of the present invention of over 3 is preferable in terms of preventing the feeling of strong sourness and difficulty in intake. The pH of the acidic liquid composition of the present invention of below 6 is preferable in terms of preventing the feeling of weak sourness, impairment of a refreshing taste, and difficulty in intake of the acidic liquid composition.

[0031]

The viscosity (10°C) of the acidic liquid composition used in the present invention is a viscosity of the acidic liquid composition measured with a B-type rotational viscometer. Examples of the viscosity (10°C) of the acidic liquid composition of the present invention include 3 to 30 mPa·s, 3.5 to 30 mPa·s, 4 to 30 mPa·s, 4.5 to 30 mPa·s, 5 to 30 mPa·s, 5.5 to 29 mPa·s, 6 to 28 mPa·s, 6.5 to 27 mPa·s, 7 to 26 mPa·s, 7.5 to 25 mPa·s, 8 to 24 mPa·s, 8.5 to 23 mPa·s, 9 to 22 mPa·s, 9.5 to 21 mPa·s, and 10 to 20 mPa·s. The viscosity (10°C) of the acidic liquid composition used in the present invention of over 3 mPa·s is preferable in terms of preventing the instability of casein protein of the acidic liquid composition and the occurrence of separation and precipitation of the acidic liquid composition. The viscosity (10°C) of the acidic liquid composition used in the present invention of below 30 mPa·s is preferable in terms of preventing impairment of a refreshing taste and difficulty in intake. The viscosity (10°C) of the acidic liquid composition of the present

invention is a viscosity of the acidic liquid composition measured with a general-purpose B-type rotational viscometer such as a Brookfield viscometer.

[0032]

5 The acidic liquid composition used in the present invention includes a milk protein mixture including casein protein and whey protein at a specific protein content ratio. The casein protein included in the milk protein mixture is generally stable in a neutral range, but in an environment of a
10 pH range lower than near the pH of 4.6, which is an isoelectric point, the casein protein aggregate each other due to acid coagulation, leading to occurrence of separation or precipitation of the acidic liquid composition. On the other hand, the acidic liquid composition composed of a specific composition used in
15 the present invention is in a form in which separation and precipitation of the acidic liquid composition are inhibited and redispersion is satisfactory, and which is easy to take at a low viscosity, even when the composition is an acidic liquid composition that includes a milk protein mixture including a
20 high concentration of casein protein. As used herein, examples of the concentration of the milk protein mixture including casein protein contained in the acidic liquid composition used in the present invention include, in the case of high concentration, 3% by weight or more, 3.2% by weight or more, 3.4% by weight or
25 more, 3.6% by weight or more, 3.8% by weight or more, 4% by weight or more, 4.2% by weight or more, 4.4% by weight or more, 3 to 10% by weight, 3 to 9.5% by weight, 3 to 9% by weight, 3 to 8.5% by weight, 3 to 8% by weight, 3 to 7.5% by weight, 3 to 7% by weight, 3.2 to 10% by weight, 3.2 to 9.5%
30 by weight, 3.2 to 9% by weight, 3.2 to 8.5% by weight, 3.2 to 8% by weight, 3.2 to 7.5% by weight, 3.2 to 7% by weight, 3.4 to 10% by weight, 3.4 to 9.5% by weight, 3.4 to 9% by weight, 3.4 to 8.5% by weight, 3.4 to 8% by weight, 3.4 to 7.5% by weight, 3.4 to 7% by weight, 3.6 to 10% by weight, 3.6 to
35 9.5% by weight, 3.6 to 9% by weight, 3.6 to 8.5% by weight, 3.6 to 8% by weight, 3.6 to 7.5% by weight, 3.6 to 7% by

weight, 3.8 to 10% by weight, 3.8 to 9.5% by weight, 3.8 to 9% by weight, 3.8 to 8.5% by weight, 3.8 to 8% by weight, 3.8 to 7.5% by weight, 3.8 to 7% by weight, 4 to 10% by weight, 4 to 9.5% by weight, 4 to 9% by weight, 4 to 8.5% by weight, 4 to 8% by weight, 4 to 7.5% by weight, 4 to 7% by weight, 4.2 to 10% by weight, 4.2 to 9.5% by weight, 4.2 to 9% by weight, 4.2 to 8.5% by weight, 4.2 to 8% by weight, 4.2 to 7.5% by weight, 4.2 to 7% by weight, 4.4 to 10% by weight, 4.4 to 9.5% by weight, 4.4 to 9% by weight, 4.4 to 8.5% by weight, 4.4 to 8% by weight, 4.4 to 7.5% by weight, and 4.4 to 7% by weight. Examples of the concentration of the milk protein mixture including casein protein contained in the acidic liquid composition used in the present invention include, in the case of not high concentration, 3% by weight or less, 2.8% by weight or less, 2.6% by weight or less, 2.4% by weight or less, 2.2% by weight or less, 2% by weight or less, 0.5 to 3% by weight, 1 to 3% by weight, 1.2 to 3% by weight, 1.4 to 3% by weight, 1.6 to 3% by weight, 1.8 to 3% by weight, 0.5 to 2.8% by weight, 1 to 2.8% by weight, 1.2 to 2.8% by weight, 1.4 to 2.8% by weight, 1.6 to 2.8% by weight, 1.8 to 2.8% by weight, 0.5 to 2.6% by weight, 1 to 2.6% by weight, 1.2 to 2.6% by weight, 1.4 to 2.6% by weight, 1.6 to 2.6% by weight, 1.8 to 2.6% by weight, 0.5 to 2.4% by weight, 1 to 2.4% by weight, 1.2 to 2.4% by weight, 1.4 to 2.4% by weight, 1.6 to 2.4% by weight, 1.8 to 2.4% by weight, 0.5 to 2.2% by weight, 1 to 2.2% by weight, 1.2 to 2.2% by weight, 1.4 to 2.2% by weight, 1.6 to 2.2% by weight, 1.8 to 2.2% by weight, 0.5 to 2% by weight, 1 to 2% by weight, 1.2 to 2% by weight, 1.4 to 2% by weight, 1.6 to 2% by weight, and 1.8 to 2% by weight. Each concentration of casein protein and whey protein included in the milk protein mixture can be easily calculated from the protein content ratio of casein protein to whey protein as mentioned above.

[0033]

35 In order to be characterized by a form in which separation and precipitation of the acidic liquid composition is

inhibited, redispersion is satisfactory, and which is easy to take at a low viscosity, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, and in order to increase the muscle synthesis-promoting effect by preventing curdling of milk proteins in the stomach and promoting the absorption of milk proteins, the acidic liquid composition used in the present invention can include 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, and 0.01 to 0.1% by weight of fibrous insoluble cellulose.

[0034]

The soybean polysaccharides of the present invention may be soybean polysaccharides that contain 1 type or 2 or more types of soybean-derived rhamnose, galactose, arabinose, xylose, glucose, and uronic acid, and of soybeans, a cotyledon-derived soybean is preferable. In the soybean polysaccharides of the present invention, there is no particular limitation on its molecular weight, and a high molecular weight is preferable, and the average molecular weight is preferably thousands to millions, specifically 5,000 to 1,000,000. The average molecular weight of the soybean polysaccharides was calculated by the intrinsic viscosity method that measures the viscosity in a 0.1 M NaNO_3 solution using standard pullulan (Showa Denko K.K.) as a reference material. The soybean polysaccharides are commercially available, and examples thereof include SM-700 (manufactured by San-Ei Gen F.F.I., Inc.) and SM-900 (manufactured by San-Ei Gen F.F.I., Inc.). The soybean polysaccharide are said to inhibit separation and precipitation of the acidic liquid composition caused by acid coagulation of each casein protein in the acidic liquid composition, due to the structure of its side chain.

