

SPECIFICATION

Title of Invention

LIQUID NUTRITIONAL COMPOSITION CONTAINING L-ARGININE, AND
MANUFACTURING METHOD THEREFOR

Technical Field

[0001]

The present invention relates to a liquid nutritional composition containing L-arginine, and a manufacturing method therefor.

Background Art

[0002]

Recently, arginine has attracted attention as an amino acid which should be supplied against inflammatory diseases, infectious diseases and renal dysfunction. Arginine performs critically important physiological function, and for children, it is regarded as an essential amino acid. For example, arginine is used, in a urea cycle (ornithine cycle) converting ammonia produced in a body into urea, for synthesizing a polyamine essential for cell proliferation and tissue repair. In addition, this is involved in various functions such as promotion of growth hormone secretion, improvement of immune functions and promotion of fat metabolism through a metabolite, nitric oxide (NO). Furthermore, an infusion solution which comprises arginine as a major ingredient supports postoperative recovery and is used for decreasing an incidence of infectious complications. In addition to them, it is suggested that the arginine is effective for symptomatic improvement in angina pectoris, peripheral vascular disease, interstitial cystitis, or the like.

[0003]

In this situation, various nutritional compositions and nonessential grocery items containing L-arginine have been proposed. For example, Patent Document 1 (Japanese Unexamined Patent Application Publication No. 2007-515417) discloses a nutritional composition in which 1.8% or less of total calories of the composition is derived from arginine, and a protein source comprises proline accounting for 3% or more of total calories of the composition. This composition comprises an appropriate amount of arginine for healing a wound. In addition, Patent Document 2 (Japanese Patent Publication No. 2002-186425) discloses a coffee beverage which contains a coffee content, arginine and a milk content. The coffee beverage is a beverage in which a precipitation resulting from appertization is prevented by adding a basic substance such as arginine. Patent Document 3 (Japanese Patent Publication No. 2005-137266) discloses a coffee beverage which contains L-histidine hydrochloride and L-arginine hydrochloride. In the coffee beverage, unpleasant taste and flavor sensations in the coffee beverage with milk are suppressed by synergistic effects between L-arginine hydrochloride and L-arginine hydrochloride. Furthermore, Patent Document 4 (Japanese Patent Publication No. 1998-139681) discloses an oral aqueous emulsified nutritional composition which comprises L-arginine and a wheat gluten degradation product containing glutamine-containing peptide. The composition is a composition in which considerable bitterness caused by adding L-arginine and glutamine, coloring caused by appertization and the like are improved by using the glutamine-containing peptide.

Prior Art

Patent Documents

[0004]

Patent Document 1: Japanese Unexamined Patent Application Publication No. 2007-515417

Patent Document 2: Japanese Patent Publication No. 2002-186425

Patent Document 3: Japanese Patent Publication No. 2005-137266

Patent Document 4: Japanese Patent Publication No. 1998-139681

Summary of Invention

Technical Problem

[0005]

By the way, L-arginine has unique bitterness as mentioned in Patent Document 4. When a carbohydrate is compounded in order to improve this bitterness, there is a problem that heating treatment for sterilization causes a reaction with aminocarbonyl, resulting in considerable coloring of the product.

[0006]

In addition, since milk protein has a favorable balance of amino acids and contains minerals such as calcium, it can be a good-quality protein source. However, L-arginine is a basic amino acid, hence, when it is added to a beverage containing the milk protein, a large amount of acidic pH adjuster is required for reducing bitterness and preventing precipitation of the milk protein. However, in some cases, burnt deposit was caused and a product's value was lost when an arginine and an acidic pH adjuster such as citric acid were heated with a beverage containing a milk protein. In addition, washing of the device was troublesome for removing the burnt deposit remaining in a flow passage of a sterilizer. For these reasons, in some cases, a high concentration of arginine could not be added depending on formulations of the composition.

[0007]

The present invention was made in light of the above-mentioned background art, and the object of the present invention is to provide a nutritional composition which allows more arginine to be added into a liquid nutritional composition containing arginine and protein, particularly, milk protein, while reducing bitterness and burnt

deposit due to heating treatment.

Solution to Problem

[0008]

In order to solve the problems, burnt deposit due to heating treatment and bitterness are reduced by using a non-micellizing protein and an insoluble calcium for keeping its flavor preferable in the present invention.

