

Nutritional Composition

TECHNICAL FIELD

[0001] The present invention relates to a nutritional composition. More particularly, the present invention relates to a fluid nutritional composition.

BACKGROUND ART

[0002] As conventional techniques, various nutritional compositions to be administered to patients or the like have been known. A nutritional composition compensates a nutritional component of which a patient or the like is short, for example, and contributes to prevent or remedy diseases.

[0003] JP 2013-515718 A discloses a nutritional composition used to prevent or treat diseases accompanied by muscle retraction. The nutritional composition contains at least about 12 g per 100 kcal of a protein-like substance. The protein-like substance includes about 80 % by weight of whey protein.

[0004] The nutritional composition disclosed in JP 2013-515718 A is constructed to be low in calories and high in protein. According to JP 2013-515718 A, in the case where vegetable protein is supplied to a low-calorie composition, amino acid reaches the circulating blood faster as compared to the case where vegetable protein is supplied to a high-calorie composition, and the level of the amino acid in blood is increased. Thus, synthesis of muscle protein is stimulated.

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005] Generally, a patient who is in rehabilitation (patient in rehabilitation) is often in a state of undernutrition. When not taking sufficient nutrients while being in the state of undernutrition, the patient in rehabilitation may not be able to improve his or her physical function. Further, the patient's physical function may even deteriorate. Therefore, it is important for the patient in rehabilitation to maintain an appropriate nutrient state (rehabilitation nutrition).

[0006] The patients who require the rehabilitation nutrition have Chronic Obstructive Pulmonary Disease (COPD), liver failure, rheumatoid arthritis, chronic cardiac failure, chronic renal failure, lower limb amputation, femoral

neck fracture, diabetes, stroke, cancer, disuse syndrome, Parkinson's disease, aspiration pneumonitis, bed sore or the like. These diseases may be accompanied by inflammation. When inflammation occurs, catabolism of muscle protein is enhanced, and cachexia accompanied by a decrease in muscle mass (secondary sarcopenia) or a weight loss is caused. Further, when inflammation persists, the patient loses appetite and is unlikely to take sufficient nutrients. Thus, it is necessary to control inflammation as well as nutritional therapy in order to make rehabilitation nutrition successful.

[0007] The nutritional composition is administered to the patient in order for the nutrient state of the patient in rehabilitation to be appropriately maintained. In this administration, the nutritional composition preferably has favorable flavor, so that it is easy for the patient in rehabilitation to continuously take the nutritional composition. Further, the nutritional composition preferably has stable physicality and maintain favorable flavor during the storage period. Further, the nutritional composition is preferably liquid and high in calories (high in energy) such that the patient in rehabilitation who is likely to lose appetite can intake a small amount and take sufficient nutritional components. Conventionally, the nutritional component mixed with a high concentration of fat or the nutritional component mixed with free amino acid as a protein source have been used for such a purpose. However, these nutritional compositions have unfavorable flavor and are difficult to be taken continuously. Further, there was a problem that the patient suffered from diarrhea when taking these nutritional components. Further, it is desirable that the content of protein in the liquid composition is increased in order for the synthesis of muscle protein to be promoted and catabolism of muscle protein to be prevented. However, when the content of the protein was increased, there was a problem that the physicality of the liquid composition was likely to change during preparation.

[0008] A problem to be solved in the present disclosure is to provide a nutritional composition that has favorable flavor and stable physicality, is high in calories and can control inflammation.

[0009] The nutritional composition according to the present disclosure contains a protein source. The protein source includes whey protein and whey peptide. The ratio of the sum of the weight of whey protein and whey

peptide to the total weight of the protein source is not less than 80 % by weight. The protein-energy ratio of the nutritional composition is not less than 16 % and less than 50 %. The nutritional composition has the calorie density of not less than 100 kcal/100 ml. The nutritional composition is acidic.

[0010] Since being acidic, the nutritional composition according to the present disclosure has favorable flavor. That is, the patient can taste refreshing flavor of the nutritional composition and take the nutritional composition without reluctance.

[0011] In the nutritional composition according to the present disclosure, not less than 80 % by weight of the total weight of the protein source is whey protein and whey peptide. Whey protein and whey peptide are unlikely to solidify under an acidic condition as compared to casein. Therefore, in the nutritional composition, an occurrence of precipitation and the like can be mostly prevented or completely prevented, and the physicality can be stabilized. Further, whey protein and whey peptide have an anti-inflammatory effect. Thus, inflammation of the patient in rehabilitation or the like can be controlled by the nutritional composition.