[0035]

When 0.1 to 0.5% by weight of HM pectin and 0.01 to 0.1% by weight of fibrous insoluble cellulose are contained in the acidic liquid composition used in the present invention, examples of the amount of the soybean polysaccharides of the

present invention added include 0.2 to 1.2% by weight, 0.25 to 1.15% by weight, 0.3 to 1.1% by weight, 0.35 to 1.05% by weight, 0.4 to 1% by weight, and 0.4 to 0.9% by weight. The amount of the soybean polysaccharides of the present invention added of below 1.2% by weight is preferable in terms of enabling the feeling of flavor unique to soybeans of the acidic liquid composition and avoiding difficulty in intake of the acidic liquid composition. The amount of the soybean polysaccharides of the present invention added of over 0.2% by weight is preferable in terms of the fact that, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, the occurrence of separation and precipitation of the acidic liquid composition used in the present invention can be inhibited, and furthermore, redispersion also becomes satisfactory, and finally, when the muscle synthesis promoter of the present invention is taken, the curdling of milk proteins in the stomach is prevented and the absorption of milk proteins is promoted, thus increasing the muscle synthesis-promoting effect.

[0036]

The HM pectin of the present invention is an acid polysaccharide containing α -D-galacturonic acid as a main chain component, existing in vegetables or fruits as a cell wall component. Galacturonic acid constituting pectin is partially methyl-esterified, and pectin is classified into LM pectin and HM pectin according to the degree of esterification. Generally, pectin having the degree of esterification of 50% or more is referred to as HM pectin. The HM pectin is commercially available, and examples thereof include SM-478 (manufactured by San-Ei Gen F.F.I., Inc.), SM-666 (manufactured by San-Ei Gen F.F.I., Inc.), and AYD5110SB (manufactured by UNITEC FOODS Co., Ltd.). HM pectin is characterized by being negatively charged, and is said to prevent aggregation of each casein protein by binding to casein protein, leading to repulsion of each casein protein bound by electric charge.

[0037]

When 0.2 to 1.2% by weight of soybean polysaccharides and 0.01 to 0.1% by weight of fibrous insoluble cellulose are contained in the acidic liquid composition used in the present invention, examples of the amount of the HM pectin of the present invention added include 0.1 to 0.5% by weight, 0.1 to 0.45% by weight, 0.1 to 0.4% by weight, 0.1 to 0.35% by weight, 0.1 to 0.3% by weight, 0.12 to 0.29% by weight, 0.14 to 0.28% by weight, 0.16 to 0.27% by weight, 0.18 to 0.26% by weight, and 0.2 to 0.25% by weight. The amount of the HM pectin of the present invention added of below 0.5% by weight is preferable in terms of a form which is easy to take at a low viscosity, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein. The amount of the HM pectin of the present invention added of over 0.1% by weight is preferable in terms of the fact that, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, the occurrence of separation and precipitation of the acidic liquid composition used in the present invention can be inhibited, and furthermore, redispersion also becomes satisfactory, and finally, when the muscle synthesis promoter of the present invention is taken, the curdling of milk proteins in the stomach is prevented and the absorption of milk proteins is promoted, thus increasing the muscle synthesis-promoting effect.

[0038]

In order to be in a form in which separation and precipitation of the acidic liquid composition is inhibited, redispersion is satisfactory, and which is easy to take at a low viscosity, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, and in order to increase the muscle synthesis-promoting effect by preventing curdling of milk proteins in the stomach and promoting the absorption of milk proteins when the muscle synthesis promoter of the present invention is taken, it is possible to add other stabilizers

such as sodium carboxymethyl cellulose and/or propylene glycol alginate ester to the acidic liquid composition of the present invention, in combination with soybean polysaccharides and/or HM pectin or instead of soybean polysaccharides and/or HM pectin. Particularly, other stabilizers such as sodium carboxymethyl cellulose and/or propylene glycol alginate ester are preferably used in combination with soybean polysaccharides and/or HM pectin or instead of soybean polysaccharides and/or HM pectin, in order to inhibit separation and precipitation of the acidic liquid composition at a lower viscosity and to make redispersion satisfactory, as compared with soybean polysaccharides and/or HM pectin, and in order to increase the muscle synthesis-promoting effect by preventing curdling of milk proteins in the stomach and promoting the absorption of milk proteins when the muscle synthesis promoter of the present invention is taken.

[0039]

Sodium carboxymethyl cellulose can be added to the acidic liquid composition used in the present invention. Sodium carboxymethyl cellulose is a substance in which the hydroxy group of glucose of cellulose is substituted by a carboxymethyl group, and usually the degree of etherification is about 0.6 to 1.5. The sodium carboxymethyl cellulose is commercially available, and examples thereof include Cellogen F-SL (manufactured by DKS Co. Ltd.), Cellogen F-810A (manufactured by DKS Co. Ltd.), Cellogen F-SB (manufactured by DKS Co. Ltd.), Cellogen F-820B (manufactured by DKS Co. Ltd.), and Cellogen F-1220B (manufactured by DKS Co. Ltd.).

[0040]

Propylene glycol alginate ester can be added to the acidic liquid composition used in the present invention. Propylene glycol alginate ester is a substance obtained by chemically modifying polysaccharide alginic acid purified from seaweeds such as tangle weed and *Undaria pinnatifida*. The propylene glycol alginate ester is commercially available, and examples thereof include Duck Loid LF-M (manufactured by Kikkoman

Biochemifa Company), Duck Loid EF (manufactured by Kikkoman Biochemifa Company), Duck Loid PF (manufactured by Kikkoman Biochemifa Company), and Duck Loid PF-H (manufactured by Kikkoman Biochemifa Company).

5 [0041]

There is no limitation on the amount of the sodium carboxymethyl cellulose or propylene glycol alginate ester of the present invention added, as long as the composition is in a form in which separation and precipitation of the acidic liquid composition is inhibited, redispersion is satisfactory, and which is easy to take at a low viscosity, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, which is a characteristic of the acidic liquid composition used in the present invention, and the muscle synthesis-promoting effect can be increased by preventing curdling of milk proteins in the stomach and promoting the absorption of milk proteins when the muscle synthesis promoter is taken. Examples of the amount of the sodium carboxymethyl cellulose or propylene glycol alginate ester added to the acidic liquid composition used in the present invention include 0.01 to 2% by weight, 0.01 to 1.5% by weight, 0.01 to 1.2% by weight, and 0.01 to 1.0% by weight. The amount of the sodium carboxymethyl cellulose or propylene glycol alginate ester of the present invention added of 2% by weight is preferable in terms of a form which is easy to take at a low viscosity, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein. The amount of the sodium carboxymethyl cellulose or propylene glycol alginate ester of the present invention added of over 0.01% by weight is preferable in terms of the fact that, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, the occurrence of separation and precipitation of the acidic liquid composition used in the present invention can be inhibited, and furthermore, redispersion also becomes satisfactory, and finally,

when the muscle synthesis promoter is taken, the curdling of milk proteins in the stomach is prevented and the absorption of milk proteins is promoted, thus increasing the muscle synthesis-promoting effect.