[0009]

In other words, the liquid nutritional composition of the present invention comprises arginine and the non-micellizing protein, wherein pH is 6.0 to 7.3, heating treatment was made, and the burnt deposit is prevented by adding the insoluble calcium, and its flavor is preferable.

[0010]

The method of the present invention is a method for manufacturing the liquid nutritional composition containing arginine, wherein the burnt deposit is not caused and the flavor is preferable by heating a fluid composition which comprises the non-micellizing protein, the insoluble calcium compound, arginine, an acidic pH adjuster and water, and pH is 6.0 to 7.3.

Advantageous Effects of Invention

[0011]

According to the present invention, the liquid composition in which bitterness due to arginine and burnt deposit due to heating treatment are reduced is provided. Also, a liquid composition comprising more arginine compared to a case using a micellizing protein and a water-soluble calcium is provided. Furthermore, burnt deposit is reduced in pipes which are flow passages in consecutive processing, and thus washing in the pipes are facilitated.

Description of Embodiments

[0012]

The liquid nutritional composition of the present invention comprises arginine and the non-micellizing protein, wherein pH is 6.0 to 7.3, heating treatment was made, and the burnt deposit is prevented by adding the insoluble calcium, and its flavor is preferable.

[0013]

The liquid nutritional composition in the present invention means a composition which comprises at least protein source, preferably milk protein and is liquid at room temperature (1 to 30°C). The nutritional composition can comprise not only the protein source but also carbohydrates, lipids, minerals and vitamins. For example, the liquid nutritional composition can be a beverage-like composition, a sol composition which is viscous by use of a gelling agent. The liquid nutritional composition of the present invention can be mainly a composition which administered orally, for example, a beverage such as a soft drink and a coffee beverage as nonessential grocery items and a sports drink, as well as an oral nutrient or an oral nutritional liquid food for supplying nutrients required for maintaining and enhancing physical strength in normal persons and sickly persons. Additionally, it can also be a nutritional composition administered through an administration route other than oral administration, like an enteral nutritional liquid food, an enteral nutrient or a central venous nutrient.

[0014]

The composition of the present invention comprises arginine, a non-micellizing protein and an insoluble calcium as essential ingredients. Although arginine may be any of L-arginine, D-arginine and their racemate DL-arginine, L-arginine is preferable because of its usefulness. In addition, as arginine, a free arginine, and one or two or more salts of arginine are used. The salts of arginine are exemplified by arginine

hydrochloride, arginine phosphate and arginine glutamate.

[0015]

The non-micellizing protein is a protein which does not form a micelle in a system containing water and oil. The non-micellizing protein is exemplified by sodium caseinate or potassium caseinate. In the present invention, a non-micellizing protein derived from a milk protein is preferably used because it may be a good-quality amino acid source. The milk protein which can be widely used for a liquid nutritional composition is exemplified by MPC (milk protein concentrate), a skim milk powder, MPI (milk protein isolate), casein and its salt caseinate. Of these milk proteins, MPC, the skim milk powder and MPI are predisposed to form a micelle. In addition, the property of the caseinate varies by its salt, and calcium caseinate and magnesium caseinate form a micelle, but sodium caseinate and potassium caseinate does not form a micelle. However, for the composition of the present invention, a non-micellizing protein other than caseinate can also be used as a protein source without departing the object of the present invention. For example, it is exemplified by whey, soya protein and peptide.

[0016]

A compounding ratio of the protein in the composition is optional unless burnt deposit and decreased flavor are caused. Its minimal amount may be, for example 0.01 g, 0.1 g, 0.5 g and 1 g in 100 ml of the composition. Its maximal amount may be, for example 50 g, 30 g, 20 g and 10 g in 100 ml of the composition. In addition, in a case of a composition used for supplying nutrients in sickly persons and perioperative patients, the calories from the proteins are preferably adjusted to 2-30% to the total calories in 100 ml of the composition.