[0012] The nutritional composition according to the present disclosure has a calorie density of not less than 100 kcal/100 ml, and is constructed to be higher in calories than general nutritional compositions. Thus, with use of the nutritional composition according to the present disclosure, nutritional components required for the patient can be compensated by a relatively small amount of intake.

[0013] In the nutritional composition according to the present disclosure, the ratio of the weight of whey protein to the weight of whey peptide may be from 5:1 to 1:10.

[0014] Although whey peptide has the high anti-inflammatory effect, when the amount of peptide becomes too large, an osmotic pressure increases and may cause diarrhea. However, in the above-mentioned construction, the weight ratio of whey protein to whey peptide is within the range of 5:1 to 1:10. Thus, the content of whey peptide is not too large. Therefore, the nutritional composition can have the high anti-inflammatory effect while the osmotic pressure of the nutritional composition is prevented from increasing and causing diarrhea.

[0015] In the nutritional composition according to the present disclosure,

the pH may be not less than 3 and not more than 5.

[0016] In the above-mentioned construction, the patient who takes the nutritional composition can taste favorable sourness. Thus, the patient can easily and continuously take the nutritional composition.

[0017] The nutritional composition according to the present disclosure may further contain a lipid source. The lipid source can include an n-3 fatty acid.

[0018] In the above-mentioned construction, the inflammation associated with the disease of the patient can be reduced by an n-3 fatty acid. Thus, enhancement of the catabolism of muscle protein caused by inflammation can be prevented. As a result, cachexia accompanied by a decrease in muscle mass (secondary sarcopenia) or a weight loss, and the like can be prevented. Further, a loss of appetite caused by persisting inflammation can be prevented.

[0019] The nutritional composition according to the present disclosure may further contain zinc.

[0020] In the nutritional composition according to the present disclosure, the protein source may further include leucine.

[0021] The nutritional composition according to the present disclosure can be used for the rehabilitation nutrition.

[0022] The nutritional composition according to the present disclosure can be used to prevent and/or remedy Chronic Obstructive Pulmonary Disease.

[0023] The nutritional composition according to the present disclosure can be used to reduce inflammation.

[0024] In the present disclosure, it is possible to acquire a nutritional composition that has favorable flavor and stable physicality, is high in calories, and can control inflammation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] [FIG. 1] FIG. 1 is a graph showing an MCP-1 concentration of a cleaning liquid for alveoli in an example 1, a comparative example 1 and a contrast example 1.

[FIG. 2] FIG. 2 is a graph showing a KC concentration of the cleaning liquid for the alveoli in the example 1, the comparative example 1 and the contrast example 1.

[FIG. 3] FIG. 3 is a graph showing an MMP-9 concentration of the

cleaning liquid for the alveoli in the example 1, the comparative example 1 and the contrast example 1.

[FIG. 4] FIG. 4 is a graph showing an NE concentration of the cleaning liquid for the alveoli in the example 1, the comparative example 1 and the contrast example 1.

[FIG. 5] FIG. 5 is a graph showing a neutrophils count of the cleaning liquid for the alveoli in the example 1, the comparative example 1 and the contrast example 1.

[FIG. 6] FIG. 6 is a graph showing a KC concentration of the cleaning liquid for the alveoli in examples 2-1 to 2-3, a comparative example 2 and a contrast example 2.

[FIG. 7] FIG. 7 is a graph showing the MMP-9 concentration of the cleaning liquid for the alveoli in the examples 2-1 to 2-3, the comparative example 2 and the contrast example 2.

[FIG. 8] FIG. 8 is a graph showing the neutrophils count of the cleaning liquid for the alveoli in the examples 2-1 to 2-3, the comparative example 2 and the contrast example 2.

[FIG. 9] FIG. 9 is a graph showing the plasma AST activity obtained when 24 hours has elapsed since ConA is administered to a mouse through its tail vein in an example 3 and a comparative example 3.

[FIG. 10] FIG. 10 is a graph showing the plasma ALT activity obtained when 24 hours has elapsed since ConA is administered to a mouse through its tail vein in the example 3 and the comparative example 3.

[FIG. 11] FIG. 11 is a graph showing the concentration of each plasma TNF- α when 2 hours and 4 hours have elapsed since ConA is administered to a mouse through its tail vein in the example 3 and the comparative example 3.

[FIG. 12] FIG. 12 is a graph showing the concentration of each plasma IL-6 when 2 hours and 4 hours have elapsed since ConA is administered to a mouse through its tail vein in the example 3 and the comparative example 3.

[FIG. 13] FIG. 13 is a graph showing the concentration of each plasma MCP-1 when 2 hours and 4 hours have elapsed since ConA is administered to a mouse through its tail vein in the example 3 and the comparative example 3.