5 [0042]

The fibrous insoluble cellulose of the present invention is a stabilizer that enables improvement in the dispersibility of insoluble ingredients such as precipitates by being contained in the acidic liquid composition used in the present invention,
10 thereby establishing a three-dimensional network in the acidic liquid composition. There is no limitation on the origin of the fibrous insoluble cellulose of the present invention, as long as the composition is in a form in which separation and precipitation of the acidic liquid composition is inhibited,
15 redispersion is satisfactory, and which is easy to take at a low viscosity, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, which is a characteristic of the acidic liquid composition used in the present invention, and
20 the muscle synthesis-promoting effect can be increased by preventing curdling of milk proteins in the stomach and promoting the absorption of milk proteins when the muscle synthesis promoter is taken, and plant-derived and/or microorganism-derived fibrous insoluble cellulose can be used.
25 The microorganism-derived fibrous insoluble cellulose is, for example, cellulose obtained by separating fermented cellulose produced by microorganisms from a medium, followed by cleaning and appropriate purification to make fibrous. Examples of the fibrous insoluble cellulose include fibrous
30 insoluble cellulose that is microfibrilized to an average diameter of 0.01 to 0.1 μm (see JP 2005-245217 A), or fermented cellulose. The fibrous insoluble cellulose of the present invention is commercially available, and examples thereof include San Artist PG (manufactured by San-Ei Gen F.F.I., Inc.)
35 and San Artist PN (manufactured by San-Ei Gen F.F.I., Inc.).
[0043]

When 0.2 to 1.2% by weight of soybean polysaccharides and 0.1 to 0.5% by weight of HM pectin are contained in the acidic liquid composition used in the present invention, examples of the amount of the fibrous insoluble cellulose of the present invention added include 0.01 to 0.1% by weight, 0.015 to 0.09% by weight, 0.02 to 0.08% by weight, 0.025 to 0.085% by weight, 0.03 to 0.07% by weight, 0.03 to 0.065% by weight, 0.03 to 0.06% by weight, 0.03 to 0.055% by weight, and 0.03 to 0.05% by weight. The amount of the fibrous insoluble cellulose of the present invention added of 0.1% by weight is preferable in terms of a form which is easy to take at a low viscosity, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein. The amount of the fibrous insoluble cellulose of the present invention added of over 0.01% by weight is preferable particularly in terms of the fact that, in particular, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, the occurrence of separation and precipitation of the acidic liquid composition can be inhibited, and furthermore, redispersion also becomes satisfactory, and finally, when the muscle synthesis promoter is taken, the curdling of milk proteins in the stomach is prevented and the absorption of milk proteins is promoted, thus increasing the muscle synthesis-promoting effect.

[0044]

Trehalose can be further added to the acidic liquid composition used in the present invention, and addition of trehalose can further impart a characteristic of a form in which separation and precipitation of the acidic liquid composition is inhibited, redispersion is satisfactory, and which is easy to take at a low viscosity, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, and finally, when the muscle synthesis promoter of the present invention is taken, the curdling of milk proteins in the stomach can be prevented and

the absorption of milk proteins can be promoted, thus enabling further increase in muscle synthesis-promoting effect. Specifically, when trehalose is further added to the acidic liquid composition of the present invention, the pH of the acidic liquid composition of the present invention is over 4, and even at near the pH of the isoelectric point of casein, the composition is in a form in which separation and precipitation of the acidic liquid composition is inhibited, redispersion is satisfactory, and which has easy drinkability at a low viscosity, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, and the muscle synthesis-promoting effect can be increased by preventing curdling of milk proteins in the stomach and promoting the absorption of milk proteins when the muscle synthesis promoter is taken. The trehalose of the present invention is commercially available, and examples thereof include TREHA (manufactured by Hayashibara Co., Ltd.).

[0045]

When 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, and 0.01 to 0.1% by weight of fibrous insoluble cellulose are contained in the acidic liquid composition used in the present invention, examples of the amount of the trehalose of the present invention added include 0.1 to 5% by weight, 0.2 to 4.5% by weight, 0.3 to 4% by weight, 0.4 to 3.5% by weight, 0.5 to 3% by weight, 0.6 to 2.5% by weight, 0.7 to 2% by weight, 0.8 to 1.5% by weight, 0.9 to 1.3% by weight, and 0.9 to 1.1% by weight. The amount of the trehalose of the present invention added of 5% by weight is preferable in terms of the fact that flavor and eating texture derived from the trehalose are not imparted to the acidic liquid composition of the present invention and that the composition is in a form which is easy to take at a low viscosity. The amount of the trehalose of the present invention added of over 0.01% by weight is preferable in terms of the fact that, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high

concentration of casein protein, the occurrence of separation and precipitation of the acidic liquid composition used in the present invention can be inhibited, and furthermore, redispersion also becomes satisfactory, and finally, as the muscle synthesis promoter of the present invention, the curdling of milk proteins in the stomach is prevented and the absorption of milk proteins is promoted, thus increasing the muscle synthesis-promoting effect of the present invention.

[0046]

A method for producing an acidic liquid composition of the present invention is characterized by including the steps of adjusting the pH of a milk-containing solution that contains 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein to be acidic, and homogenizing the milk-containing solution.

[0047]

There is no particular limitation on the means or methods for adjusting the pH to be acidic in the method for producing an acidic liquid composition used in the present invention, as long as the pH of the milk-containing solution can be decreased to a specified pH to the extent that it is possible to obtain an acidic liquid composition that is in a form in which separation and precipitation of the acidic liquid composition is inhibited, redispersion is satisfactory, and which has easy drinkability at a low viscosity, and that can increase the muscle synthesis-promoting effect by preventing curdling of milk proteins in the stomach and promoting the absorption of milk proteins when the muscle synthesis promoter of the present invention is taken, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, which is a characteristic of the present invention. Examples of the method for adjusting the pH of a milk-containing solution to be acidic include a method in which the milk-containing solution is fermented by

fermentation microorganisms such as lactic acid bacteria, and a method in which acid is added to the milk-containing solution.

[0048]

5 The milk-containing solution in the method for producing an acidic liquid composition used in the present invention preferably contain 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, and 0.01 to 0.1% by weight of fibrous insoluble cellulose, in order to impart a characteristic of a form in which separation and precipitation of the acidic liquid composition is inhibited, redispersion is satisfactory, and which has easy drinkability at a low viscosity, and of increasing the muscle synthesis-promoting effect by preventing curdling of milk proteins in the stomach and promoting the absorption of milk proteins when the muscle synthesis promoter is taken, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, which is one characteristic of the acidic liquid composition of the present invention. The soybean polysaccharides, HM pectin, and fibrous insoluble cellulose contained in the milk-containing solution in the method for producing an acidic liquid composition of the present invention may be dissolved in a state warmed to 50 to 100°C while being added together with part or all of other raw materials, or those dissolved in hot water in advance may be prepared. The milk-containing solution in the method for producing an acidic liquid composition of the present invention can be obtained by, for example, mixing an emulsion obtained by dissolving a milk protein mixture in water with a stabilizer solution obtained by dissolving soybean polysaccharides, HM pectin, and fibrous insoluble cellulose in water.

[0049]

35 In the method for producing an acidic liquid composition used in the present invention, in addition to adjusting the pH by adding acid to the milk-containing solution, the milk-containing solution can be homogenized by mechanical shearing treatment in order to increase the muscle synthesis-promoting effect of

the present invention. By homogenization, casein protein in the milk-containing solution whose pH was adjusted are atomized to bind to 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, and 0.01 to 0.1% by weight of fibrous insoluble cellulose, which are contained in advance, thereby obtaining an acidic liquid composition that is in a form in which separation and precipitation of the acidic liquid composition is inhibited, redispersion is satisfactory, and which has easy drinkability at a low viscosity, and that can increase the muscle synthesis-promoting effect by preventing curdling of milk proteins in the stomach and promoting the absorption of milk proteins when the muscle synthesis promoter is taken, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, which is one characteristic of the acidic liquid composition of the present invention. For homogenization, a general-purpose homogenizer used for homogenization of fat globules such as milk and liquefaction of fermented milk can be used.

