

ACIDIC MILK BEVERAGE AND PRODUCTION METHOD FOR THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

5 [0001]

This application claims the priority of Japanese Patent Application No. 2014-222049, filed October 30, 2014, the disclosure of which is hereby incorporated by reference in its entirety.

10 BACKGROUND OF THE INVENTION

Field of the Invention

[0002]

The present invention relates to an acidic milk beverage and a method for producing the same.

15 Background Art

[0003]

Acidic milk beverage is a drink produced by the acidification of milk. Representative examples of the acidic milk beverage include fermented milk beverages produced from
20 fermented milk (yoghurt) as a raw material, such as drinkable yoghurt (drinking yoghurt), lactic acid bacteria beverage and the like. These fermented milk beverages offer advantages, such as easy ingestion of fermented milk and/or lactic acid bacteria without use of eating utensils including spoon and the
25 like. Examples of the acidic milk beverage include, in addition to these fermented milk beverages, those represented by fruity flavored milk (fruity flavored milk beverage) such as, for example, strawberry milk, banana milk, melon milk and the like, in which a food acidulant is directly added to a milk-containing
30 solution to adjust the pH to an acidic value. These acidic milk beverages are characterized by being produced to have a fresh and quaffable flavor even without use of fermented milk (yoghurt) as a raw material.

[0004]

35 As described above, the step of acidifying a milk-containing solution is essential in the production of an

acidic milk beverage. Casein protein contained in milk is coagulated by acid in this step, which will induce phase separation and precipitation due to the acid coagulation if the situation is left unchanged. Stabilization by reducing phase separation and precipitation in an acidic milk beverage is a conventional problem and the following approaches have been known to solve the problem.

[0005]

It is known for the phase separation and precipitation in an acidic milk beverage that casein protein loses its repulsive force based on the electric charge thereon and is easily coagulated by acid while being acidified below the pH of its isoelectric point. In order to reduce phase separation and precipitation in such a condition by suppressing acid coagulation of casein protein in an acidic milk beverage having the form of a less viscous liquid and consequently to stabilize the acidic milk beverage, a stabilizer such as HM pectin (high-methoxyl pectin) is used in a method, which associates with and stabilizes casein protein by providing the protein with a repulsive force based on the electric charge thereon, and such a method has been known. HM pectin is used as a stabilizer in commercially available drinkable yoghurt products and the like.

[0006]

Furthermore, acidified protein foods characterized by comprising water-soluble soybean polysaccharides as a dispersant have been known (Patent Document 1). Patent Document 1 describes that the use of soybean polysaccharides as a stabilizer in an acidified protein food can prevent disadvantages such as aggregation, precipitation and phase separation of protein particles without providing the protein food with a highly viscous texture whereas a conventionally known stabilizer such as HM pectin (high-methoxyl pectin), carboxymethyl cellulose, or propylene glycol alginate should be added more abundantly to completely prevent aggregation and precipitation of protein particles, resulting in a highly viscous texture as in a nectar juice.

[0007]

Additionally, Patent Document 2 describes an acidic milk beverage characterized by comprising micro-fibrillated fibrous insoluble cellulose having an average diameter of 0.01 to 0.1 μm , which is added to a concentration of 0.03 to 0.2% by weight based on the acidic milk beverage, as well as one, two or more selected from high-methoxyl pectin, soybean polysaccharides and carboxymethyl cellulose, which is/are added to a concentration of 0.05 to 5% by weight in total based on the acidic milk beverage, which results in homogeneously dispersed insoluble solids in the acidic milk beverage.

[0008]

The acidic milk beverages according to Patent Documents 1 and 2 are directed to those comprising therein low concentrations of non-fat milk solids and milk proteins including casein but those patent documents have no mention on the reduction of phase separation and precipitation in an acidic milk beverage and the consequent stabilization at a low viscosity, with respect to an acidic milk beverage comprising non-fat milk solids at a concentration of 8% by weight (milk proteins at a concentration of 3% by weight) or more, which comprises the milk proteins including a high concentration of casein. Furthermore, the acidic milk beverage according to Patent Document 2 is generally directed to those having a high viscosity but that patent document has no mention on the successful reduction of phase separation and precipitation and the consequent stabilization of these acidic milk beverages even after the viscosity has been lowered in the acidic milk beverages.

[0009]

Milk proteins including casein are expected to provide nutritional values as proteins, functionalities based on casein protein and/or whey proteins (appealing health benefits), and the like. Thus, there is a request in the market for commercial products that enable efficient ingestion of milk proteins including casein. In other words, commercial products that

enable efficient ingestion of milk proteins including casein would be obtainable once an acidic milk beverage comprising milk proteins including a high concentration of casein could be provided, in which phase separation and precipitation in an acidic milk beverage have been reduced and consequently the stability is maintained at a low viscosity.

[0010]

Meanwhile, with respect to the acidic milk beverages according to Patent Documents 1 and 2, in the adaptation to an acidic milk beverage comprising non-fat milk solids at a concentration of 8% by weight (milk proteins at a concentration of 3% by weight) or more, which comprises the milk proteins including a high concentration of casein, the concentration of a stabilizer should be further increased to produce an acidic milk beverage having a higher viscosity so that phase separation and precipitation would be reduced and consequently the stability would be maintained in the acidic milk beverage.

[0011]

A critical problem in such a situation is to provide a less viscous and more quaffable acidic milk beverage and a method for producing the same, with respect to the acidic milk beverage comprising milk proteins including a high concentration of casein, wherein phase separation and precipitation in an acidic milk beverage have been reduced.

PRIOR ARTS

Patent Documents

[0012]

Patent Document 1: Japanese Patent Application Laid-Open No. Hei 5-7458

Patent Document 2: Japanese Patent Application Laid-Open No. 2005-245217

SUMMARY OF THE INVENTION

[0013]

The inventors intensively studied and consequently found that a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as

well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein, was obtainable by selecting a particular composition for the acidic milk beverage. Additionally, it was found that the acidic milk beverage of the particular composition also enabled efficient ingestion of milk proteins including a high concentration of casein with the aid of a fresh flavor from the acidic milk beverage. Additionally, it was found that milk proteins in the acidic milk beverage of the particular composition were hardly aggregated (curdled) in the stomach after ingestion as compared with cow milk and defatted milk, so that the absorbability of the milk proteins in the intestinal tract was increased at a later time.

The present invention is based on such findings.

[0014]

That is, the present invention is as follows.

[1] An acidic milk beverage comprising 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.

[2] The acidic milk beverage according to [1], further comprising 0.5 to 5% by weight of trehalose.

[3] The acidic milk beverage according to [1] or [2], comprising milk proteins, the milk proteins comprising casein at a concentration of not less than 3% by weight.

[4] The acidic milk beverage according to any one of [1] to [3], wherein the pH of the acidic milk beverage is from 3 to 6.

[5] The acidic milk beverage according to any one of [1] to [4], wherein the viscosity of the acidic milk beverage (at 10°C) is from 3 to 30 mPa·s.

[6] The acidic milk beverage according to any one of [1] to [4], wherein the fibrous insoluble cellulose is fermented cellulose.

[7] A method for producing an acidic milk beverage, comprising the steps of adjusting the pH of a milk-containing solution to an acidic value; and homogenizing the

milk-containing solution, the milk-containing solution comprising 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.

5 [8] The method for producing the acidic milk beverage according to [7], further comprising making 0.5 to 5% by weight of trehalose comprised in the milk-containing solution.

[9] The method for producing the acidic milk beverage according to [7] or [8], wherein the acidic milk beverage
10 comprises milk proteins, the milk proteins comprising casein at a concentration of not less than 3% by weight.

[10] The method for producing the acidic milk beverage according to any one of [7] to [9], comprising adjusting the pH of the acidic milk beverage to an acidic value of from pH 3 to 6.

15 [11] The method for producing the acidic milk beverage according to any one of [7] to [10], further comprising heat sterilization.

[12] The method for producing the acidic milk beverage according to any one of [7] to [11], wherein the pH is adjusted
20 to the acidic value without curdling the milk-containing solution.

[13] The method for producing the acidic milk beverage according to any one of [7] to [12], wherein the viscosity of the acidic milk beverage (at 10°C) is from 3 to 30 mPa·s.

[14] A protein-absorption promoter comprising as an active
25 ingredient the acidic milk beverage according to any one of [1] to [6].

[0015]

According to the present invention, a less viscous and more quaffable acidic milk beverage, in which phase separation
30 and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein, is obtainable. Furthermore, according to the present invention, the efficient ingestion of milk proteins including a high
35 concentration of casein with the aid of a fresh flavor from the acidic milk beverage is also enabled. Additionally, according to

the present invention, milk proteins are hardly aggregated (curdled) in the stomach after ingestion as compared with cow milk and defatted milk, so that the absorbability of the milk proteins in the intestinal tract may be increased at a later time.

5 BRIEF DESCRIPTION OF THE DRAWING

[0016]

Figure 1 shows the effects of an acidic milk beverage of the present invention (one from the group of Examples), cow milk, and defatted milk on the total amino acid (TAA) content in blood
10 in the cases where they are administered orally.

DETAILED DESCRIPTION OF THE INVENTION

[0017]

The present invention will be described in detail below. However, the present invention is not limited to any single
15 embodiment in the specification.

[0018]

The acidic milk beverage of the present invention refers to an acidified milk beverage. Furthermore, the milk beverage of the present invention refers to a beverage comprising milk
20 and/or a dairy product. Milk as described herein refers to milk from mammalian animals, such as cow milk, sheep milk, goat milk, buffalo milk, domestic sheep milk, camel milk, whale milk, dolphin milk, human milk and the like, for example. Furthermore, a dairy product as described herein refers to a
25 product from milk. A known liquid raw material such as, for example, defatted milk, partially defatted milk, desalted and defatted milk, desalted milk, milk with adjusted nutrient contents, whey, concentrated milk, defatted concentrated milk, partially defatted concentrated milk, desalted and defatted
30 concentrated milk, condensed milk, cream, permeate derived from a milk raw material and prepared by a known method, a milk protein concentrate prepared by a known method, or the like may be used as the dairy product, while a known processed raw material such as, for example, skim milk, butter,
35 concentrated milk, condensed milk, lactose, whey minerals, or the like may be used as the dairy product. Among them, a milk

protein concentrate (MPC), which is a milk raw material comprising an abundance of milk proteins including casein, is preferably used for an acidic milk beverage comprising milk proteins including a high concentration of casein, as in the case of the acidic milk beverage of the present invention. In this milk protein concentrate, casein protein and whey proteins are contained in a ratio by weight of (casein protein) to (whey proteins), for example, of 5-3:2-0.5, and preferably of 4:1.