[FIG. 14] FIG. 14 is a graph showing the concentration of the plasma

AST activity when 24 hours have elapsed since ConA is administered to a mouse through its tail vein in examples 4-1 to 4-2 and a comparative example 4.

[FIG. 15] FIG. 15 is a graph showing the concentration of plasma ALT activity when 24 hours have elapsed since ConA is administered to a mouse through its tail vein in the examples 4-1 to 4-2 and the comparative example 4.

[FIG. 16] FIG. 16 is a graph showing the concentration of each plasma TNF- α when 2 hours and 4 hours have elapsed since ConA is administered to a mouse through its tail vein in the examples 4-1 to 4-2 and the comparative example 4.

[FIG. 17] FIG. 17 is a graph showing the concentration of each plasma IL-6 when 2 hours and 4 hours have elapsed since ConA is administered to a mouse through its tail vein in the examples 4-1 to 4-2 and the comparative example 4.

EMBODIMENTS FOR CARRYING OUT THE INVENTION

[0026] For example, a patient who is in rehabilitation (patient in rehabilitation) is generally often in a state of undernutrition. When not taking sufficient nutrients, the patient in rehabilitation may not be able to improve physical functions. Further, his or her physical functions may deteriorate. Therefore, it is important to consider and appropriately maintain a nutrient state of a patient who is likely to fall into a state of undernutrition such as the patient in rehabilitation.

[0027] The consideration of a nutrient state is to be given to patients with diseases such as Chronic Obstructive Pulmonary Disease (COPD), liver failure, rheumatoid arthritis, chronic cardiac failure, chronic renal failure, lower limb amputation, femoral neck fracture, diabetes, stroke, cancer, disuse syndrome, Parkinson's disease, aspiration pneumonitis and bed sore. These diseases may be accompanied by inflammation. When inflammation occurs, catabolism of muscle protein is enhanced, and cachexia accompanied by a decrease in muscle mass (secondary sarcopenia) or a weight loss, and the like are caused. Further, when the inflammation persists, the patient loses an appetite and is unlikely to take sufficient nutrients.

[0028] [Structure of Nutritional Composition]

The nutritional composition according to the present embodiment is

used to appropriately maintain the nutrient state of a patient. The nutritional composition according to the present embodiment is mainly used for rehabilitation nutrition or is used to support the rehabilitation nutrition. That is, this nutritional composition can be used for a patient in rehabilitation and contribute to prevent and/or remedy undernutrition. This nutritional composition can be administered to a patient who is to maintain an appropriate nutrient state such as a patient with above-mentioned diseases. This nutritional composition is used to prevent and/or remedy Chronic Obstructive Pulmonary Disease (COPD). This nutritional composition is also used to promote the synthesis of muscle protein and prevent decomposition of muscle protein. This nutritional composition can also contribute to reduce inflammation. The structure of this nutritional composition will be described below.

[0029] The nutritional composition according to the present embodiment has fluidity. This nutritional composition is a liquid, for example. This nutritional composition is acidic. The pH of this nutritional composition is preferably 3 to 5.

[0030] When the pH of the nutritional composition according to the present embodiment is from 3 to 5, the patient who takes this nutritional composition can taste moderate sourness. Thus, the patient easily continues to take this nutritional composition, and the nutrient state of the patient can be maintained appropriately.

[0031] The nutritional composition according to the present embodiment is relatively high in calories. That is, this nutritional composition preferably has the caloric density of not less than 100 kcal/100 ml, more preferably has the caloric density of not less than 125 kcal/100 ml, and even more preferably has the caloric density of not less than 150 kcal/100 ml.

[0032] The nutritional composition according to the present embodiment contains a protein source and a lipid source. This nutritional composition can preferably contain 2 to 8 g/100 kcal of the protein source, more preferably contain 3 to 6 g/100 kcal of the protein source, and even more preferably contain 4 to 6 g/100 kcal the protein source. This nutritional composition can preferably contain 1 to 4 g/100 kcal of the lipid source, more preferably contain 2 to 3.5 g/100 kcal of the lipid source, and even more preferably contain 2 to 3 g/100 kcal of the lipid source. When containing the above-mentioned amounts of the protein source and the lipid source, the

nutritional composition is high in calories (has a high caloric density) and has better physicality for storage.

[0033] In the nutritional composition according to the present embodiment, the protein source contributes to promote the synthesis of the muscle protein. This protein source includes whey protein and whey peptide. In this nutritional composition, the ratio of the sum of the weight of the whey protein and the whey peptide to the total weight of the protein source is preferably not less than 80 % by weight, and more preferably not less than 90 %. In this nutritional composition, the ratio of the weight of the whey protein to the weight of the whey peptide is preferably from 5 : 1 to 1 : 10, and more preferably from 3 : 1 to 1 : 7.