[0050]

When the milk-containing solution is homogenized with a homogenizer in order to increase the effect of the present invention, in addition to adjusting the pH by adding acid to the milk-containing solution, in the method for producing an acidic liquid composition of the present invention, examples of the homogenization pressure include 1 to 100 MPa, 2 to 80 MPa, 3 to 60 MPa, 4 to 40 MPa, 5 to 20 MPa, 6 to 19 MPa, 7 to 18 MPa, 8 to 17 MPa, 9 to 16 MPa, and 10 to 15 MPa. Examples of the homogenization temperature include 50 to 100°C, 55 to 95°C, 60 to 90°C, 65 to 85°C, and 70 to 80°C. In the method for producing an acidic liquid composition used in the present invention, there is no limitation on the order of the steps of adjusting the pH by adding acid to the milk-containing solution, and homogenizing the milk-containing solution with a homogenizer. In other words, in the method for producing an

acidic liquid composition of the present invention, after the pH is adjusted by adding acid to the milk-containing solution, it is possible to homogenize the milk-containing solution with a homogenizer, and after the milk-containing solution is homogenized with a homogenizer, it is possible to adjust the pH by adding acid to the milk-containing solution. The homogenization treatment step in the method for producing an acidic liquid composition of the present invention can be set at before or after heat sterilization as mentioned below, to the extent that it is possible to obtain an acidic liquid composition that is in a form in which separation and precipitation of the acidic liquid composition is inhibited, redispersion is satisfactory, and which is easy to take at a low viscosity, and that can increase the muscle synthesis-promoting effect by preventing curdling of milk proteins in the stomach and promoting the absorption of milk proteins when the muscle synthesis promoter is taken, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, which is one characteristic of the acidic liquid composition.

[0051]

In the method for producing an acidic liquid composition used in the present invention, heat sterilization can be performed in order to increase the preservation of the acidic liquid composition. As the method for heat sterilization of the acidic liquid composition in the method for producing an acidic liquid composition used in the present invention, a publicly known method and condition for sterilization of milk and/or beverages can be set. Examples of the sterilization method include plate-type heat sterilization, tube-type heat sterilization, batch-type heat sterilization, electric heat sterilization, heat sterilization by microwave, indirect heat sterilization such as retort heating, and direct heat sterilization such as steam injection and steam infusion. Examples of the sterilization condition include, like milk, maintenance at 60 to 65°C for 20 to 30 minutes, maintenance at 80 to 100°C for 15 seconds to 10

minutes, and maintenance at 110°C to 150°C for 2 to 15 seconds, and the sterilization condition can be appropriately changed as long as it is equivalent to this condition.

[0052]

5 In the method for producing an acidic liquid composition used in the present invention, non-heat sterilization can be performed in order to increase the preservation of the acidic liquid composition. As the method for non-heat sterilization of the acidic liquid composition of the present invention in the
10 method for producing an acidic liquid composition of the present invention, a publicly known sterilization method and sterilization condition can be set. Examples of the sterilization method in non-heat sterilization include photoirradiation sterilization, radiation sterilization, and high-voltage pulse sterilization.
15 Examples of the sterilization condition in non-heat sterilization include, for obtaining the same sterilization effect as that of heat sterilization of milk, maintenance at 60 to 65°C for 20 to 30 minutes, maintenance at 80 to 100°C for 15 seconds to 10 minutes, and maintenance at 110°C to 150°C for 2 to 15
20 seconds, and the sterilization condition in non-heat sterilization can be appropriately changed as long as a sterilization effect equivalent to this is obtained.

[0053]

 In the method for producing an acidic liquid composition
25 used in the present invention, it is possible to cool the acidic liquid composition obtained in the steps of adjusting the pH of a milk-containing solution that contains 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, and 0.01 to 0.1% by weight of fibrous insoluble cellulose to be
30 acidic, and homogenizing the milk-containing solution, in order to increase the preservation of the acidic liquid composition. Examples of the temperature of the acidic liquid composition finally cooled include 0 to 30°C, 0 to 25°C, 0 to 20°C, 0 to 15°C, 0 to 12°C, and 0 to 10°C.

35 [0054]

 Other food raw materials and/or food additive raw

materials can be added to the acidic liquid composition used in the present invention, as long as the composition is in a form in which separation and precipitation of the acidic liquid composition is inhibited, redispersion is satisfactory, and which
5 has easy drinkability at a low viscosity, and the muscle synthesis-promoting effect can be increased by preventing curdling of milk proteins in the stomach and promoting the absorption of milk proteins when the muscle synthesis promoter is taken, even when the composition is an acidic liquid
10 composition that includes a milk protein mixture including a high concentration of casein protein, which is one characteristic of the acidic liquid composition used in the present invention. For example, in order to impart the palatability of the acidic liquid composition of the present invention, it is possible to add
15 sweeteners (sugars, liquid sugars, fruit sugar, malt sugar, soft brown sugar, and the like), sugar alcohol (erythritol, etc.), highly potency sweeteners (stevia, aspartame, sucralose, acesulfame potassium), flavorings, fruit juice, vegetable juice, and the like. In order to impart the functionality of the acidic
20 liquid composition of the present invention, minerals (calcium, iron, manganese, magnesium, zinc, and the like), vitamins, functional raw materials, probiotic lactic acid bacteria, and the like are added, thus making it possible to fabricate the muscle synthesis promoter of the present invention.

25 [0055]

The muscle synthesis promoter of the present invention can be in a form of a beverage packed in a container and a beverage in a container, in order to be provided to the market. It is possible to use, as the container, a publicly known
30 container such as a paper container (a gable top type container, a brick type container, and the like), a soft bag, a PET bottle, a can, and a bottle. There is no limitation on the volume of the container, and examples thereof include 10 to 5,000 g, 20 to 4,000 g, 30 to 3,000 g, 40 to 2,000 g, 50 to 1,500 g, 60 to
35 1,400 g, 70 to 1,300 g, 80 to 1,200 g, and 90 to 1,100 g. Of these, in the case of family size (for drink by plural persons),

examples thereof include 300 to 5,000 g, 300 to 4,000 g, 300 to 3,000 g, 300 to 2,000 g, 300 to 1,500 g, 300 to 1,400 g, 300 to 1,300 g, 300 to 1,200 g, and 300 to 1,100 g, and in the case of personal size (for drink by an individual), examples thereof
5 include 10 to 500 g, 20 to 500 g, 30 to 500 g, 40 to 500 g, 50 to 500 g, 60 to 500 g, 70 to 500 g, 80 to 500 g, and 90 to 500 g.

[0056]

There is no limitation on the form provided to the market
10 of the muscle synthesis promoter of the present invention, as long as the composition is in a form in which separation and precipitation of the acidic liquid composition is inhibited, redispersion is satisfactory, and which has easy drinkability at a low viscosity, and the muscle synthesis-promoting effect can be
15 increased by preventing curdling of milk proteins in the stomach and promoting the absorption of milk proteins when the muscle synthesis promoter is taken, even when the composition is an acidic liquid composition that includes a milk protein mixture including a high concentration of casein protein, which is one
20 characteristic of the present invention. For example, for the muscle synthesis promoter of the present invention, chilled distribution at 10°C or lower and normal temperature distribution are possible. The muscle synthesis promoter of the present invention also has a heat resistance effect. Therefore,
25 since the muscle synthesis promoter of the present invention exhibits the heat resistance effect in the composition in which the muscle synthesis promoter of the present invention is blended (added or mixed), preferably, the muscle synthesis promoter of the present invention can be provided in a liquid
30 product form and in a product form for sale by warming using a hot vendor, etc.

[0057]

According to one embodiment of the present invention, for example, in the muscle synthesis promoter of the present
35 invention, the milk protein mixture is taken (administered) at a total protein content per meal of 0.06 g/kg body weight or more,

specifically, taken (administered) at 0.06 to 0.7 g/kg body weight, preferably 0.06 to 0.6 g/kg body weight, more preferably 0.06 to 0.5 g/kg body weight, still more preferably 0.08 to 0.4 g/kg body weight, and particularly preferably 0.1 to
5 0.4 g/kg body weight. The representative body weight of the subject is estimated to be about 60 kg.