[0017]

The composition of the present invention comprises an insoluble calcium compound. Because burnt deposit by heating can be prevented by using the insoluble

calcium compound. The insoluble calcium compound is a substance which is hardly dissolved in water and has a solubility of 0.05 g/ml or lower, preferably 0.01 g/ml or lower, desirably 0.005 g/ml or lower in water at 20°C. It is exemplified by calcium phosphate and calcium carbonate, and preferably calcium phosphate for foods and pharmaceutical preparations is used. The insoluble calcium compound is significant as an alternative for the calcium content contained in the milk protein such as the MPC, skim milk powder and MPI and used for nutritional support. A compounding ratio of the insoluble calcium compound is optionally prescribed from the viewpoint of nutritional support. Its minimal amount may be, for example 0.0001 g, 0.001 g, 0.005 g, 0.01 g, 0.05 g, 0.1 g in 100 ml of the composition. In addition, its maximal amount may be, for example 10 g, 5 g, 2 g and 1 g.

[0018]

In order to reduce precipitation of protein and bitterness due to arginine, pH of the composition is adjusted to 6.0-7.3 by the acidic pH adjuster. If the pH of the composition is less than 6.0, burnt deposit may be caused by heating in sterilization. In addition, if pH of the composition exceeds 7.3, the flavor of the composition may be impaired by bitterness of arginine and burnt deposit.

[0019]

The acidic pH adjuster is a component for adjusting pH of the composition and is an acidic substance mainly for neutralizing a basic component, arginine. The acidic pH adjuster is exemplified by inorganic acids such as phosphoric acid, hydrochloric acid and sulfuric acid as well as organic acids such as citric acid, oxalic acid, malic acid and acetic acid. Since the composition of the present invention is a nutritional composition, it is preferably an acid usable as a food additive such as phosphoric acid, citric acid, malic acid and acetic acid. However, an acid constituting the arginine salt can also be used as the acidic pH adjuster.

[0020]

In the present invention, compounding of the non-micellizing protein as a protein source and the insoluble calcium prevents burnt deposit due to heating and maintains the flavor. Although this mechanism is not sufficiently clarify, the burnt deposit is attributed to destruction of the micelle of the milk protein by the acid compounded with arginine leading to release of calcium (ion), in the composition using the milk protein. That is, the composition of the present invention may be a composition which is planned to prevent the micellization by the non-micellizing protein and to reduce release of calcium by use of the insoluble calcium. As a result, the amount of the acidic pH adjuster usable for adjustment of pH of the composition can be increased, a high concentration of arginine can be compounded. In other words, the method of the present invention may be a method in which burnt deposit caused by heating of the liquid composition comprising arginine, the protein source, the calcium source and the acidic pH adjuster is reduced by wholly or partially using the non-micellizing protein as the protein source in the composition and the insoluble calcium compound as the calcium source in the composition.

[0021]

A compounding ratio of the arginine in the composition of the present invention is not particularly limited as long as burnt deposit can be prevented and flavor can be maintained preferable. As free arginine, its minimal amount may be, for example 0.001 g, 0.01 g, 0.1 g, 0.5 g, 1.0 g and 1.5 g in 100 ml of the composition. In addition, its maximal amount may be, for example 4.5 g, 4.0 g, 3.5 g and 3.0 g in 100 ml of the composition. When the amount is increased to 4.5 g or more in 100 ml of the composition, the flavor of the composition may be impaired, and thus it is preferable that the compounding ratio is less than 4.5 g in 100 ml of the composition.

[0022]

The composition of the present invention is also used as a composition for perioperative nutritional support such as a composition for oral nutrients and a

composition for enteral nutrients. Consequently, the composition can contain carbohydrates, proteins, lipids, minerals, vitamins and a viscosity modifier for the composition such as a gelling agent. However, in a case that a micellizing protein is used as a protein source or a case that a calcium compound other than the insoluble calcium is used as a calcium source which is a mineral, burnt deposit may be caused, and flavor may be impaired. Consequently, it is desirable that the protein source in the composition is only the non-micellizing protein, and the calcium source in the composition is only the insoluble calcium. However, the micellizing protein can be added as the protein source and the water-soluble calcium compound can be added as the calcium source as long as the burnt deposit is prevented and the flavor is maintained. In this case, the maximal compounding ratio of the micellizing protein may be 0.1 g, 0.05 g, 0.01 g and 0.005 g in 100 ml of the composition. The maximal compounding ratio of the water-soluble calcium compound may be 0.1 g, 0.05 g, 0.01 g and 0.005 g in 100 ml of the composition.