[0019]

The acidic milk beverage of the present invention is characterized by being a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein. Detailed features (such as pH and viscosity) on the acidic milk beverage may be designed arbitrarily as long as the resulting acidic milk beverage is within this embodiment.

[0020]

The pH of the acidic milk beverage of the present invention is, for example, from 3 to 6, from 3.1 to 5.8, from 3.2 to 5.6, from 3.3 to 5.4, from 3.4 to 5.2, from 3.5 to 5, from 3.6 to 4.8, 3.7 to 4.6, or from 3.8 to 4.4. A pH of more than 3 is preferable in the acidic milk beverage of the present invention to prevent the acidic milk beverage from becoming less quaffable because of its perceived strong acidic taste. Furthermore, a pH of less than 6 is preferable in the acidic milk beverage of the present invention to prevent the acidic milk beverage from becoming less quaffable as an acidic milk beverage because of its perceived weak acidic taste.

[0021]

The viscosity (at 10°C) of the acidic milk beverage of the present invention refers to the viscosity of the acidic milk beverage measured with a B-type rotational viscometer. The viscosity (at 10°C) of the acidic milk beverage of the present invention is, for example, from 3 to 30 mPa·s, from 3.5 to 30

mPa·s, from 4 to 30 mPa·s, from 4.5 to 30 mPa·s, from 5 to 30 mPa·s, from 5.5 to 29 mPa·s, from 6 to 28 mPa·s, from 6.5 to 27 mPa·s, from 7 to 26 mPa·s, from 7.5 to 25 mPa·s, from 8 to 24 mPa·s, from 8.5 to 23 mPa·s, from 9 to 22 mPa·s, from 9.5 to 21 mPa·s, or from 10 to 20 mPa·s. A viscosity (at 10°C) of more than 3 mPa·s is preferable in the acidic milk beverage of the present invention to prevent casein protein in the acidic milk beverage from becoming less stable and easily inducing phase separation and precipitation in the acidic milk beverage. Furthermore, a viscosity (at 10°C) of less than 30 mPa·s is preferable in the acidic milk beverage of the present invention to prevent the acidic milk beverage from being no longer a less viscous and more quaffable acidic milk beverage while comprising milk proteins including a high concentration of casein. In addition, the viscosity (at 10°C) of the acidic milk beverage of the present invention refers to the viscosity of the acidic milk beverage measured with a generic B-type rotational viscometer such as Brookfield viscometer.

[0022]

Furthermore, according to one aspect of the present invention, a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein, can be provided. Casein proteins in milk proteins including casein here are generally stable in the neutral pH range and aggregate each other through acid coagulation in an environment with a pH range below around pH 4.6, the isoelectric point of casein, which leads to the induction of phase separation and precipitation in an acidic milk beverage. On the other hand, according to the acidic milk beverage of the present invention, a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein,

is obtainable. As described herein, the concentration of milk proteins including a high concentration of casein contained in the acidic milk beverage of the present invention is, for example, not less than 3% by weight, not less than 3.2% by weight, not less than 3.4% by weight, not less than 3.6% by weight, not less than 3.8% by weight, not less than 4% by weight, not less than 4.2% by weight, not less than 4.4% by weight, from 3 to 10% by weight, from 3 to 9.5% by weight, from 3 to 9% by weight, from 3 to 8.5% by weight, from 3 to 8% by weight, from 3 to 7.5% by weight, from 3 to 7% by weight, from 3.2 to 10% by weight, from 3.2 to 9.5% by weight, from 3.2 to 9% by weight, from 3.2 to 8.5% by weight, from 3.2 to 8% by weight, from 3.2 to 7.5% by weight, from 3.2 to 7% by weight, from 3.4 to 10% by weight, from 3.4 to 9.5% by weight, from 3.4 to 9% by weight, from 3.4 to 8.5% by weight, from 3.4 to 8% by weight, from 3.4 to 7.5% by weight, from 3.4 to 7% by weight, from 3.6 to 10% by weight, from 3.6 to 9.5% by weight, from 3.6 to 9% by weight, from 3.6 to 8.5% by weight, from 3.6 to 8% by weight, from 3.6 to 7.5% by weight, from 3.6 to 7% by weight, from 3.8 to 10% by weight, from 3.8 to 9.5% by weight, from 3.8 to 9% by weight, from 3.8 to 8.5% by weight, from 3.8 to 8% by weight, from 3.8 to 7.5% by weight, from 3.8 to 7% by weight, from 4 to 10% by weight, from 4 to 9.5% by weight, from 4 to 9% by weight, from 4 to 8.5% by weight, from 4 to 8% by weight, from 4 to 7.5% by weight, from 4 to 7% by weight, from 4.2 to 10% by weight, from 4.2 to 9.5% by weight, from 4.2 to 9% by weight, from 4.2 to 8.5% by weight, from 4.2 to 8% by weight, from 4.2 to 7.5% by weight, from 4.2 to 7% by weight, from 4.4 to 10% by weight, from 4.4 to 9.5% by weight, from 4.4 to 9% by weight, from 4.4 to 8.5% by weight, from 4.4 to 8% by weight, from 4.4 to 7.5% by weight, or from 4.4 to 7% by weight.

[0023]

Milk proteins including casein in the acidic milk beverage of the present invention refer to milk proteins composed of

casein protein and whey proteins. Here, the ratio by weight of casein protein to whey proteins in the acidic milk beverage of the present invention is, for example, 20:1, 15:1, 12:1, 10:1, 9:1, 8:1, 7:1, 6:1, 5:1, 4:1, 3:1, 2:1, 1:1, 1:2, 1:3, 1:4, 1:5, 1:6, 1:7, 1:8, 1:9, 1:10, 1:12, 1:15, or 1:20 of (casein protein):(whey proteins). That is, the ratio by weight of casein protein to whey proteins in the acidic milk beverage of the present invention is, for example, 20-1:1-20, 15-1:1-15, 12-1:1-12, 10-1:1-10, 9-1:1-9, 8-1:1-8, 7-1:1-7, 6-1:1-6, 5-1:1-5, 4-1:1-4, 3-1:1-3, or 2-1:1-2 of (casein protein):(whey proteins).

[0024]

The acidic milk beverage of the present invention may comprise 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 provide those characteristics of a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein.

[0025]

The soybean polysaccharides of the present invention may be those comprising one, two or more of rhamnose, galactose, arabinose, xylose, glucose, and uronic acid derived from soybean and are preferably those derived particularly from cotyledons of soybean. The soybean polysaccharide of the present invention is not particularly limited in terms of molecular weight but is preferably a soybean polysaccharide having a molecular weight as in a polymer, preferably having an average molecular weight of thousands to millions, particularly five thousand to one million. In addition, this average molecular weight of a soybean polysaccharide is a value determined by the intrinsic viscosity method, in which the determination is based on the measurement of viscosity in 0.1 M NaNO₃ solution using standard pullulan (Showa Denko K. K.)

as standards. Such soybean polysaccharides are commercially available and examples of the soybean polysaccharides include, for example, SM-700 (manufactured by San-Ei Gen F.F.I., Inc.), and SM-900 (manufactured by San-Ei Gen F.F.I., Inc.).

5 Soybean polysaccharides have been considered to reduce phase separation and precipitation in an acidic milk beverage based on their side chain structures, which phase separation and precipitation are caused by acid coagulation among casein proteins in the acidic milk beverage.

10 [0026]

The amount of the soybean polysaccharides of the present invention to be added is, for example, from 0.2 to 1.2% by weight, from 0.25 to 1.15% by weight, from 0.3 to 1.1% by weight, from 0.35 to 1.05% by weight, from 0.4 to 1% by weight, or from 0.4 to 0.9% by weight in cases where the acidic milk beverage of the present invention comprises 0.1 to 0.5% by weight of HM pectin and 0.01 to 0.1% by weight of fibrous insoluble cellulose. The addition of an amount of the soybean polysaccharides of the present invention corresponding to less than 1.2% by weight is preferable to avoid giving the acidic milk beverage a flavor unique to soybean. Furthermore, the addition of an amount of the soybean polysaccharides of the present invention corresponding to more than 0.2% by weight is preferable to suppress the induction of phase separation and precipitation in the acidic milk beverage of the present invention and additionally to increase the redispersibility.

[0027]

The HM pectin of the present invention refers to an acidic polysaccharide present in vegetables and fruits as a cell-wall component and comprising α -D-galacturonic acid as a component of main chain architecture. The galacturonic acid residues constituting a type of pectin are partially methyl-esterified and the degree of esterification classifies that type of pectin into LM pectin or HM pectin. In general, HM pectin refers to those having a degree of esterification of not less than 50%. Such HM pectin is commercially available and

examples of the HM pectin include, for example, SM-478 (manufactured by San-Ei Gen F.F.I., Inc.), SM-666 (manufactured by San-Ei Gen F.F.I., Inc.), AYD5110SB (manufactured by Unitec Foods Co., Ltd.) and the like. HM pectin is characterized by carrying a negative charge and is considered to prevent casein proteins from aggregating each other based on the association of HM pectin with casein protein and the repulsion among the associated casein proteins due to the electric charge thereon.

10 [0028]

The amount of the HM pectin of the present invention to be added is, for example, from 0.1 to 0.5% by weight, from 0.1 to 0.45% by weight, from 0.1 to 0.4% by weight, from 0.1 to 0.35% by weight, from 0.1 to 0.3% by weight, from 0.12 to 0.29% by weight, from 0.14 to 0.28% by weight, from 0.16 to 0.27% by weight, from 0.18 to 0.26% by weight, or from 0.2 to 0.25% by weight in cases where the acidic milk beverage of the present invention comprises 0.2 to 1.2% by weight of soybean polysaccharides and 0.01 to 0.1% by weight of fibrous insoluble cellulose. The addition of an amount of the HM pectin of the present invention corresponding to less than 0.5% by weight is preferable to produce a less viscous and more quaffable acidic milk beverage while comprising milk proteins including a high concentration of casein. Furthermore, the addition of an amount of the HM pectin of the present invention corresponding to more than 0.1% by weight is preferable to suppress the induction of phase separation and precipitation in the acidic milk beverage and additionally to increase the redispersibility.