[0058]

“Per meal” means per state that requires instantaneous promotion of muscle synthesis, and for example, the muscle
10 synthesis promoter of the present invention may be taken in several divided portions not at one gulp (once) per meal. The timing when the muscle synthesis promoter of the present invention is taken by (administered to) a subject in need of instantaneous promotion of muscle synthesis is, in the case of
15 intake in several divided portions, preferably within 2 hours after the end of exercise, more preferably within 1 hour after the end of exercise, still more preferably within 30 minutes after the end of exercise, and particularly preferably within 5 minutes after the end of exercise, in terms of the fact that the amino
20 acid concentration in blood flow can be instantaneously increased.

[0059]

A method in which the muscle synthesis promoter of the present invention is taken by (administered to) a subject in
25 need of instantaneous promotion of muscle synthesis can be appropriately selected from oral intake (oral administration), enteral administration, gastrostomy, and the like depending on the subject and use, and is preferably oral intake.

[0060]

30 According to another embodiment of the present invention, for example, the muscle synthesis promoter of the present invention is in a unit packaging form per meal, and in the unit, the milk protein mixture is desirably adjusted to a total protein content of 3 g or more as an intake per meal,
35 specifically, 3 to 40 g, preferably 3 to 20 g, more preferably 4 to 20 g, still more preferably 4 to 15 g, and particularly preferably

5 to 15 g. "Unit packaging form per meal" is a form in which an intake per meal is specified in advance, and for example, as foods whose specific amount may be orally taken, it means a form such as beverages (drinks, etc.), dietary supplements, health functional foods, and supplements, in addition to common foods. Examples of the "unit packaging form per meal" include, in the case of liquid beverages, gel/sticky paste/paste jelly, powdered/granular/capsular/block solid foods, and the like, a form in which a specific amount (dose) can be specified in a packaging container, such as a metal can, a glass bottle (a bottle, etc.), a plastic container (a PET bottle, etc.), a pack, a pouch, a film container, and a paper box, or a form in which a specific amount can be specified by indicating the intake per meal (dosage and administration) on a packaging container or a website, etc.

[0061]

According to a preferred embodiment of the present invention, the muscle synthesis promoter of the present invention is a muscle synthesis promoter including, as an active ingredient, an acidic liquid composition that includes 0.4 to 0.9% by weight of soybean polysaccharides, 0.2 to 0.25% by weight of HM pectin, 0.03 to 0.05% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein,

wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 6.

[0062]

According to a more preferred embodiment of the present invention, the muscle synthesis promoter of the present invention is a muscle synthesis promoter including, as an active ingredient, an acidic liquid composition that includes 0.4 to 0.9% by weight of soybean polysaccharides, 0.2 to 0.25% by weight of HM pectin, 0.03 to 0.05% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein,

wherein the protein content ratio of casein protein to

whey protein (casein protein/whey protein) is 2 to 4.

[0063]

According to a still more preferred embodiment of the present invention, the muscle synthesis promoter of the present invention is a muscle synthesis promoter including, as an active ingredient, an acidic liquid composition that includes 0.4 to 0.9% by weight of soybean polysaccharides, 0.2 to 0.25% by weight of HM pectin, 0.03 to 0.05% by weight of fibrous insoluble cellulose, 0.9 to 1.1% by weight of trehalose, and a milk protein mixture including casein protein and whey protein, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 4.

[0064]

According to one embodiment of the present invention, for example, the muscle synthesis promoter of the present invention can provide a composition including the muscle synthesis promoter. In other words, the muscle synthesis promoter of the present invention can be used as itself alone, and as long as the muscle synthesis-promoting function is exhibited, the muscle synthesis promoter of the present invention can be included as a raw material (material) or an additive, etc. in various compositions for oral intake (oral administration) such as foods and medicines, and a composition having the muscle synthesis-promoting effect can be obtained. Therefore, according to one embodiment of the present invention, a composition including the muscle synthesis promoter of the present invention is provided.

[0065]

According to one embodiment of the present invention, it is possible to provide a composition for promotion of muscle synthesis, which is a composition including, as an active ingredient, an acidic liquid composition that includes 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, wherein the protein content ratio of casein

protein to whey protein (casein protein/whey protein) is 2 to 20. The composition of the present invention may be a food composition or a pharmaceutical composition.

[0066]

5 There is no particular limitation on the food composition, as long as it is other than a pharmaceutical composition and is in a form that can be orally taken, such as a solution, a suspension, an emulsion, a powder, and a solid molding. Specific examples thereof include instant foods such as instant
10 noodles, retort pouch foods, canned foods, foods for microwave cooking, instant soups/miso soups, and freeze-dried foods; beverages such as cooling beverages, fruit juice beverages, vegetable beverages, soymilk beverages, coffee beverages, tea
15 beverages, powder beverages, concentrated beverages, and alcohol beverages; wheat flour products such as bread, pasta, noodles, cake mixes, and bread crumbs; confectionery such as candies, caramels, chewing gum, chocolates, cookies, biscuits, cakes, pies, snacks, crackers, Japanese-style confectionery, and dessert confectionary; seasonings such as sauce, tomato
20 processed seasonings, flavor seasonings, cooking mixes, basting, dressings, soups, and curry/stew premixes; oils and fats such as processed oils and fats, butter, margarine, and mayonnaise; dairy products such as milk beverages, yogurts, lactic acid bacteria beverages, ice creams, and creams;
25 agricultural processed products such as agricultural canned foods, jams/marmalades, and cereals; frozen foods, and the like. Preferably, foods are dairy products, and more preferably milk beverages or lactic acid bacteria beverages.

[0067]

30 The foods include foods classified as health foods, functional foods, nutritional supplementary foods, foods with function claims, foods for specified health uses, foods for patients, homogenized powdered milk for infants, powdered milk for expectant mothers or nursing mothers, or foods with
35 reduction of disease risk claims.

[0068]

According to another embodiment of the present invention, there is provided a food for promotion of muscle synthesis including, as an active ingredient, an acidic liquid composition that includes 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20. The food for promotion of muscle synthesis of the present invention includes a food indicating the muscle synthesis-promoting effect or an effect due to the same. According to a preferred embodiment of the present invention, there is provided a dairy product for promotion of muscle synthesis, which is a beverage for promotion of muscle synthesis (preferably a dairy product, more preferably a milk beverage or a lactic acid bacteria beverage) including, as an active ingredient, an acidic liquid composition that includes 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20.

[0069]

The pharmaceutical composition is a composition prepared as an oral preparation or a parenteral preparation in accordance with the ordinary method, in combination with additives acceptable for formulation. In the case of an oral preparation, the pharmaceutical composition can be in a form of a solid preparation such as a tablet, a powder, a fine granule, a granule, a capsule, a pill, and a controlled-release preparation, or a liquid preparation such as a solution, a suspension, and an emulsion. In the case of a parenteral preparation, the pharmaceutical composition can be in a form of an injection or a suppository. In terms of easiness, an oral preparation is preferable. Examples of the additives acceptable for

formulation include diluents, stabilizers, preservatives, humectants, emulsifiers, lubricants, sweeteners, colorants, flavorings, buffers, antioxidants, pH adjusters, and the like. The pharmaceutical composition of the present invention includes a composition for intervention, more specifically a composition for prevention and a composition for treatment of diseases that require promotion of muscle synthesis, specifically muscle damage, for example, sarcopenia.

[0070]

According to further another embodiment of the present invention, there is provided a method for promoting muscle synthesis, which includes allowing a subject in need of promotion of muscle synthesis to simultaneously or sequentially take an acidic liquid composition that includes 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20. The method for promoting muscle synthesis of the present invention is preferably a method excluding medical practice for humans. "Medical practice for humans" means an act by which medicines are taken by (administered to) humans, requiring a doctor's prescription, etc. The method for promoting muscle synthesis of the present invention can be performed in accordance with the contents mentioned herein for the muscle synthesis promoter of the present invention.