[0023]

The compounds are prepared with water into the fluid composition of pH 6.0-7.3. The prepared fluid composition is heated and pasteurized or sterilized. The heating treatment method is exemplified by batch processing by an autoclave and consecutive processing by steam injection. After heating treatment, it is cooled to normal temperature, resulting in the liquid nutritional composition in which burnt deposit is not caused and the flavor is preferable. Additionally, in the consecutive processing, burnt deposit is prevented in the pipes, thereby cleaning of the manufacturing line is simplified.

[0024]

Next, the present invention will be detailed on the basis of the following Examples. The following Examples are for merely illustrative purposes, and it is no doubt that the invention is not limited to the following Examples.

Example 1

[0025] [Relationship between generation of burnt deposit and protein and calcium to be used]

Relationship between generation of burnt deposit and types of protein and calcium to be used was studied in a composition comprising L-arginine (KYOWA HAKKO BIO Co., Ltd.). The fluidal composition was prepared with water to have the compounding ratio shown in Table 1, heated by steam injection (145°C, 5 sec.), then homogenized at 45 MPa, and cooled down. A skim milk powder produced by Meiji Dairies Corporation (protein content: 34 w/w%), a milk protein concentrate (MPC) produced by Fonterra Japan Limited (protein content: 80 w/w%), a calcium slurry as calcium phosphate produced by MARUO CALCIUM CO., LTD. (containing 21 w/w% as calcium phosphate), and a whey calcium produced by Fonterra Japan Limited (containing 30 w/w% as calcium) were used.

[0026]

[Table 1]

		Compounding ratio [w/v%]						
		1-A	1-B	1-C	1-D	1-E	1-F	1-G
	L-arginine	1.0	1.0	1.5	2.0	1.0	1.0	2.0
Source of protein	Skim milk powder	2.8	2.8	2.6	2.8	-	-	-
	MPC	2.8	2.8	2.6	2.8	-	-	-
	Sodium caseinate	4.2	-	3.9	3.0	6.5	6.5	6.5
Calcium	Calcium phosphate	-	-	0.05	-	1.2	-	1.2
	Whey calcium	-	1.6	-	-		1.6	
pH adjuster	Citric acid	0.43	0.43	0.65	0.85	0.43	0.43	0.85
		Result						
		1-A	1-B	1-C	1-D	1-E	1-F	1-G

Burnt deposit	Found	Found	Found	Found	None	Found	None
Flavor	Good	Good	Good	Good	Good	Good	Good
pH	7.13	7.05	7.02	7.02	7.08	6.96	7.10
Comprehensive evaluation	×	×	×	×	○	×	○

[0027]

According to this, when 1% or more of L-arginine, the micellizing protein and the water-soluble calcium were used, generation of burnt deposit was found regardless of the presence of the non-micellizing protein.

[0028] [Study on amount of the arginine added]

Subsequently, the fluidal composition was prepared with water to have the compounding ratio shown in Table 2, heated by steam injection (145°C, 5 sec.), then homogenized at 45 MPa, and cooled down.

[0029]

[Table 2]

		Compounding ratio [w/v%]					
		2-A	2-B	2-C	2-D	2-E	2-F
	L-arginine	0.5	1.5	2.0	3.5	4.0	4.5
Source of protein	Sodium caseinate	7.1	7.1	6.5	5.0	4.3	4.3
Calcium	Calcium phosphate	1.2	1.2	1.2	1.2	1.2	1.2
pH adjuster	Citric acid	0.23	0.65	0.85	1.50	1.70	1.95
		Result					
		2-A	2-B	2-C	2-D	2-E	2-F
	Burnt deposit	None	None	None	None	None	None

Flavor	Good	Good	Good	Good	Good	Poor
pH	6.68	7.25	7.10	7.05	7.10	7.12
Comprehensive evaluation	○	○	○	○	○	×

[0030]

According to this, when the content of L-arginine was less than 4.5%, generation of burnt deposit was not found, meanwhile when the content of L-arginine was 4.5% or more, burnt deposit was not found but flavor was impaired in a case.

[0031] [Study on pH]

Subsequently, the fluidal composition was prepared with water to have the compounding ratio shown in Table 3, heated by steam injection (145°C, 5 sec.), then homogenized at 45 MPa, and cooled down.