[0029]

30 The acidic milk beverage of the present invention may be supplemented with other stabilizers such as sodium carboxymethyl cellulose and/or propylene glycol alginate in combination with or instead of soybean polysaccharides and/or HM pectin to provide those characteristics of a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high

redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein. Other stabilizers such as sodium carboxymethyl cellulose and/or propylene glycol alginate are preferably used in combination with or instead of soybean polysaccharides and/or HM pectin particularly in cases where those stabilizers reduce phase separation and precipitation in an acidic milk beverage as well as maintain the high redispersibility at a lower viscosity in the comparison with soybean polysaccharides and/or HM pectin.

10 [0030]

The acidic milk beverage of the present invention may be supplemented with sodium carboxymethyl cellulose. Sodium carboxymethyl cellulose refers to those obtained by substitution of a carboxymethyl group for a hydroxy group in glucose residues in cellulose, in which the degree of etherification is usually from 0.6 to 1.5. Such sodium carboxymethyl cellulose is commercially available and examples of the sodium carboxymethyl cellulose include, for example, 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.), Cellogen F-1220B (manufactured by DKS Co., Ltd.) and the like.

[0031]

25 The acidic milk beverage of the present invention may be supplemented with propylene glycol alginate. Propylene glycol alginate refers to a substance obtained by chemical modification of alginate polysaccharides purified from algae such as konbu seaweed, wakame seaweed and the like. Such propylene glycol alginate is commercially available and examples of the propylene glycol alginate include, for example, Duck Loid LF-M (Kikkoman Biochemifa Co.), Duck Loid EF (Kikkoman Biochemifa Co.), Duck Loid PF (Kikkoman Biochemifa Co.), Duck Loid PF-H (Kikkoman Biochemifa Co.) and the like.

35 [0032]

The amount of the sodium carboxymethyl cellulose or

propylene glycol alginate of the present invention to be added is not limited as long as the acidic milk beverage of the present invention maintains its characteristics, that is, being a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein. The amount of sodium carboxymethyl cellulose or propylene glycol alginate to be added to the acidic milk beverage of the present invention is, for example, from 0.01 to 2% by weight, from 0.01 to 1.5% by weight, from 0.01 to 1.2% by weight, or from 0.01 to 1.0% by weight. The addition of an amount of sodium carboxymethyl cellulose or propylene glycol alginate corresponding to less than 1% by weight to the acidic milk beverage of the present invention is preferable to avoid the acidic milk beverage from being no longer less viscous and more quaffable. Furthermore, the addition of an amount of sodium carboxymethyl cellulose or propylene glycol alginate corresponding to more than 0.01% by weight to the acidic milk beverage of the present invention is preferable to suppress the induction of phase separation and precipitation in the acidic milk beverage as well as to maintain the high redispersibility, all of which contribute to the addition of such a stabilizer.

[0033]

The fibrous insoluble cellulose of the present invention is a stabilizer, which is contained in an acidic milk beverage to establish a three-dimensional network structure in the acidic milk beverage and thereby successfully increases the dispersibility of insoluble components such as precipitates. The fibrous insoluble cellulose of the present invention is not limited in terms of its origin and the like as long as the acidic milk beverage of the present invention maintains its characteristics, that is, being a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including

a high concentration of casein, but fibrous insoluble cellulose of plant origin and/or microbial origin may be used. Fibrous insoluble cellulose of microbial origin refers to those obtained, for example, by separating microbe-produced fermented cellulose from a medium, washing it, purifying it as appropriate, and then processing it into a fibrous form. This fibrous insoluble cellulose is, for example, micro-fibrillated fibrous insoluble cellulose having an average diameter of 0.01 to 0.1 μm (Patent Document 2) or fermented cellulose. The fibrous insoluble cellulose of the present invention is commercially available and examples of the fibrous insoluble cellulose of the present invention include, for example, San Artist PG (manufactured by San-Ei Gen F.F.I., Inc.) and San Artist PN (manufactured by San-Ei Gen F.F.I., Inc.).

15 [0034]

The amount of the fibrous insoluble cellulose of the present invention to be added is, for example, from 0.01 to 0.1% by weight, from 0.015 to 0.09% by weight, from 0.02 to 0.08% by weight, from 0.025 to 0.085% by weight, from 0.03 to 0.07% by weight, from 0.03 to 0.065% by weight, from 0.03 to 0.06% by weight, from 0.03 to 0.055% by weight, or from 0.03 to 0.05% by weight in cases where the acidic milk beverage of the present invention comprises 0.2 to 1.2% by weight of soybean polysaccharides and 0.1 to 0.5% by weight of HM pectin. The addition of an amount of the fibrous insoluble cellulose of the present invention corresponding to less than 0.1% by weight is preferable to avoid the acidic milk beverage comprising milk proteins including a high concentration of casein from being no longer less viscous and more quaffable. Furthermore, more than 0.01% by weight of the fibrous insoluble cellulose of the present invention is preferable to avoid unsuccessful suppression of the induction of phase separation and precipitation in the acidic milk beverage and additionally to avoid the redispersibility from being reduced.

35 [0035]

Additional supplementation of trehalose into the acidic

milk beverage of the present invention can further impart the characteristics of the acidic milk beverage of the present invention, that is, being a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein. Specifically, the characteristics of the acidic milk beverage of the present invention, that is, being a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein, can be enhanced even at a pH above 4 and close to the isoelectric point of casein protein in the acidic milk beverage of the present invention by the additional supplementation of trehalose into the acidic milk beverage of the present invention. The trehalose of the present invention is likewise commercially available and examples of the trehalose include, for example, TREHA (manufactured by Hayashibara Co., Ltd.).

[0036]

The amount of the trehalose of the present invention to be added is, for example, from 0.1 to 5% by weight, from 0.2 to 4.5% by weight, from 0.3 to 4% by weight, from 0.4 to 3.5% by weight, from 0.5 to 3% by weight, from 0.6 to 2.5% by weight, from 0.7 to 2% by weight, from 0.8 to 1.5% by weight, from 0.9 to 1.3% by weight, or from 0.9 to 1.1% by weight in cases where the acidic milk beverage of the present invention comprises 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. The addition of an amount of the trehalose of the present invention corresponding to less than 5% by weight is preferable to avoid giving the acidic milk beverage a flavor and texture derived from trehalose. Furthermore, the addition of an amount of trehalose corresponding to more than 0.1% by weight is preferable to

suppress the induction of phase separation and precipitation in the acidic milk beverage as well as to maintain the high redispersibility, all of which contribute to the addition of trehalose.

5 [0037]

The production method for the acidic milk beverage of the present invention is characterized by comprising the steps of adjusting the pH of a milk-containing solution to an acidic value; and homogenizing the milk-containing solution, the
10 milk-containing solution comprising 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.

[0038]

The adjustment of pH to an acidic value in the method for
15 producing the acidic milk beverage of the present invention is not limited in terms of the technique and the method therefor as long as the pH of this milk-containing solution can be decreased to a predetermined value to the extent that an acidic milk beverage having the characteristics of the present
20 invention, that is, a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein, is obtainable. Examples of the
25 method of adjusting the pH of this milk-containing solution to an acidic value include, for example, a method in which a milk-containing solution is fermented by fermenting microbes such as lactic acid bacteria, and a method in which a milk-containing solution is supplemented with an acid.

30 [0039]

The milk-containing solution in the production method for the acidic milk beverage of the present invention refers to a beverage comprising milk and/or a dairy product. Milk as described herein refers to milk from mammalian animals, such
35 as cow milk, sheep milk, goat milk, buffalo milk, domestic sheep milk, camel milk, whale milk, dolphin milk, human milk and the

like, for example. Furthermore, a dairy product as described herein refers to a product from milk. A known liquid raw material such as, for example, defatted milk, partially defatted milk, desalted and defatted milk, desalted milk, milk with
5 adjusted nutrient contents, whey, concentrated milk, defatted concentrated milk, partially defatted concentrated milk, desalted and defatted concentrated milk, condensed milk, cream, permeate derived from a milk raw material and prepared by a known method, a milk protein concentrate prepared by a known
10 method, or the like may be used as the dairy product, while a known processed raw material such as, for example, skim milk, butter, concentrated milk, condensed milk, lactose, whey minerals, or the like may be used as the dairy product. Among them, a milk protein concentrate (MPC), which is a milk raw
15 material comprising an abundance of milk proteins including casein, is preferably used for an acidic milk beverage comprising milk proteins including a high concentration of casein, as in the case of the acidic milk beverage of the present invention.

[0040]

20 Examples the method of adding an acid to a milk-containing solution in the production method for the acidic milk beverage of the present invention include, for example, a method in which an acid solution, such as citric acid, lactic acid, acetic acid, malic acid, fumaric acid, or hydrochloric acid
25 solution, is added to a milk-containing solution under predetermined conditions including conditions under which the milk-containing solution is not coagulated. For example, in cases where a milk-containing solution for the acidic milk beverage of the present invention comprising milk proteins
30 including casein at a concentration of not less than 3% by weight is supplemented with a citric acid solution at a concentration of 5 to 15% by weight to adjust the pH of the milk-containing solution to a pH range from 3 to 6, the citric acid solution at a concentration of 5 to 15% by weight is added
35 portionwise to the milk-containing solution with stirring over a predetermined time period. Specifically, in cases where a

milk-containing solution for the acidic milk beverage of the present invention comprising milk proteins including casein at a concentration of not less than 3% by weight is supplemented with a citric acid solution at a concentration of 5 to 15% by weight to adjust the pH of the milk-containing solution to a pH range from 3 to 6, the time period required for the addition is, for example, from 0.5 to 30 minutes, from 0.6 to 25 minutes, from 0.7 to 20 minutes, from 0.8 to 17 minutes, from 0.9 to 15 minutes, or from 1 to 13 minutes. The addition of an organic acid solution to this milk-containing solution can be coordinated as appropriate according to the stirring conditions, the concentration of the organic acid solution, and the like.

[0041]

The pH of the milk-containing solution adjusted by the addition of an acid in the production method for the acidic milk beverage of the present invention is, for example, from 3 to 6, from 3.1 to 5.8, from 3.2 to 5.6, from 3.3 to 5.4, from 3.4 to 5.2, from 3.5 to 5, from 3.6 to 4.8, from 3.7 to 4.6, or from 3.8 to 4.4. The adjustment of the milk-containing solution to a pH of more than 3 by the addition of an acid in the production method for the acidic milk beverage of the present invention is advantageous to avoid the acidic milk beverage from becoming less quaffable because of its perceived strong acidic taste. Furthermore, the adjustment of the milk-containing solution to a pH of less than 6 by the addition of an acid in the production method for the acidic milk beverage of the present invention is advantageous to avoid the acidic milk beverage from becoming less quaffable as an acidic milk beverage because of its perceived weak acidic taste.