[0034] When the ratio of the weight of the whey protein to the whey peptide is set within the range of 5 : 1 to 1 : 10 in the nutritional composition according to the present embodiment, the content of the whey peptide that increases an osmotic pressure can be prevented from becoming too large in this nutritional composition. Thus, this nutritional composition can have an anti-inflammatory effect while the osmotic pressure is prevented from increasing in this nutritional composition and causing diarrhea and so on.

[0035] The whey according to the present embodiment is a soluble component that remains when fat, casein, fat-soluble Vitamins and so on are removed from milk, for example. Generally, whey is cheese whey or rennet whey (alternatively referred to as sweet whey) that is a byproduct produced during manufacture of natural cheese or rennet casein, and casein whey, acid whey or quark whey that is acquired when acid casein, fermented milk, quark or the like is manufactured from skim-milk. Whey protein is a collective term of proteins except for casein in milk, for example. Whey protein is constructed to include a plurality of components such as β -lactoglobulin, α -lactalbumin and lactoferrin, and does not include lactose, Vitamins, minerals and the like. When a raw milk material such as milk is adjusted to be acidic, the protein that precipitates is casein, and the protein that does not precipitate is whey protein.

[0036] The whey according to the present embodiment includes a whey concentrate that is acquired when whey is concentrated, whey powder that is acquired when whey is dried, a Whey Protein Concentrate (hereinafter also referred to as a "WPC") that is acquired when major proteins and the like of whey are concentrated by a Ultrafiltration (UF) method or the like and then

dried, a defatted WPC (low in fat and high in protein) that is acquired when fat is removed from whey by a Microfiltration (MF) method, a centrifugal separation method or the like, concentrated by the UF method and then dried, a whey protein Isolate (hereinafter also referred to as a "WPI") that is acquired when major proteins and the like of whey are selectively fractionated by an ion exchange resin method, a gel filtration method or the like and then dried, desalted whey that is acquired when whey is desalted by a Nanofiltration (NF) method, an electrodialysis method or the like and then dried, and mineral concentrated whey that is acquired when a mineral component derived from whey is precipitated and then concentrated by the centrifugal separation method or the like.

[0037] The whey peptide according to the present embodiment can be manufactured when whey or whey protein, for example, are hydrolyzed with use of the following enzymes or the like. While the enzymes used for the hydrolysis of whey are pepsin, trypsin and chymotrypsin, there is also a research report (Food Technol., 48:68-71, 1994; Trends Food Sci. Technol., 7:120-125, 1996; Food Proteins and Their Applications, pp. 443-472, 1997) in which papain of plant origin, bacteria or fungi-derived protease is used. Enzyme activity of hydrolyzing whey protein largely changes. While decomposing α -La and the denatured α -La, pepsin does not decompose native β -Lg (Neth. Milk dairy J., 47:15-22, 1993). While slowly hydrolyzing α -La, trypsin hardly decomposes β -Lg (Neth. Milk dairy J., 45:225-240, 1991). While quickly decomposing α -La, chymotrypsin slowly decomposes β -Lg. While papain hydrolyzes bovine serum albumin (BSA) and β -Lg, α -La is resistant to the hydrolysis (Int. Dairy Journal 6:13-31, 1996a). However, α -La not binding with Ca is completely decomposed by papain in a pH in the acidic range (J. Dairy Sci., 76:311-320, 1993).

[0038] The hydrolysis of a peptide bond causes an increase in number of charged groups, an increase in hydrophobic property, a reduction in molecular weight and modification of the configuration of molecules (J. Dairy Sci., 76: 311-320, 1993). A change in functional characteristics largely depends on a degree of hydrolysis. The common largest changes in functionality of whey protein are an increase in solubility and a reduction in viscosity. When the degree of hydrolysis is high, a hydrolysate often does not precipitate even when being heated, and has high solubility in a pH of 3.5 to 4.2. The hydrolysate has the viscosity significantly lower than that of

an intact protein. This difference is significant especially when the concentration of protein is high. Other influences include a change in gel property, an increase in thermal stability, enhancement of emulsification and foaming property, and a reduction in stability of emulsification and foam.