[0032]

[Table 3]

		Compounding ratio [w/v%]				
		3-A	3-B	3-C	3-D	3-E
L-arginine		2.0	2.0	2.0	2.0	2.0
Source of protein	Sodium caseinate	6.5	6.5	6.5	6.5	6.5
Calcium	Calcium phosphate	1.2	1.2	1.2	1.2	1.2
pH adjuster	Citric acid	0.80	0.85	0.92	1.00	1.09
		Result				
		3-A	3-B	3-C	3-D	3-E
Burnt deposit		None	None	None	None	Found
Flavor		Poor	Good	Good	Good	Good

pH	7.31	7.02	6.69	6.48	5.96
Comprehensive evaluation	×	○	○	○	×

[0033]

According to this, when pH was less than 6.0, burnt deposit was found. Meanwhile, when pH exceeded 7.3, burnt deposit was not found but flavor was impaired in a case.

Example 2

[0034]

The beverage that was the composition of the present invention was manufactured from the components shown in Table 4. The composition caused no burnt deposit and had preferable flavor. In addition, this beverage was also adequate as an enteral nutritional composition or an oral nutritional composition.

[0035]

[Table 4]

Raw material	Example 1
	Oral liquid nutritional supplement (drinkable type)
	(w/v%)
L-arginine	2.0
Sodium caseinate (Tatua107)	6.52
Dextrin	20.0
Sucrose	1.8
Dietary fiber	1.8
Potassium chloride	0.183

Citric acid	0.85
Minerals and yeast mix ^{*1}	0.017
Ferrous sulfate	0.0095
Magnesium carbonate	0.096
Calcium phosphate slurry ^{*2}	1.2
Fractionated canola and palm oil	5.68
Emulsifier	0.25
Vitamin mix	0.29
Sweetener	Small quantity
Flavor	Small quantity
Water	Residual quantity
Total	100.0

*1 Minerals and yeast mix contains 75.7% of zinc gluconate, 3.8% of copper gluconate and 20.5% of selenium yeast.

*2 Calcium phosphate slurry contains 21w/w% of calcium phosphate produced by MARUO CALCIUM CO., LTD..

Industrial Applicability

[0036]

The present invention provides the liquid nutritional composition which allows a relatively large amount of arginine to be ingested while the composition intake is small.

CLAIMS

1. An appertized liquid nutritional composition, comprising 1.0 g or more but less than 4.5 g of an arginine in 100 ml of the composition, only sodium caseinate and/or potassium caseinate as a protein source and an insoluble calcium compound whose solubility to water at 20°C is below 0.05 g/ml is solely added as a calcium source, and having pH from 6.0 to 7.3.
2. The liquid nutritional composition according to Claim 1, wherein the insoluble calcium compound is calcium phosphate and/or calcium carbonate.
3. The liquid nutritional composition according to Claim 1 or 2, wherein the liquid nutritional composition is any of a beverage, an enteral nutrient and an oral liquid composition.
4. A method for manufacturing a liquid nutritional composition comprising 1.0 g or more but less than 4.5 g of an arginine in 100 ml of the composition, and having pH from 6.0 to 7.3, wherein the method includes:
 - a step of preparing a fluid composition comprising only sodium caseinate and/or potassium caseinate as a protein source, only an insoluble calcium compound whose solubility to water at 20°C is below 0.05 g/ml as a calcium source, the arginine, an acidic pH adjuster and water, pH being from 6.0 to 7.3; and
 - a step of heating the fluid composition.
5. The method according to Claim 4, wherein the insoluble calcium compound is a calcium phosphate and/or calcium carbonate.
6. The method according to Claim 4 or 5, wherein the composition is any of a beverage, an enteral nutrient and an oral liquid composition.

7. A method for preventing burnt deposit caused by heating a liquid nutritional composition comprising 1.0 g or more but less than 4.5 g of an arginine in 100 ml of the composition, a protein source, a calcium source and an acidic pH adjuster, wherein
- a pH of the composition is from 6.0 to 7.3,
 - only sodium caseinate and/or potassium is used as a protein source in the composition, and
 - only an insoluble calcium compound whose solubility to water at 20°C is below 0.05 g/ml is used as a calcium source in the composition.
8. The method according to Claim 7, wherein the insoluble calcium compound is calcium phosphate and/or calcium carbonate.