[0071]

According to one preferred embodiment of the present invention, in the method for promoting muscle synthesis of the present invention, the acidic liquid composition can contain 0.5 to 5% by weight of trehalose. According to one preferred embodiment of the present invention, in the method for promoting muscle synthesis of the present invention, the pH of the acidic liquid composition can be adjusted to 3 to 6. Furthermore, according to one preferred embodiment of the

present invention, in the method for promoting muscle synthesis of the present invention, the acidic liquid composition can contain fermented cellulose as fibrous insoluble cellulose.

[0072]

5 According to one preferred embodiment of the present invention, in the method for promoting muscle synthesis of the present invention, the milk protein mixture can be taken (administered) at a total protein content per meal of 0.06 g/kg body weight or more, specifically, taken at 0.06 to 0.7 g/kg
10 body weight, preferably 0.06 to 0.6 g/kg body weight, more preferably 0.06 to 0.5 g/kg body weight, still more preferably 0.08 to 0.4 g/kg body weight, and particularly preferably 0.1 to 0.4 g/kg body weight.

[0073]

15 According to one preferred embodiment of the present invention, in the method for promoting muscle synthesis of the present invention, the milk protein mixture can be taken at a total protein content per meal of 3 g or more, specifically, 3 to 40 g, preferably 3 to 20 g, more preferably 4 to 20 g, still more
20 preferably 4 to 15 g, and particularly preferably 5 to 15 g.

[0074]

 According to one preferred embodiment of the present invention, in the method for promoting muscle synthesis of the present invention, the subject in need of promotion of muscle
25 synthesis are preferably the subject in need of instantaneous promotion of muscle synthesis, more preferably the subject who performs exercise, and still more preferably the subject who performs muscle training.

[0075]

30 According to one embodiment of the present invention, in the method for promoting muscle synthesis of the present invention, the acidic liquid composition can be taken by a subject in need of promotion of muscle synthesis in a warmed liquid form.

35 [0076]

 According to another embodiment of the present

invention, there is provided a method for treatment of diseases that require promotion of muscle synthesis, which includes allowing a subject with diseases that require promotion of muscle synthesis to take an acidic liquid composition that includes 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20. The method for treatment of diseases that require promotion of muscle synthesis of the present invention include a method for treatment of muscle damage, for example, a method for treatment of sarcopenia. The method for treatment includes a method for prevention and a method of therapy. The method for intervention of the present invention can be performed in accordance with the contents mentioned herein for the method for promoting muscle synthesis of the present invention.

[0077]

According to one embodiment of the present invention, there is provided use of a muscle synthesis promoter including, as an active ingredient, an acidic liquid composition that includes 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, or a composition including the same, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20, for promotion of muscle synthesis. According to one preferred embodiment of the present invention, the use of the present invention is non-therapeutic use. The use of the muscle synthesis promoter of the present invention or the composition including the same can be performed in accordance with the contents mentioned herein for the muscle synthesis promoter and the method for promoting muscle synthesis of the present invention.

[0078]

According to one embodiment of the present invention, there is provided use of a muscle synthesis promoter including, as an active ingredient, an acidic liquid composition that includes 0.2 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, or a composition including the same, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20, for production of foods or medicines for promotion of muscle synthesis. The use of the muscle synthesis promoter or the composition of the present invention can be performed in accordance with the contents mentioned herein for the muscle synthesis promoter and the method for promoting muscle synthesis of the present invention.

[0079]

According to one preferred embodiment of the present invention, in the use of the present invention, the acidic liquid composition can contain 0.5 to 5% by weight of trehalose. According to one preferred embodiment of the present invention, in the use of the present invention, the pH of the acidic liquid composition can be adjusted to 3 to 6. Furthermore, according to one preferred embodiment of the present invention, in the use of the present invention, the acidic liquid composition can contain fermented cellulose as fibrous insoluble cellulose.

[0080]

According to one preferred embodiment of the present invention, in the use of the present invention, the milk protein mixture can be taken (administered) at a total protein content per meal of 0.06 g/kg body weight or more, specifically, taken at 0.06 to 0.7 g/kg body weight, preferably 0.06 to 0.6 g/kg body weight, more preferably 0.06 to 0.5 g/kg body weight, still more preferably 0.08 to 0.4 g/kg body weight, and particularly preferably 0.1 to 0.4 g/kg body weight.

[0081]

According to one preferred embodiment of the present invention, in the use of the present invention, the milk protein mixture can be taken at a total protein content per meal of 3 g or more, specifically, 3 to 40 g, preferably 3 to 20 g, more
5 preferably 4 to 20 g, still more preferably 4 to 15 g, and particularly preferably 5 to 15 g.

[0082]

According to one preferred embodiment of the present invention, in the use of the present invention, the subject is
10 subject who performs exercise, and preferably the subject who performs muscle training.

[0083]

According to one embodiment of the present invention, there is provided an acidic liquid composition that includes 0.2
15 to 1.2% by weight of soybean polysaccharides, 0.1 to 0.5% by weight of HM pectin, 0.01 to 0.1% by weight of fibrous insoluble cellulose, and a milk protein mixture including casein protein and whey protein, wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20,
20 for promotion of muscle synthesis. The acidic liquid composition for promotion of muscle synthesis of the present invention can be designed in accordance with the contents mentioned herein for the muscle synthesis promoter of the present invention.

25 [0084]

By the way, the muscle synthesis promoter of the present invention further increases the muscle synthesis-promoting effect, as compared with, for example, a muscle synthesis promoter not including 0.2 to 1.2% by weight of soybean
30 polysaccharides, 0.1 to 0.5% by weight of HM pectin, and 0.01 to 0.1% by weight of fibrous insoluble cellulose, and including, as an active ingredient, a non-acidified milk protein mixture including casein protein and whey protein, wherein the protein content ratio of casein protein to whey protein (casein
35 protein/whey protein) is 4, which is based on the findings of Non Patent Document 1 (hereinafter referred to as "muscle

synthesis promoter including, as an active ingredient, a neutral liquid composition composed of only a milk protein mixture"). For example, in Examples (Test Example 1) using an animal experiment as mentioned below, when the same amount of a milk protein is taken (administered), the muscle synthesis promoter of the present invention was shown to have a higher effect, as compared with the muscle synthesis promoter including, as an active ingredient, a neutral liquid composition composed of only a milk protein mixture. In Examples (Test Example 2) using an animal experiment as mentioned below, the effect as a muscle synthesis promoter when the muscle synthesis promoter of the present invention was taken (administered) at a low dose of 0.85 g milk protein/kg body weight was equivalent to that when the muscle synthesis promoter including, as an active ingredient, a neutral liquid composition composed of only a milk protein mixture was taken (administered) at a high dose of 1.8 g milk protein/kg body weight.

[0085]

In other words, the muscle synthesis promoter of the present invention is expected to exhibit a strong muscle synthesis-promoting effect when a certain amount of milk protein is taken (administered), as compared with the muscle synthesis promoter including, as an active ingredient, a neutral liquid composition composed of only a milk protein mixture. In the muscle synthesis promoter of the present invention, the amount of the milk protein mixture to be taken can be reduced, in order to obtain an effect equivalent to that of the muscle synthesis promoter including, as an active ingredient, a neutral liquid composition composed of only a milk protein mixture, and as a result, the muscle synthesis promoter of the present invention becomes easier to take (administer). Furthermore, the muscle synthesis promoter of the present invention has a refreshing taste due to appropriate sourness, and thus is easier to take (administer) even when the same concentration of a milk protein mixture is contained, as compared with the muscle

synthesis promoter including, as an active ingredient, a neutral liquid composition composed of only a milk protein mixture.

EXAMPLES

[0086]

5 The present invention will be described by way of Examples, but the present invention is not limited to these Examples.