[0042]

The concentration of milk proteins including casein contained in the milk-containing solution in the production method for the acidic milk beverage of the present invention is not particularly limited as long as the acidic milk beverage of the present invention maintains its characteristics, that is, being a less viscous and more quaffable acidic milk beverage, in which

phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein. Casein proteins in milk proteins including casein here are generally stable in the neutral pH range and aggregate each other through acid coagulation in an environment with a pH range below around pH 4.6, the isoelectric point of casein, which leads to the induction of phase separation and precipitation in an acidic milk beverage. On the other hand, as described above, the acidic milk beverage of the present invention has been found to be a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein. As described herein, the concentration of milk proteins including casein contained in the milk-containing solution in the production method for the acidic milk beverage of the present invention is, for example, not less than 3% by weight, not less than 3.2% by weight, not less than 3.4% by weight, not less than 3.6% by weight, not less than 3.8% by weight, not less than 4% by weight, not less than 4.2% by weight, not less than 4.4% by weight, from 3 to 10% by weight, from 3 to 9.5% by weight, from 3 to 9% by weight, from 3 to 8.5% by weight, from 3 to 8% by weight, from 3 to 7.5% by weight, from 3 to 7% by weight, from 3.2 to 10% by weight, from 3.2 to 9.5% by weight, from 3.2 to 9% by weight, from 3.2 to 8.5% by weight, from 3.2 to 8% by weight, from 3.2 to 7.5% by weight, from 3.2 to 7% by weight, from 3.4 to 10% by weight, from 3.4 to 9.5% by weight, from 3.4 to 9% by weight, from 3.4 to 8.5% by weight, from 3.4 to 8% by weight, from 3.4 to 7.5% by weight, from 3.4 to 7% by weight, from 3.6 to 10% by weight, from 3.6 to 9.5% by weight, from 3.6 to 9% by weight, from 3.6 to 8.5% by weight, from 3.6 to 8% by weight, from 3.6 to 7.5% by weight, from 3.6 to 7% by weight, from 3.8 to 10% by weight, from 3.8 to 9.5% by weight, from 3.8 to 9% by weight,

from 3.8 to 8.5% by weight, from 3.8 to 8% by weight, from 3.8 to 7.5% by weight, from 3.8 to 7% by weight, from 4 to 10% by weight, from 4 to 9.5% by weight, from 4 to 9% by weight, from 4 to 8.5% by weight, from 4 to 8% by weight, from 4 to 7.5% by weight, from 4 to 7% by weight, from 4.2 to 10% by weight, from 4.2 to 9.5% by weight, from 4.2 to 9% by weight, from 4.2 to 8.5% by weight, from 4.2 to 8% by weight, from 4.2 to 7.5% by weight, from 4.2 to 7% by weight, from 4.4 to 10% by weight, from 4.4 to 9.5% by weight, from 4.4 to 9% by weight, from 4.4 to 8.5% by weight, from 4.4 to 8% by weight, from 4.4 to 7.5% by weight, or from 4.4 to 7% by weight.

[0043]

The milk-containing solution in the method for producing the acidic milk beverage of the present invention preferably comprises 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 provide those characteristics of a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein.

[0044]

The soybean polysaccharides in the method for producing the acidic milk beverage of the present invention may be those comprising one, two or more of rhamnose, galactose, arabinose, xylose, glucose, and uronic acid derived from soybean and are preferably those derived particularly from cotyledons of soybean. The soybean polysaccharide of the present invention is not particularly limited in terms of molecular weight but is preferably a soybean polysaccharide having a molecular weight as in a polymer, preferably having an average molecular weight of thousands to millions, particularly five thousand to one million. In addition, this average molecular weight of a soybean polysaccharide is a value determined by the intrinsic

viscosity method, in which the determination is based on the measurement of viscosity in 0.1 M NaNO₃ solution using standard pullulan (Showa Denko K. K.) as standards. Such soybean polysaccharides are commercially available and examples of the soybean polysaccharides include, for example, SM-700 (manufactured by San-Ei Gen F.F.I., Inc.), and SM-900 (manufactured by San-Ei Gen F.F.I., Inc.). Soybean polysaccharides have been considered to reduce phase separation and precipitation in an acidic milk beverage based on their side chain structures, which phase separation and precipitation are caused by acid coagulation among casein proteins in the acidic milk beverage.

[0045]

The amount of soybean polysaccharides added to the milk-containing solution in the method for producing the acidic milk beverage of the present invention is preferably, for example, from 0.2 to 1.2% by weight, from 0.25 to 1.15% by weight, from 0.3 to 1.1% by weight, from 0.35 to 1.05% by weight, from 0.4 to 1% by weight, or from 0.4 to 0.9% by weight in cases where the milk-containing solution in the production method for the acidic milk beverage of the present invention comprises 0.1 to 0.5% by weight of HM pectin and 0.01 to 0.1% by weight of fibrous insoluble cellulose. The addition of an amount of soybean polysaccharides corresponding to more than 1.2% by weight to the milk-containing solution in the method for producing the acidic milk beverage of the present invention is not preferable because it causes a flavor unique to soybean to be perceived in the acidic milk beverage of the present invention. Furthermore, the addition of an amount of soybean polysaccharides corresponding to less than 0.2% by weight to the milk-containing solution in the production method for the acidic milk beverage of the present invention is not preferable because it causes unsuccessful suppression of the induction of phase separation and precipitation in the acidic milk beverage of the present invention and additionally the redispersibility to be

reduced.

[0046]

The HM pectin in the production method for the acidic milk beverage of the present invention refers to an acidic polysaccharide present in vegetables and fruits as a cell-wall component and comprising α -D-galacturonic acid as a component of main chain architecture. The galacturonic acid residues constituting a type of pectin are partially methyl-esterified and the degree of esterification classifies that type of pectin into LM pectin or HM pectin. In HM pectin, the degree of esterification is not less than 50%. Such HM pectin is commercially available and examples of the HM pectin include, for example, SM-478 (manufactured by San-Ei Gen F.F.I., Inc.), SM-666 (manufactured by San-Ei Gen F.F.I., Inc.), AYD5110SB (manufactured by Unitec Foods Co., Ltd.) and the like. HM pectin is characterized by carrying a negative charge and is considered to prevent casein proteins from aggregating each other based on the association of HM pectin with casein protein and the repulsion among the associated casein proteins due to the electric charge thereon.

[0047]

The amount of HM pectin added to the milk-containing solution in the production method for the acidic milk beverage of the present invention is, for example, from 0.1 to 0.5% by weight, from 0.1 to 0.45% by weight, from 0.1 to 0.4% by weight, from 0.1 to 0.35% by weight, from 0.1 to 0.3% by weight, from 0.12 to 0.29% by weight, from 0.14 to 0.28% by weight, from 0.16 to 0.27% by weight, from 0.18 to 0.26% by weight, or from 0.2 to 0.25% by weight in cases where the milk-containing solution in the production method for the acidic milk beverage of the present invention comprises 0.2 to 1.2% by weight of soybean polysaccharides and 0.01 to 0.1% by weight of fibrous insoluble cellulose. The addition of an amount of the HM pectin of the present invention corresponding to less than 0.5% by weight is preferable to produce a less viscous and more quaffable acidic milk beverage while comprising milk

proteins including a high concentration of casein. Furthermore, the addition of an amount of HM pectin corresponding to more than 0.1% by weight to the milk-containing solution in the production method for the acidic milk beverage of the present invention is preferable to suppress the induction of phase separation and precipitation in the acidic milk beverage of the present invention and additionally to increase the redispersibility.

[0048]

The milk-containing solution in the production method for the acidic milk beverage of the present invention may be supplemented with other stabilizers such as sodium carboxymethyl cellulose and/or propylene glycol alginate in combination with or instead of soybean polysaccharides and/or HM pectin to provide the characteristics of the present invention, that is, those characteristics of a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein. Other stabilizers such as sodium carboxymethyl cellulose and/or propylene glycol alginate are preferably added to the milk-containing solution in the method for producing the acidic milk beverage of the present invention in combination with or instead of soybean polysaccharides and/or HM pectin particularly in cases where those stabilizers reduce phase separation and precipitation in an acidic milk beverage as well as maintain the high redispersibility at a lower viscosity in the comparison with soybean polysaccharides and/or HM pectin.

[0049]

The milk-containing solution in the production method for the acidic milk beverage of the present invention may be supplemented with sodium carboxymethyl cellulose. Sodium carboxymethyl cellulose refers to those obtained by substitution of a carboxymethyl group for a hydroxy group in glucose residues in cellulose, in which the degree of etherification is

usually from 0.6 to 1.5. Such sodium carboxymethyl cellulose is commercially available and examples of the sodium carboxymethyl cellulose include, for example, 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.), Cellogen F-1220B (manufactured by DKS Co., Ltd.) and the like.

[0050]

The milk-containing solution in the production method for the acidic milk beverage of the present invention may be supplemented with propylene glycol alginate. Propylene glycol alginate refers to a substance obtained by chemical modification of alginate polysaccharides purified from algae such as konbu seaweed, wakame seaweed and the like. Such propylene glycol alginate is commercially available and examples of the propylene glycol alginate include, for example, Duck Loid LF-M (Kikkoman Biochemifa Co.), Duck Loid EF (Kikkoman Biochemifa Co.), Duck Loid PF (Kikkoman Biochemifa Co.), Duck Loid PF-H (Kikkoman Biochemifa Co.) and the like.

[0051]

The amount of sodium carboxymethyl cellulose or propylene glycol alginate added to the milk-containing solution in the production method for the acidic milk beverage of the present invention is not limited as long as the acidic milk beverage of the present invention maintains its characteristics, that is, being a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein. The amount of sodium carboxymethyl cellulose or propylene glycol alginate added to the milk-containing solution in the production method for the acidic milk beverage of the present invention is, for example, from 0.01 to 2% by weight, from 0.01 to 1.5% by weight, from 0.01 to 1.2% by weight, or from 0.01 to 1.0% by weight. The

addition of an amount of sodium carboxymethyl cellulose or propylene glycol alginate corresponding to less than 1% by weight to the milk-containing solution in the production method for the acidic milk beverage of the present invention is
5 preferable to avoid the acidic milk beverage from being no longer less viscous and more quaffable. Furthermore, the addition of an amount of sodium carboxymethyl cellulose or propylene glycol alginate corresponding to more than 0.01% by weight to the milk-containing solution in the production method
10 for the acidic milk beverage of the present invention is preferable to suppress the induction of phase separation and precipitation in the acidic milk beverage as well as to maintain the high redispersibility, all of which contribute to the addition of such a stabilizer.

15 [0052]

The fibrous insoluble cellulose in the production method for the acidic milk beverage of the present invention is a stabilizer, which is contained in an acidic milk beverage to establish a three-dimensional network structure in the acidic
20 milk beverage and thereby successfully increases the dispersibility of insoluble components such as precipitates. The fibrous insoluble cellulose in the production method for the acidic milk beverage of the present invention is not limited in terms of its origin and the like as long as the acidic milk beverage of the present invention maintains its characteristics,
25 that is, being a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein, but fibrous insoluble cellulose of plant origin and/or microbial origin may be used. Fibrous insoluble cellulose of microbial origin refers to those obtained,
30 for example, by separating microbe-produced fermented cellulose from a medium, washing it, purifying it as appropriate, and then processing it into a fibrous form. This fibrous insoluble cellulose is, for example, micro-fibrillated fibrous
35

insoluble cellulose having an average diameter of 0.01 to 0.1 μm (Patent Document 2) or fermented cellulose. The fibrous insoluble cellulose of the present invention is commercially available and examples of the fibrous insoluble cellulose of the present invention include, for example, San Artist PG (manufactured by San-Ei Gen F.F.I., Inc.) and San Artist PN (manufactured by San-Ei Gen F.F.I., Inc.).

[0053]

The amount of the fibrous insoluble cellulose added to the milk-containing solution in the production method for the acidic milk beverage of the present invention is, for example, from 0.01 to 0.1% by weight, from 0.015 to 0.09% by weight, from 0.02 to 0.08% by weight, from 0.025 to 0.085% by weight, from 0.03 to 0.07% by weight, from 0.03 to 0.065% by weight, from 0.03 to 0.06% by weight, from 0.03 to 0.055% by weight, or from 0.03 to 0.05% by weight in cases where the milk-containing solution in the production method for the acidic milk beverage of the present invention comprises 0.2 to 1.2% by weight of soybean polysaccharides and 0.1 to 0.5% by weight of HM pectin. The addition of an amount of the fibrous insoluble cellulose corresponding to not less than 0.1% by weight to the milk-containing solution in the production method for the acidic milk beverage of the present invention is preferable to avoid the acidic milk beverage comprising milk proteins including a high concentration of casein from being no longer less viscous and more quaffable. Furthermore, not less than 0.01% by weight of the fibrous insoluble cellulose in the milk-containing solution in the production method for the acidic milk beverage of the present invention is preferable to suppress the induction of phase separation and precipitation in the acidic milk beverage and additionally to avoid the redispersibility from being reduced.

[0054]

Additional supplementation of trehalose into the milk-containing solution in the production method for the acidic milk beverage of the present invention can enhance the

characteristics of the acidic milk beverage of the present invention, that is, being a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein. Specifically, the characteristics of the acidic milk beverage of the present invention, that is, being a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein, can be enhanced even at a pH above 4 and close to the isoelectric point of casein protein in the acidic milk beverage of the present invention by the additional supplementation of trehalose into the milk-containing solution in the production method for the acidic milk beverage of the present invention. The trehalose of the present invention is likewise commercially available and examples of the trehalose include, for example, TREHA (manufactured by Hayashibara Co., Ltd.).

[0055]

The amount of trehalose added to the milk-containing solution in the production method for the acidic milk beverage of the present invention is, for example, from 0.1 to 5% by weight, from 0.2 to 4.5% by weight, from 0.3 to 4% by weight, from 0.4 to 3.5% by weight, from 0.5 to 3% by weight, from 0.6 to 2.5% by weight, from 0.7 to 2% by weight, from 0.8 to 1.5% by weight, from 0.9 to 1.3% by weight, or from 0.9 to 1.1% by weight in cases where the milk-containing solution in the production method for the acidic milk beverage of the present invention comprises 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. The addition of an amount of trehalose corresponding to less than 5% by weight to the milk-containing solution in the production method for the acidic milk beverage of the present invention is

preferable to avoid giving the acidic milk beverage a flavor and texture derived from trehalose. Furthermore, the addition of an amount of trehalose corresponding to less than 0.1% by weight to the milk-containing solution in the production method for the acidic milk beverage of the present invention is preferable to suppress the induction of phase separation and precipitation in the acidic milk beverage of the present invention as well as to maintain the high redispersibility, all of which contribute to the addition of trehalose.

10 [0056]

In the production method for the acidic milk beverage of the present invention, the milk-containing solution preferably comprises 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 provide the characteristics of the acidic milk beverage of the present invention, that is, those characteristics of a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein. The soybean polysaccharides, HM pectin and fibrous insoluble cellulose comprised in the milk-containing solution in the production method for the acidic milk beverage of the present invention may be added and dissolved together with other raw materials in part or in whole while heated at 50 to 100°C or may be dissolved beforehand in warm water to prepare solutions. The milk-containing solution in the production method for the acidic milk beverage of the present invention can be obtained, for example, by combining an emulsion comprising a milk raw material dissolved in water and a stabilizer solution comprising soybean polysaccharides, HM pectin and fibrous insoluble cellulose dissolved in water.

[0057]

In the production method for the acidic milk beverage of the present invention, the milk-containing solution may be homogenized by mechanical shearing, in addition to the

adjustment of the pH by addition of an acid to the milk-containing solution, to enhance the effects of the present invention. Once the homogenization allows casein protein in the pH-adjusted milk-containing solution to be incorporated in atomized particles and to be associated with 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 already comprised in the solution, a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein, can be obtained. In the homogenization, a generic homogenizer such as those used in the homogenization of fat globules in cow milk and the like and in the liquefaction of fermented milk can be used.

[0058]

In the production method for the acidic milk beverage of the present invention, when the milk-containing solution is homogenized using a homogenizer, in addition to the adjustment of the pH by addition of an acid to the milk-containing solution, to enhance the effects of the present invention, the homogenization pressure is, for example, from 1 to 100 MPa, from 2 to 80 MPa, from 3 to 60 MPa, from 4 to 40 MPa, from 5 to 20 MPa, from 6 to 19 MPa, from 7 to 18 MPa, from 8 to 17 MPa, from 9 to 16 MPa, or from 10 to 15 MPa. Furthermore, the homogenization temperature is, for example, from 50 to 100°C, from 55 to 95°C, from 60 to 90°C, from 65 to 85°C, or from 70 to 80°C. Furthermore, in the production method for the acidic milk beverage of the present invention, the steps of adjusting the pH by adding an acid to the milk-containing solution and of homogenizing the milk-containing solution with use of a homogenizer are carried out in any order, without limitation. That is, in the production method for the acidic milk beverage of the present invention, the milk-containing solution may be supplemented with an acid

for the adjustment of pH and subsequently homogenized using a homogenizer, or the milk-containing solution may be homogenized using a homogenizer and subsequently supplemented with an acid for the adjustment of pH. In addition, the homogenization step in the method for producing the acidic milk beverage of the present invention may be placed before or after heat sterilization as described below to the extent that an acidic milk beverage having the characteristics of the acidic milk beverage of the present invention, that is, being a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein, is obtainable.

15 [0059]

In the production method for the acidic milk beverage of the present invention, heat sterilization may be carried out to increase the storage stability of the acidic milk beverage of the present invention. As a heat sterilization method for the acidic milk beverage of the present invention in the production method for the acidic milk beverage of the present invention, any known sterilization method and sterilization conditions for cow milk and/or beverages can be incorporated. Examples of the sterilization method include, for example, plate pasteurization, tubular pasteurization, batch pasteurization, ohmic heating pasteurization, microwave pasteurization, ultra-pasteurization by indirect heating such as retort heating, and ultra-pasteurization by direct heating such as steam injection and steam infusion. Examples of the sterilization conditions include, for example, heating at 60 to 65°C for 20 to 30 minutes, heating at 80 to 100°C for 15 seconds to 10 minutes, and heating at 110°C to 150°C for 2 to 15 seconds, as in the case of cow milk. The sterilization conditions can be changed as appropriate as long as the changed conditions are comparable to the sterilization conditions described above.

35 [0060]

In the production method for the acidic milk beverage of the present invention, non-thermal sterilization may be carried out to increase the storage stability of the acidic milk beverage of the present invention. As a non-thermal sterilization method for the acidic milk beverage of the present invention in the production method for the acidic milk beverage of the present invention, any known sterilization method and sterilization conditions can be incorporated. Examples of the non-thermal sterilization method include, for example, light activated disinfection, sterilization by irradiation, sterilization by the application of pulses of high voltage, and the like. Examples of the sterilization conditions for the non-thermal sterilization include, for example, heating at 60 to 65°C for 20 to 30 minutes, heating at 80 to 100°C for 15 seconds to 10 minutes, and heating at 110°C to 150°C for 2 to 15 seconds, as in the case of the effects of the pasteurization of cow milk. The sterilization conditions for the non-thermal sterilization can be changed as appropriate as long as the changed conditions are comparable to the sterilization conditions described above.

[0061]

In the production method for the acidic milk beverage of the present invention, an acidic milk beverage may be cooled down to increase the storage stability of the acidic milk beverage of the present invention, which acidic milk beverage is obtained by steps comprising: adjusting the pH of a milk-containing solution to an acidic value; and homogenizing the milk-containing solution, the milk-containing solution comprising 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. Eventually, the temperature of the cooled acidic milk beverage is, for example, from 0 to 30°C, from 0 to 25°C, from 0 to 20°C, from 0 to 15°C, from 0 to 12°C, or from 0 to 10°C.

[0062]

The acidic milk beverage of the present invention may be supplemented with other food raw materials and/or food

additive materials as long as the acidic milk beverage of the present invention maintains its characteristics, that is, being a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein. For example, sweeteners (such as sugars, liquid sugars, fructose, maltose, and soft brown sugar), sugar alcohols (such as erythritol), high-potency sweeteners (stevia, aspartame, sucralose, acesulfame potassium), flavoring agents, fruit juice, vegetable juice, and the like may be added for the purpose of providing palatability to the acidic milk beverage of the present invention. Furthermore, minerals (such as calcium, iron, manganese, magnesium, and zinc), vitamins, functional materials, probiotic lactic acid bacteria, and the like may be added for the purpose of providing functionality to the acidic milk beverage of the present invention.