[0087]

[Example 1]

10 4.25 kg of a milk protein concentrate (80% by weight of milk protein and 6.5% by weight of milk sugar) were dissolved in 40.75 kg of water by heating to obtain a solution A. 0.45 kg of soybean polysaccharides (SM-900, manufactured by San-Ei Gen F.F.I., Inc.), 0.2 kg of HM pectin (AYD5110SB, 15 manufactured by UNITEC FOODS Co., Ltd.), 0.05 kg of fermented cellulose (San Artist PG, manufactured by San-Ei Gen F.F.I., Inc.), 1 kg of trehalose, 3.3 kg of sugar, and 0.0063 kg of sucralose were dissolved in 39.99 kg of water by warming to obtain a solution B. Citric acid (0.64 kg) was dissolved in 9.36 20 kg of water to obtain a solution C. After mixing the solution A with the solution B, the solution C was added 10 times over 5 minutes while stirring this mixture, and the obtained mixture was used as a base mix before sterilization. This base mix was homogenized at 15 MPa (70 to 80°C) with a plate sterilizer, 25 sterilized at 130°C for 2 seconds, and then cooled to 10°C or lower, and then used as a muscle synthesis promoter of Example 1 (3.4% by weight of milk protein, 0.45% by weight of soybean polysaccharides, 0.2% by weight of HM pectin, 0.05% by weight of fermented cellulose, and 1% by weight of trehalose). The muscle synthesis promoter of Example 1 had a 30 pH of 4.1 and a viscosity of 10 mPa·s (10°C). All of "taste", "precipitation", and "redispersion" were good. Hereinafter, in Test Examples 1 and 2, Example 1 is referred to as the "muscle synthesis promoter". The milk protein concentrate used herein 35 is a mixture of casein protein and whey protein which was obtained by performing a membrane separation treatment (UF

treatment, MF treatment, etc.) of skimmed milk to remove milk sugar and ash and by condensing mainly casein protein and whey protein, and its form is dry powder. The protein content ratio of the milk protein concentrate is casein protein:whey protein = about 8:2 like that of raw milk (milk) (see *Milk Sogo Jiten* (Encyclopedia of Milk), edited by Kunio Yamauchi and Kenkichi Yokoyama).

[0088]

[Test Example 1]

10 The muscle synthesis-promoting effect of the muscle synthesis promoter of Example 1 was verified as follows.

[0089]

(1) Rat Swimming Test

15 As experimental animals, SD male rats (obtained from CLEA Japan, Inc.) having an initial body weight of 130 to 170 g were used. All rats were individually kept in a stainless cage under conditions where room temperature was $22 \pm 2^{\circ}\text{C}$, the light period was 7:00 to 19:00, and the dark period was 19:00 to 7:00.

20 [0090]

 Rats were preliminarily bred for 3 to 5 days using pellets (manufactured by Oriental Yeast Co., Ltd.), and then subjected to 30-minute swimming exercise (water temperature of 34°C) so that the rats were acclimated to swimming exercise. The rats were fasted for 16 hours on the next day of the acclimation swimming exercise to the day after next, and then the rats were divided into 9 test groups (6 to 8 rats in each test group) so that no difference in body weight was observed between the test groups. Then, the rats were subjected to 2-hour swimming exercise. Immediately after the swimming exercise, the muscle synthesis promoter or a skimmed milk solution containing 3.4% by weight of milk protein was orally administered to rats at a dose of 24.24 mL/kg body weight. At 15, 45, 75, or 105 minutes after oral intake, a deuterium-labeled phenylalanine solution (prepared by dissolving 225 mg of deuterium-labeled phenylalanine in 10 mL

of physiological saline) was administered to the tail vein of the rats at a dose of 2.0 mL/kg body weight. At 15 minutes after the tail vein administration (i.e., 30, 60, 90, or 120 minutes after the oral intake), the rats were dissected under anesthesia with isoflurane. After whole blood was collected from the abdominal vena cava, the triceps brachii muscle was removed and washed with physiological saline, and then immediately frozen by liquid nitrogen. The time of the tail vein administration and the time of the cryopreservation of the triceps brachii muscle were accurately recorded. The triceps brachii muscle was stored at -80°C until analysis.

[0091]

(2) Measurement of Skeletal Muscle Protein Fractional Synthesis Rate (FSR)

Based on the description of the prior document (A. Kanda et al., Br J Nutr, Sep. 28, 981-987, 2013), the skeletal muscle protein fractional synthesis rate (FSR) of the removed and stored triceps brachii muscle was measured. Specifically, the amounts of phenylalanine (Phe) and deuterium-labeled phenylalanine (Phe(Ring-D5)) existing in the form anabolized to proteins in skeletal muscle cells or in the free state in skeletal muscle cells were respectively determined using LC/MS/MS (manufactured by Waters Corporation). This measurement condition was as follows: apparatus, LC/MS/MS (manufactured by Waters Corporation); column, ACQUITY UPLC BEH C18 (manufactured by Waters Corporation); mobile phase, 0.05% TFA water/0.05% TFA-containing acetonitrile; injection volume, 3 µL; flow rate, 0.3 mL/min; and UV, 215 nm.

[0092]

The skeletal muscle protein fractional synthesis rate (FSR) was calculated by the following equation:

$$\text{FSR (\%/day)} = (\text{Eb} \times 100) / (\text{Ea} \times t)$$

where

Ea: Enrichment (existing in the free state in skeletal muscle cells)

Eb: Enrichment (existing in the form anabolized to proteins in

skeletal muscle cells)

t: Time from the tail vein administration to the cryopreservation of the triceps brachii muscle (unit: day)

Enrichment = $\text{Phe(Ring-D5)} / (\text{Phe} + \text{Phe(Ring-D5)})$

5 [0093]

The mean $\pm$ standard error in each test group was calculated from the obtained values. As statistical processing, Student's t-test was performed between the muscle synthesis promoter group and the skimmed milk solution group at each time point (at 30, 60, 90, or 120 minutes after oral intake). The significance level was less than 5% ($p < 0.05$). The results are shown in Fig. 1.

[0094]

After intake of the muscle synthesis promoter, the skeletal muscle protein fractional synthesis rate in rats at 30 minutes after intake was significantly higher than that after intake of the skimmed milk solution ($p < 0.05$, Fig. 1). After intake of the muscle synthesis promoter, the skeletal muscle protein fractional synthesis rate tended to increase also at 60, 90, and 120 after intake as compared with that after intake of the skimmed milk solution ($p < 0.10$, Fig. 1). These results showed that the muscle synthesis promoter has a higher skeletal muscle synthesis-promoting effect than that of the skimmed milk solution.

25 [0095]

[Test Example 2]

The muscle synthesis-promoting effect of the muscle synthesis promoter of Example 1 was verified as follows.

[0096]

30 (1) Rat Swimming Test

As experimental animals, SD male rats (obtained from CLEA Japan, Inc.) having an initial body weight of 130 to 170 g were used. All rats were individually kept in a stainless cage under conditions where room temperature was $22 \pm 2^\circ\text{C}$, the light period was 7:00 to 19:00, and the dark period was 19:00 to 7:00.

[0097]

Rats were preliminarily bred for 3 to 5 days using pellets (manufactured by Oriental Yeast Co., Ltd.), and then subjected to 30-minute swimming exercise (water temperature of 34°C) so that the rats were acclimated to swimming exercise. The rats were fasted for 16 hours on the next day of the acclimation swimming exercise to the day after next, and then the rats were divided into 9 test groups (6 to 8 rats in each test group) so that no difference in body weight was observed between the test groups. Then, the rats were subjected to 2-hour swimming exercise. Immediately after the swimming exercise, the muscle synthesis promoter or a skimmed milk solution containing 6.8% by weight of milk protein (high-dose skimmed milk solution) was orally administered to rats at a dose of 24.24 mL/kg body weight. At 15, 45, 75, or 105 minutes after oral intake, a deuterium-labeled phenylalanine solution (prepared by dissolving 225 mg of deuterium-labeled phenylalanine in 10 mL of physiological saline) was administered to the tail vein of the rats at a dose of 2.0 mL/kg body weight. At 15 minutes after the tail vein administration (i.e., 30, 60, 90, or 120 minutes after the oral intake), the rats were dissected under anesthesia with isoflurane. After whole blood was collected from the abdominal vena cava, the triceps brachii muscle was removed and washed with physiological saline, and then immediately frozen by liquid nitrogen. The time of the tail vein administration and the time of the cryopreservation of the triceps brachii muscle were accurately recorded. The triceps brachii muscle was stored at -80°C until analysis.

[0098]

(2) Measurement of Skeletal Muscle Protein Fractional Synthesis Rate (FSR)

Based on the description of the prior document (A. Kanda et al., Br J Nutr, Sep. 28, 981-987, 2013), the skeletal muscle protein fractional synthesis rate (FSR) of the removed and stored triceps brachii muscle was measured. Specifically, the amounts of phenylalanine (Phe) and deuterium-labeled

phenylalanine (Phe(Ring-D5)) existing in the form anabolized to proteins in skeletal muscle cells or in the free state in skeletal muscle cells were respectively determined using LC/MS/MS (manufactured by Waters Corporation). This measurement condition was as follows: apparatus, LC/MS/MS (manufactured by Waters Corporation); column, ACQUITY UPLC BEH C18 (manufactured by Waters Corporation); mobile phase, 0.05% TFA water/0.05% TFA-containing acetonitrile; injection volume, 3 μ L; flow rate, 0.3 mL/min; and UV, 215 nm.

10 [0099]

The skeletal muscle protein fractional synthesis rate (FSR) was calculated by the following equation:

$$\text{FSR (\%/day)} = (\text{Eb} \times 100) / (\text{Ea} \times t)$$

where

15 Ea: Enrichment (existing in the free state in skeletal muscle cells)

Eb: Enrichment (existing in the form anabolized to proteins in skeletal muscle cells)

t: Time from the tail vein administration to the cryopreservation of the triceps brachii muscle (unit: day)

20 Enrichment = Phe(Ring-D5)/(Phe + Phe(Ring-D5))

[0100]

The mean $\pm$ standard error in each test group was calculated from the obtained values. As statistical processing, Student's t-test was performed between the muscle synthesis promoter group and the skimmed milk solution group at each time point (at 30, 60, 90, or 120 minutes after oral intake). The significance level was less than 5% ($p < 0.05$). The results are shown in Fig. 2.

30 [0101]

The muscle synthesis promoter showed a skeletal muscle synthesis-promoting effect equivalent to that of the high-dose skimmed milk solution. The intake of milk protein, which is the active body, was 0.85 g/kg body weight in the muscle synthesis promoter group and 1.8 g/kg body weight in the high-dose skimmed milk solution group, showing that the muscle synthesis

promoter promotes skeletal muscle synthesis at a lower milk protein intake than that of the skimmed milk solution.

[0102]

[Test Example 3]

5 An artificial gastric juice (containing 0.6% of pepsin, pH 1.2) was mixed with the muscle synthesis promoter at a weight ratio of (artificial gastric juice):(muscle synthesis promoter) = 1:1.6, and the mixture was maintained at 37°C for 10 minutes. At this time, in the muscle synthesis promoter mixed with the
10 artificial gastric juice, milk proteins derived from the muscle synthesis promoter did not aggregate. As a control, a similar test using the skimmed milk solution containing 3.4% by weight of milk protein used in Test Example 1 and the skimmed milk solution containing 6.8% by weight of milk protein (high-dose
15 skimmed milk solution) used in Test Example 2 was also performed. The artificial gastric juice (containing 0.6% of pepsin, pH 1.2) was mixed with the skimmed milk solutions at a weight ratio of (artificial gastric juice):(skimmed milk solution) = 1:1.6, and the mixture was maintained at 37°C for 10
20 minutes. At this time, in both of the skimmed milk solutions mixed with the artificial gastric juice, milk proteins derived from the skimmed milk solutions aggregated.

[0103]

25 Based on Test Examples 1 to 3, it was assumed that the muscle synthesis promoter of the present invention, as compared with the skimmed milk solution, causes no aggregation (curdling) of milk proteins in the stomach after intake (administration), and thus the absorbability of milk proteins in the subsequent intestinal tract is increased, resulting
30 in increase in the muscle synthesis-promoting effect.

CLAIMS

1. A muscle synthesis promoter comprising, as an active ingredient, an acidic liquid composition that comprises:
0.2 to 1.2% by weight of soybean polysaccharides,
0.1 to 0.5% by weight of HM pectin,
0.01 to 0.1% by weight of fibrous insoluble cellulose, and
a milk protein mixture including casein protein and whey protein,
wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20.
2. The muscle synthesis promoter according to claim 1, wherein the acidic liquid composition further comprises 0.5 to 5% by weight of trehalose.
3. The muscle synthesis promoter according to claim 1 or 2, wherein the pH of the acidic liquid composition is 3 to 6.
4. The muscle synthesis promoter according to any one of claims 1 to 3, wherein the fibrous insoluble cellulose is fermented cellulose.
5. The muscle synthesis promoter according to any one of claims 1 to 4, wherein the milk protein mixture contained in the acidic liquid composition is taken so that the total protein content is 0.06 to 0.7 g/kg body weight per meal.
6. The muscle synthesis promoter according to any one of claims 1 to 5, which is in a unit packaging form per meal, wherein the unit packaging form contains 3 to 40 g (total protein content) of the milk protein mixture as an intake per meal.
7. The muscle synthesis promoter according to any one of claims 1 to 6, which is for a subject who performs exercise.

8 The muscle synthesis promoter according to claim 7, wherein the exercise is muscle training.

9 A method for promoting muscle synthesis, which comprises allowing a subject in need of promotion of muscle synthesis to take an acidic liquid composition that comprises:

0.2 to 1.2% by weight of soybean polysaccharides,
0.1 to 0.5% by weight of HM pectin,
0.01 to 0.1% by weight of fibrous insoluble cellulose, and
a milk protein mixture including casein protein and whey protein,

wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20.

10 A method for promoting muscle synthesis (excluding medical practice for humans), which comprises allowing a subject in need of promotion of muscle synthesis to take an acidic liquid composition that comprises:

0.2 to 1.2% by weight of soybean polysaccharides,
0.1 to 0.5% by weight of HM pectin,
0.01 to 0.1% by weight of fibrous insoluble cellulose, and
a milk protein mixture including casein protein and whey protein,

wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20.

11 Use of a muscle synthesis promoter comprising, as an active ingredient, an acidic liquid composition that comprises:

0.2 to 1.2% by weight of soybean polysaccharides,
0.1 to 0.5% by weight of HM pectin,
0.01 to 0.1% by weight of fibrous insoluble cellulose, and
a milk protein mixture including casein protein and whey protein, for promotion of muscle synthesis,

wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20.

12 Use of a muscle synthesis promoter comprising, as an active ingredient, an acidic liquid composition that comprises:
0.2 to 1.2% by weight of soybean polysaccharides,
0.1 to 0.5% by weight of HM pectin,
0.01 to 0.1% by weight of fibrous insoluble cellulose, and
a milk protein mixture including casein protein and whey protein, for production of foods or medicines for promotion of muscle synthesis,

wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20.

13 An acidic liquid composition for promotion of muscle synthesis, comprising:

0.2 to 1.2% by weight of soybean polysaccharides,
0.1 to 0.5% by weight of HM pectin,
0.01 to 0.1% by weight of fibrous insoluble cellulose, and
a milk protein mixture including casein protein and whey protein,

wherein the protein content ratio of casein protein to whey protein (casein protein/whey protein) is 2 to 20.