[0063]

The acidic milk beverage of the present invention may be provided in the form of a bottled or packaged drink for the commercial purpose. Any known containers may be used, such as paper cartons (such as gable top carton and brick shape carton), beverage bag, PET bottle, can, and glass bottle. The capacity of the container is not particularly limited but is, for example, from 10 to 5000 g, from 20 to 4000 g, from 30 to 3000 g, from 40 to 2000 g, from 50 to 1500 g, from 60 to 1400 g, from 70 to 1300 g, from 80 to 1200 g, or from 90 to 1100 g. Among them, the capacity suitable for a family (for multiple drinks) is, for example, from 300 to 5000 g, from 300 to 4000 g, from 300 to 3000 g, from 300 to 2000 g, from 300 to 1500 g, from 300 to 1400 g, from 300 to 1300 g, from 300 to 1200 g, or from 300 to 1100 g, and the capacity suitable for an individual (for single drink) is from 10 to 300 g, from 20 to 300 g, from 30 to 300 g, from 40 to 300 g, from 50 to 300 g, from 60 to 300 g, from 70 to 300 g, from 80 to 300 g, or from 90 to 300 g.

[0064]

The acidic milk beverage of the present invention is marketed by any distribution measures, without limitation, as long as the acidic milk beverage of the present invention maintains its characteristics, that is, being a less viscous and more quaffable acidic milk beverage, in which phase separation and precipitation have been reduced as well as the high redispersibility is maintained while the acidic milk beverage comprises milk proteins including a high concentration of casein, and examples of the distribution measure include, for example, chilled distribution, in which the temperature is kept at a temperature of not higher than 10°C, and ambient distribution. Chilled distribution, in which the temperature is kept at a temperature of not higher than 10°C, is preferable in consideration of the reduction of phase separation and precipitation in an acidic milk beverage.

[0065]

The acidic milk beverage of the present invention may also be used as a nutritional food providing a promotive effect on the absorption of proteins including casein for the purpose of the efficient ingestion of milk proteins including casein. Here, examples of the nutritional food include, for example, functional foods, supplements, and the like. For example, in cases where 100 g of the acidic milk beverage of the present invention is marketed as a bottled nutritional food, the nutritional food may be produced to enable ingestion of, for example, not less than 3 g, not less than 3.2 g, not less than 3.4 g, not less than 3.6 g, not less than 3.8 g, not less than 4 g, not less than 4.2 g, not less than 4.4 g, not less than 3 to 10 g, 3 to 9.5 g, 3 to 9 g, 3 to 8.5 g, 3 to 8 g, 3 to 7.5 g, 3 to 7 g, 3.2 to 10 g, 3.2 to 9.5 g, 3.2 to 9 g, 3.2 to 8.5 g, 3.2 to 8 g, 3.2 to 7.5 g, 3.2 to 7 g, 3.4 to 10 g, 3.4 to 9.5 g, 3.4 to 9 g, 3.4 to 8.5 g, 3.4 to 8 g, 3.4 to 7.5 g, 3.4 to 7 g, 3.6 to 10 g, 3.6 to 9.5 g, 3.6 to 9 g, 3.6 to 8.5 g, 3.6 to 8 g, 3.6 to 7.5 g, 3.6 to 7 g, 3.8 to 10 g, 3.8 to 9.5 g, 3.8 to 9 g, 3.8 to 8.5 g, 3.8 to 8 g, 3.8 to 7.5 g, 3.8 to 7 g, 4 to 10 g, 4 to 9.5 g, 4 to 9 g, 4 to 8.5 g, 4 to 8 g, 4 to 7.5

g, 4 to 7 g, 4.2 to 10 g, 4.2 to 9.5 g, 4.2 to 9 g, 4.2 to 8.5 g, 4.2 to 8 g, 4.2 to 7.5 g, 4.2 to 7 g, 4.4 to 10 g, 4.4 to 9.5 g, 4.4 to 9 g, 4.4 to 8.5 g, 4.4 to 8 g, 4.4 to 7.5 g, or 4.4 to 7 g of milk proteins including casein per one bottle.

5 [0066]

The inventors found that milk proteins in the acidic milk beverage of the present invention are not aggregated (curdled) in the stomach after ingestion as compared with cow milk and defatted milk, so that the absorbability of the milk proteins in the intestinal tract was increased at a later time. Based on this, the potency as an absorption promoter for milk proteins including casein can also be expected, wherein the absorption promoter comprises as an active ingredient an acidic milk beverage of the present invention, that is, an acidic milk beverage characterized by comprising 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. This absorption promoter for milk proteins including casein is likewise applicable for pharmaceutical applications and can be applied in all the known pharmaceutical dosage forms.

[0067]

Thus, according to one aspect of the present invention, a method for promoting absorption of milk proteins is provided, which method comprises simultaneous or sequential introduction of milk proteins, 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 a subject in need thereof. Furthermore, in the above method, the subject is preferably human. The relevant subject may be a healthy subject or a patient but a healthy subject is preferable. Furthermore, in cases where the subject is a healthy subject, the above method is a non-therapeutic method.

[0068]

Furthermore, according to another aspect of the present invention, the combination use of 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 the production of a milk protein-absorption promoter is provided. Furthermore, according to still another aspect of the present invention, the combination use of 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 as a milk protein-absorption promoter is provided.

EXAMPLES

[0069]

10 The present invention will be described in more detail below with reference to examples, but the invention is not limited thereto. In addition, the measurement techniques and the units in the present invention follow the specifications of the Japanese Industrial Standards (JIS), unless otherwise indicated.

15 [Example 1]

 To produce Solution A, 5.65 kg of a milk protein concentrate (milk proteins, 80% by weight; lactose, 6.5% by weight) was dissolved in 39.35 kg of water while heated. To produce Solution B, 0.45 kg of soybean polysaccharides (SM-900; manufactured by San-Ei Gen F.F.I., Inc.), 0.2 kg of HM pectin (AYD5110SB; manufactured by Unitec Foods Co., Ltd.), 0.03 kg of fermented cellulose (San Artist PG; manufactured by San-Ei Gen F.F.I., Inc.), 4.5 kg of sugar and 0.0053 kg of sucralose were dissolved in 39.81 kg of water while heated. To produce Solution C, 1.15 kg of citric acid was dissolved in 8.85 kg of water. After the admixture of Solutions A and B, Solution C was added in ten portions to this mixture with stirring over five minutes to produce a base mixture, followed by sterilization. With a plate pasteurizer, this base mixture was homogenized at 15 MPa (at 70 to 80°C) and then sterilized at 130°C for two seconds and subsequently cooled down to a temperature of not higher than 10°C to produce Example 1 (milk proteins, 4.5% by weight; soybean polysaccharides, 0.45% by weight; HM pectin, 0.2% by weight; fermented cellulose, 0.03% by weight). Example 1 had a pH of 3.8 and a viscosity of 15 mPa·s (at 10°C).

[0070]

[Example 2]

To produce Solution A, 5.65 kg of a milk protein concentrate (milk proteins, 80% by weight; lactose, 6.5% by weight) was dissolved in 39.35 kg of water while heated. To produce Solution B, 0.45 kg of soybean polysaccharides (SM-900; manufactured by San-Ei Gen F.F.I., Inc.), 0.2 kg of HM pectin (AYD5110SB; manufactured by Unitec Foods Co., Ltd.), 0.05 kg of fermented cellulose (San Artist PG; manufactured by San-Ei Gen F.F.I., Inc.), 4.5 kg of sugar and 0.0053 kg of sucralose were dissolved in 39.79 kg of water while heated. To produce Solution C, 1.15 kg of citric acid was dissolved in 8.85 kg of water. After the admixture of Solutions A and B, Solution C was added in ten portions to this mixture with stirring over five minutes to produce a base mixture, followed by sterilization. With a plate pasteurizer, this base mixture was homogenized at 15 MPa (at 70 to 80°C) and then sterilized at 130°C for two seconds and subsequently cooled down to a temperature of not higher than 10°C to produce Example 2 (milk proteins, 4.5% by weight; soybean polysaccharides, 0.45% by weight; HM pectin, 0.2% by weight; fermented cellulose, 0.05% by weight). Example 2 had a pH of 3.8 and a viscosity of 15 mPa·s (at 10°C).

[0071]

[Comparative Example 1]

To produce Solution A, 5.65 kg of a milk protein concentrate (milk proteins, 80% by weight; lactose, 6.5% by weight) was dissolved in 39.35 kg of water while heated. To produce Solution B, 0.45 kg of soybean polysaccharides (SM-900; manufactured by San-Ei Gen F.F.I., Inc.), 0.2 kg of HM pectin (AYD5110SB; manufactured by Unitec Foods Co., Ltd.), 0 kg of fermented cellulose (San Artist PG; manufactured by San-Ei Gen F.F.I., Inc.), 4.5 kg of sugar and 0.0053 kg of sucralose were dissolved in 39.84 kg of water while heated. To produce Solution C, 1.15 kg of citric acid was dissolved in 8.85 kg of water. After the admixture of Solutions A and B, Solution

C was added in ten portions to this mixture with stirring over five minutes to produce a base mixture, followed by sterilization. With a plate pasteurizer, this base mixture was homogenized at 15 MPa (at 70 to 80°C) and then sterilized at 130°C for two seconds and subsequently cooled down to a temperature of not higher than 10°C to produce Comparative Example 1 (milk proteins, 4.5% by weight; soybean polysaccharides, 0.45% by weight; HM pectin, 0.2% by weight; fermented cellulose, 0% by weight). Comparative Example 1 had a pH of 3.8 and a viscosity of 15 mPa·s (at 10°C).

[0072]

Examples 1 to 2 and Comparative Example 1 were evaluated. The evaluation items were "blandness," "precipitates (by visual inspection)" and "redispersibility (by visual inspection)". "Blandness" and "redispersibility (by visual inspection)" were evaluated in five-grade systems, in each of which a score of 5, 4, 3, 2, or 1 was awarded and a score of not less than 4 was regarded as acceptable (Table 1). For example, as for blandness, scores of 5 and 4 correspond to smooth and somewhat smooth blandness, respectively. Examples 1 and 2 were excellent in terms of all of the evaluation items "blandness," "precipitates" and "redispersibility". On the other hand, Comparative Example 1 was inferior in "redispersibility".

[0073]

[Table 1]

	Fermented Cellulose (% by weight)	Sensory Evaluation		
		Blandness	Precipitates	Redispersibility
Example 1	0.03	5	tiny amount	4
Example 2	0.05	5	tiny amount	5
Comparative Example 1	0	5	tiny amount	3

[0074]

In addition, acidic milk beverages were produced similarly to Comparative Example 1, except that the final

concentration of the fermented cellulose was adjusted to 0.1% by weight or more, and the evaluation as seen in Table 1 was supplementarily carried out. Consequently, in the acidic milk beverages comprising 0.1% by weight or more of fermented cellulose, a downward trend was observed in terms of "redispersibility" and "blandness" compared with Examples 1 and 2. A particularly strong downward trend was observed in terms of "blandness".

[0075]

The above results indicated that an acidic milk beverage would be excellent in terms of all the evaluation items "blandness," "precipitates" and "redispersibility" as long as the fermented cellulose is added in an amount corresponding to 0.01 to 0.1% by weight.

[0076]

[Example 3]

To produce Solution A, 5.65 kg of a milk protein concentrate (milk proteins, 80% by weight; lactose, 6.5% by weight) was dissolved in 39.35 kg of water while heated. To produce Solution B, 0.55 kg of soybean polysaccharides (SM-900; manufactured by San-Ei Gen F.F.I., Inc.), 0.2 kg of HM pectin (AYD5110SB; manufactured by Unitec Foods Co., Ltd.), 0.05 kg of fermented cellulose (San Artist PG; manufactured by San-Ei Gen F.F.I., Inc.), 4.5 kg of sugar and 0.0053 kg of sucralose were dissolved in 39.69 kg of water while heated. To produce Solution C, 1.15 kg of citric acid was dissolved in 8.85 kg of water. After the admixture of Solutions A and B, Solution C was added in ten portions to this mixture with stirring over five minutes to produce a base mixture, followed by sterilization. With a plate pasteurizer, this base mixture was homogenized at 15 MPa (at 70 to 80°C) and then sterilized at 130°C for two seconds and subsequently cooled down to a temperature of not higher than 10°C to produce Example 3 (milk proteins, 4.5% by weight; soybean polysaccharides, 0.55% by weight; HM pectin, 0.2% by weight; fermented cellulose, 0.05% by weight). Example 3 had a pH of 3.8 and a

viscosity of 15 mPa·s (at 10°C). This example was excellent in terms of all the evaluation items "blandness," "precipitates" and "redispersibility".

[0077]

5 [Comparative Example 2]

To produce Solution A, 5.65 kg of a milk protein concentrate (milk proteins, 80% by weight; lactose, 6.5% by weight) was dissolved in 39.35 kg of water while heated. To produce Solution B, 0.60 kg of soybean polysaccharides
10 (SM-900; manufactured by San-Ei Gen F.F.I., Inc.), 0 kg of HM pectin (AYD5110SB; manufactured by Unitec Foods Co., Ltd.), 0.05 kg of fermented cellulose (San Artist PG; manufactured by San-Ei Gen F.F.I., Inc.), 4.5 kg of sugar and 0.0053 kg of sucralose were dissolved in 39.84 kg of water while heated. To
15 produce Solution C, 1.15 kg of citric acid was dissolved in 8.85 kg of water. After the admixture of Solutions A and B, Solution C was added in ten portions to this mixture with stirring over five minutes to produce a base mixture, followed by sterilization. With a plate pasteurizer, this base mixture was
20 homogenized at 15 MPa (at 70 to 80°C) and then sterilized at 130°C for two seconds and subsequently cooled down to a temperature of not higher than 10°C to produce Comparative Example 2 (milk proteins, 4.5% by weight; soybean polysaccharides, 0.6% by weight; HM pectin, 0% by weight;
25 fermented cellulose, 0.05% by weight). Comparative Example 2 had a pH of 3.8 and a viscosity of 5 mPa·s (at 10°C). "Precipitates" were attached to the bottom of a container and additionally "redispersibility" was poor.

[0078]

30 [Example 4]

To produce Solution A, 5.65 kg of a milk protein concentrate (milk proteins, 80% by weight; lactose, 6.5% by weight) was dissolved in 39.35 kg of water while heated. To produce Solution B, 0.3 kg of soybean polysaccharides (SM-900;
35 manufactured by San-Ei Gen F.F.I., Inc.), 0.4 kg of HM pectin (AYD5110SB; 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, 4.5 kg of sugar and 0.0053 kg of sucralose were dissolved in 38.74 kg of water while heated. To produce Solution C, 0.9 kg of citric acid was dissolved in 9.1 kg of water. After the admixture of Solutions A and B, Solution C was added in ten portions to this mixture with stirring over five minutes to produce a base mixture, followed by sterilization. With a plate pasteurizer, this base mixture was homogenized at 15 MPa (at 70 to 80°C) and then sterilized at 130°C for two seconds and subsequently cooled down to a temperature of not higher than 10°C to produce Example 5 (milk proteins, 4.5% by weight; soybean polysaccharides, 0.3% by weight; HM pectin, 0.4% by weight; fermented cellulose, 0.05% by weight; trehalose, 1% by weight). Example 4 had a pH of 4.0 and a viscosity of 17 mPa·s (at 10°C). This example was excellent in terms of all the evaluation items "blandness," "precipitates" and "redispersibility".

[0079]

[Example 5]

To produce Solution A, 7.5 kg of a milk protein concentrate (milk proteins, 80% by weight; lactose, 6.5% by weight) was dissolved in 37.5 kg of water while heated. To produce Solution B, 0.7 kg of soybean polysaccharides (SM-900; manufactured by San-Ei Gen F.F.I., Inc.), 0.15 kg of HM pectin (AYD5110SB; 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, 4.5 kg of sugar and 0.0053 kg of sucralose were dissolved in 38.64 kg of water while heated. To produce Solution C, 0.9 kg of citric acid was dissolved in 9.1 kg of water. After the admixture of Solutions A and B, Solution C was added in ten portions to this mixture with stirring over five minutes to produce a base mixture, followed by sterilization. With a plate pasteurizer, this base mixture was homogenized at 15 MPa (at 70 to 80°C) and then sterilized at 130°C for two seconds and subsequently cooled down to a temperature of not higher than 10°C to produce Example 5

(milk proteins, 6% by weight; soybean polysaccharides, 0.7% by weight; HM pectin, 0.15% by weight; fermented cellulose, 0.05% by weight; trehalose, 1% by weight). Example 5 had a pH of 4.0 and a viscosity of 10 mPa·s (at 10°C). This example was excellent in terms of all the evaluation items "blandness," "precipitates" and "redispersibility".

[0080]

[Example 6]

To produce Solution A, 7.5 kg of a milk protein concentrate (milk proteins, 80% by weight; lactose, 6.5% by weight) was dissolved in 37.5 kg of water while heated. To produce Solution B, 0.9 kg of soybean polysaccharides (SM-900; manufactured by San-Ei Gen F.F.I., Inc.), 0.25 kg of HM pectin (AYD5110SB; 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, 4.5 kg of sugar and 0.0053 kg of sucralose were dissolved in 38.64 kg of water while heated. To produce Solution C, 0.9 kg of citric acid was dissolved in 9.1 kg of water. After the admixture of Solutions A and B, Solution C was added in ten portions to this mixture with stirring over five minutes to produce a base mixture, followed by sterilization. With a plate pasteurizer, this base mixture was homogenized at 15 MPa (at 70 to 80°C) and then sterilized at 130°C for two seconds and subsequently cooled down to a temperature of not higher than 10°C to produce Example 6 (milk proteins, 6% by weight; soybean polysaccharides, 0.9% by weight; HM pectin, 0.25% by weight; fermented cellulose, 0.05% by weight; trehalose, 1% by weight). Example 6 had a pH of 4.0 and a viscosity of 16 mPa·s (at 10°C). This example was excellent in terms of all the evaluation items "blandness," "precipitates" and "redispersibility".

[0081]

[Example 7]

To produce Solution A, 8.75 kg of a milk protein concentrate (milk proteins, 80% by weight; lactose, 6.5% by weight) was dissolved in 36.25 kg of water while heated. To

produce Solution B, 0.7 kg of soybean polysaccharides (SM-900; manufactured by San-Ei Gen F.F.I., Inc.), 0.2 kg of HM pectin (AYD5110SB; 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, 4.5 kg of sugar and 0.0053 kg of sucralose were dissolved in 38.54 kg of water while heated. To produce Solution C, 0.63 kg of citric acid was dissolved in 9.37 kg of water. After the admixture of Solutions A and B, Solution C was added in ten portions to this mixture with stirring over five minutes to produce a base mixture, followed by sterilization. With a plate pasteurizer, this base mixture was homogenized at 15 MPa (at 70 to 80°C) and then sterilized at 130°C for two seconds and subsequently cooled down to a temperature of not higher than 10°C to produce Example 7 (milk proteins, 7% by weight; soybean polysaccharides, 0.7% by weight; HM pectin, 0.2% by weight; fermented cellulose, 0.05% by weight; trehalose, 1% by weight). Example 7 had a pH of 4.0 and a viscosity of 16 mPa·s (at 10°C). This example was excellent in terms of all the evaluation items "blandness," "precipitates" and "redispersibility".

[0082]

[Example 8]

To produce Solution A, 8.75 kg of a milk protein concentrate (milk proteins, 80% by weight; lactose, 6.5% by weight) was dissolved in 36.25 kg of water while heated. To produce Solution B, 0.9 kg of soybean polysaccharides (SM-900; manufactured by San-Ei Gen F.F.I., Inc.), 0.25 kg of HM pectin (AYD5110SB; 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, 4.5 kg of sugar and 0.0053 kg of sucralose were dissolved in 38.29 kg of water while heated. To produce Solution C, 0.63 kg of citric acid was dissolved in 9.37 kg of water. After the admixture of Solutions A and B, Solution C was added in ten portions to this mixture with stirring over five minutes to produce a base mixture,

followed by sterilization. With a plate pasteurizer, this base mixture was homogenized at 15 MPa (at 70 to 80°C) and then sterilized at 130°C for two seconds and subsequently cooled down to a temperature of not higher than 10°C to produce

5 Example 8 (milk proteins, 7% by weight; soybean polysaccharides, 0.9% by weight; HM pectin, 0.25% by weight; fermented cellulose, 0.05% by weight; trehalose, 1% by weight). Example 8 had a pH of 4.1 and a viscosity of 23 mPa·s (at 10°C). This example was excellent in terms of all the

10 evaluation items "blandness," "precipitates" and "redispersibility".

[0083]

[Example 9]

To produce Solution A, 9.375 kg of a milk protein

15 concentrate (milk proteins, 80% by weight; lactose, 6.5% by weight) was dissolved in 35.625 kg of water while heated. To produce Solution B, 0.7 kg of soybean polysaccharides (SM-900; manufactured by San-Ei Gen F.F.I., Inc.), 0.2 kg of HM pectin (AYD5110SB; manufactured by Unitec Foods Co., Ltd.), 0.05 kg

20 of fermented cellulose (San Artist PG; manufactured by San-Ei Gen F.F.I., Inc.), 1 kg of trehalose and 0.0063 kg of sucralose were dissolved in 43.04 kg of water while heated. To produce Solution C, 0.63 kg of citric acid was dissolved in 9.37 kg of water. After the admixture of Solutions A and B, Solution C

25 was added in ten portions to this mixture with stirring over five minutes to produce a base mixture, followed by sterilization. With a plate pasteurizer, this base mixture was homogenized at 15 MPa (at 70 to 80°C) and then sterilized at 130°C for two seconds and subsequently cooled down to a temperature of not

30 higher than 10°C to produce Example 9 (milk proteins, 7.5% by weight; soybean polysaccharides, 0.7% by weight; HM pectin, 0.2% by weight; fermented cellulose, 0.05% by weight; trehalose, 1% by weight). Example 9 had a pH of 4.0 and a viscosity of 16 mPa·s (at 10°C). This example was excellent in

35 terms of all the evaluation items "blandness," "precipitates" and "redispersibility".

[0084]

[Example 10]

To produce Solution A, 9.375 kg of a milk protein concentrate (milk proteins, 80% by weight; lactose, 6.5% by weight) was dissolved in 35.625 kg of water while heated. To produce Solution B, 0.9 kg of soybean polysaccharides (SM-900; manufactured by San-Ei Gen F.F.I., Inc.), 0.2 kg of HM pectin (AYD5110SB; 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 and 0.0063 kg of sucralose were dissolved in 42.84 kg of water while heated. To produce Solution C, 0.63 kg of citric acid was dissolved in 9.37 kg of water. After the admixture of Solutions A and B, Solution C was added in ten portions to this mixture with stirring over five minutes to produce a base mixture, followed by sterilization. With a plate pasteurizer, this base mixture was homogenized at 15 MPa (at 70 to 80°C) and then sterilized at 130°C for two seconds and subsequently cooled down to a temperature of not higher than 10°C to produce Example 10 (milk proteins, 7.5% by weight; soybean polysaccharides, 0.9% by weight; HM pectin, 0.2% by weight; fermented cellulose, 0.05% by weight; trehalose, 1% by weight). Example 11 had a pH of 4.0 and a viscosity of 19 mPa·s (at 10°C). This example was excellent in terms of all the evaluation items "blandness," "precipitates" and "redispersibility".

[0085]

[Example 11]

To produce Solution A, 4.25 kg of a milk protein concentrate (milk proteins, 80% by weight; lactose, 6.5% by weight) was dissolved in 40.75 kg of water while heated. To produce Solution B, 0.45 kg of soybean polysaccharides (SM-900; manufactured by San-Ei Gen F.F.I., Inc.), 0.2 kg of HM pectin (AYD5110SB; 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

while heated. To produce Solution C, 0.64 kg of citric acid was dissolved in 9.36 kg of water. After the admixture of Solutions A and B, Solution C was added in ten portions to this mixture with stirring over five minutes to produce a base mixture, followed by sterilization. With a plate pasteurizer, this base mixture was homogenized at 15 MPa (at 70 to 80°C) and then sterilized at 130°C for two seconds and subsequently cooled down to a temperature of not higher than 10°C to produce Example 11 (milk proteins, 3.4% by weight; soybean polysaccharides, 0.45% by weight; HM pectin, 0.2% by weight; fermented cellulose, 0.05% by weight; trehalose, 1% by weight). Example 11 had a pH of 4.1 and a viscosity of 10 mPa·s (at 10°C). This example was excellent in terms of all the evaluation items "blandness," "precipitates" and "redispersibility".

[0086]

[Test Example 1]

Fourteen 8-week-old male S-D rats (bred by CLEA Japan) were used as experimental animals. All the experimental animals were preliminarily housed individually in stainless-steel cages in a light-dark cycle consisting of a light period from 7:00 to 19:00 and a dark period from 19:00 to 7:00 under conditions of room temperature around $22\pm 2^{\circ}\text{C}$.

After the end of 5 days of the preliminary housing, a catheter was placed into the portal vein in all the experimental animals. One day after the placement of a catheter into the portal vein, all the experimental animals were fasted for 16 hours and then these experimental animals were assigned to three groups: the acidic milk group (energy, 32 kcal/100 g; proteins, 3.4 g/100 g; citric acid, 640 mg/100 g), the cow milk group (energy, 67 kcal/100 g; proteins, 3.3 g/100 g; fats, 3.8 g/100 g) and the defatted milk group (energy, 33 kcal/100 g; proteins, 3.4 g/100 g), such that the mean body weight was comparable among those groups (acidic milk and cow milk groups, $n = 5$; defatted milk group, $n = 4$). Example 11 was used for the acidic milk group. A single oral administration of

each test solution was carried out at a dose of 10 mL/kg BW in each experimental animal of each group. Before the single oral administration, and 30, 60, 90, 120 and 240 minutes after the single oral administration, 200 μ L of blood was sampled from the portal vein catheter and placed into tubes for serum separation to obtain serum. Subsequent to the end of blood sampling at 240 minutes after the single oral administration, all the experimental animals were euthanized by excess anesthesia.

- 10 The concentration of amino acids in the blood from the portal vein was measured using a LC/MS machine. For each bleeding time, a one-way analysis of variance was carried out, followed by a Tukey's multiple-comparison test.

The time-dependent change of the total amino acid (TAA) concentration in the portal vein blood is shown in Figure 1. The TAA concentration in the portal vein blood at 30 minutes after the administration in the acidic milk group showed a significantly higher value than those in the cow milk and the defatted milk groups. It was indicated that the acidic milk group showed a faster protein-absorption rate than those of the cow milk and the defatted milk groups.

[0087]

[Test Example 2]

- 25 An artificial gastric fluid (the content of pepsin, 0.6%; pH 1.2) and Example 11 were mixed in a ratio by weight of 1:1.6 = (artificial gastric fluid):(Example 11) and incubated at 37°C for 10 minutes. At this time, in the sample of Example 11 mixed with the artificial gastric fluid, the milk proteins derived from Example 11 were not aggregated. As a control, a similar test was carried out except for using defatted milk instead of Example 11. An artificial gastric fluid (the content of pepsin, 0.6%; pH 1.2) and defatted milk were mixed in a ratio by weight of 1:1.6 = (artificial gastric fluid):(defatted milk) and incubated at 37°C for 10 minutes. At this time, in the sample of defatted milk mixed with the artificial gastric fluid, the milk proteins derived from the defatted milk were aggregated.
- 30
- 35

[0088]

Test Examples 1 to 2 suggested that milk proteins in the acidic milk beverage of the present invention were not aggregated (curdled) in the stomach after ingestion
5 (administration) as compared with cow milk and defatted milk, so that the absorbability of the milk proteins was increased in the intestinal tract at a later time.

[0089]

The acidic milk beverage of the present invention is less
10 viscous and more quaffable, in which phase separation and precipitation have been reduced while the acidic milk beverage comprises milk proteins including a high concentration of casein, and can also enable efficient ingestion of milk proteins including
15 a high concentration of casein with the aid of a fresh flavor from the acidic milk beverage. Furthermore, it was found that milk proteins in the acidic milk beverage of the present invention were not aggregated (curdled) in the stomach after ingestion as compared with cow milk and defatted milk, so that the absorbability of the milk proteins in the intestinal tract was
20 increased at a later time.

CLAIMS

1. An acidic milk beverage comprising 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.
5
2. The acidic milk beverage according to claim 1, further comprising 0.5 to 5% by weight of trehalose.
10
3. The acidic milk beverage according to claim 1 or 2, comprising milk proteins, the milk proteins comprising casein at a concentration of not less than 3% by weight.
- 15 4. The acidic milk beverage according to any one of claims 1 to 3, wherein the pH of the acidic milk beverage is from 3 to 5.
5. The acidic milk beverage according to any one of claims 1 to 4, wherein the viscosity of the acidic milk beverage (at 10°C) is from 3 to 30 mPa·s.
20
6. The acidic milk beverage according to any one of claims 1 to 5, wherein the fibrous insoluble cellulose is fermented cellulose.
25
7. A method for producing an acidic milk beverage, comprising the steps of adjusting the pH of a milk-containing solution to an acidic value; and homogenizing the milk-containing solution, the milk-containing solution comprising
30 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.
8. A method for producing the acidic milk beverage, wherein
35 comprising making 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 comprised in the milk-containing solution.

5 9. The method for producing the acidic milk beverage according to claim 7 or 8, further comprising making 0.5 to 5% by weight of trehalose comprised in the milk-containing solution.

10 10. The method for producing the acidic milk beverage according to any one of claims 7 to 9, wherein the acidic milk beverage comprises milk proteins, the milk proteins comprising casein at a concentration of not less than 3% by weight.

15 11. The method for producing the acidic milk beverage according to any one of claims 7 to 10, comprising adjusting the pH of the acidic milk beverage to an acidic value of from pH 3 to 5.

20 12. The method for producing the acidic milk beverage according to any one of claims 7 to 11, further comprising heat sterilization.

25 13. The method for producing the acidic milk beverage according to any one of claims 7 to 12, wherein the pH is adjusted to the acidic value without curdling the milk-containing solution.

30 14. The method for producing the acidic milk beverage according to any one of claims 7 to 12, wherein the viscosity of the acidic milk beverage (at 10°C) is from 3 to 30 mPa·s.

35 15. An absorption promoter for milk proteins including casein, comprising as an active ingredient the acidic milk beverage according to any one of claims 1 to 6.

16. A method for promoting absorption of milk proteins, the

method comprising simultaneous or sequential introduction of milk proteins, 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 a subject in
5 need thereof.

17. Use of the combination of 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 the
10 production of a milk protein-absorption promoter.

18. Use of the combination of 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 as a
15 milk protein-absorption promoter.