[0039] The whey peptide used in the present embodiment preferably has an anti-inflammatory effect. For example, the effect of preventing production of LPS-Induced TNF- α and IL-6 in vivo is confirmed. Whether whey peptide has an effect of preventing the production of LPS-Induced TNF- α and IL-6 can be confirmed in known assays (for example, a separate volume of Experimental Medicine, "Bio-Manual Up Experiment Series", Cytokines Experiment Method, Edited by Atsushi Miyajima and Tadashi Yamamoto, Yodosha company, Ltd, 1997). The optimization of a hydrolysis condition (a denaturation temperature, a pH, a temperature, a hydrolysis time and a ratio of enzyme to substrate) can be attempted with reference to the above-mentioned document (International Dairy Journal 12:813-820, 2002) with the effect of preventing production of LPS-Induced TNF- α and IL-6 as an index. The whey peptide that is used in the present embodiment contains whey peptide itself, retentate that has been used in ultrafiltration membrane processing or permeate that is generated in ultrafiltration membrane processing.

[0040] Whey protein hydrolysate that can be used in the present embodiment includes the following, for example. JP 3183945 A discloses whey protein hydrolysate (a peptide mixture of which a molecular weight is from 200 to 3,000) that is acquired when a heated and denatured Whey Protein Isolate (WPI) is hydrolyzed with use of endopeptidase and exopeptidase, and then an aromatic amino acid in this hydrolysate is adsorbed by an ion exchange resin. The Fischer ratio of the whey protein hydrolysate is not less than 10, and the whey protein hydrolysate includes not less than 15 % of a branched chain amino acid and less than 2 % of an aromatic amino acid.

[0041] JP 6-50756 A discloses odourless and less bitter whey peptide that is acquired when an aqueous solution including 12 % of the whey protein concentrate (WPC) containing at least 65 % of protein is thermally processed at a temperature exceeding 60 °C, is hydrolyzed with use of alcalase derived from *B. licheniformis* and neutrase derived from *B. subtilis* until a DH is from 15 to 35 %, Ultrafiltration (UF) using a membrane having a cut-off value

exceeding 10, 000 is performed on this hydrolysate, this hydrolysate is concentrated by Nanofiltration (NF), and then this NF retentate is spray-dried.

[0042] While including Peptigen IF-3080, Peptigen IF-3090, Peptigen IF-3091 and Lacprodan DI-3065 (Arla Foods), WE80BD (DMV), Hyprol 3301, Hyprol 8361 and Hyprol 8034 (Kerry), Tatua2016, HMP406 (Tatua), Whey Hydrolysate 7050 (Fonterra) and Biozate3 (Davisco), for example, commercially available lactoprotein hydrolysates used in the present embodiment are not limited to these. A method of adjusting the protein hydrolysate includes a method of manufacturing whey peptide that includes the following steps 1) to 5), for example.

[0043] 1)Whey protein including at least 65 % of protein that is calculated as a dry matter is mixed with water, whereby a slurry with the protein content of up to 20 % is produced.

2) Thermal processing is performed at a temperature exceeding 60 °C.

3)The mixture produced in the step 2) is proteolytically hydrolyzed by a non-pH stat method with use of protease that can be produced by *B. licheniformis* and/or protease that can be produced by *B.subtilis* until the DH is between 15 and 35 %.

4) The mixture produced in the step 3) is separated on an ultrafiltration/microfiltration device having a cut-off value exceeding 10,000 such that the permeate constructs the protein hydrolysate product (whey peptide).

5)Then, the hydrolysis is completed by inactivation of the above-mentioned enzymes.

[0044] The protein content of the slurry produced in the above-mentioned step 1) is preferably from 7 to 12 %. The thermal processing in the above-mentioned step 2)is performed preferably at a temperature of 70 to 90 °C. The hydrolysis in the above-mentioned step 3) is preferably carried out until the DH is between 20 and 30 %. The cut-off value of the above-mentioned ultrafiltration/microfiltration device preferably exceeds 50,000.

[0045] The mixture produced at the end of the above-mentioned step 3) or 5) is preferably processed by an activated carbon at the temperature preferably between 50 and 70 °C for a period longer than 5 minutes, and then the

activated carbon is removed. The amount of the activated carbon added to the mixture is preferably equivalent to 1 to 5 % to the mixture that is calculated with respect to the content of dry matter. Preferably, after the above-mentioned step 5), concentration is carried out by nanofiltration/hyperfiltration/reverse osmosis and/or evaporation preferably at a temperature between 50 and 70 °C. Then, the retentate is collected as the protein hydrolysis product (whey peptide) solution.

[0046] The protein hydrolysis product (whey peptide) solution that is produced in the above-mentioned step 5) is spray-dried until the moisture content is lower than 6.5 %.

[0047] Therefore, the method of manufacturing the whey protein hydrolysis product is characterized in

1) mixing whey protein including at least 65 % of protein that is calculated as a dry matter with water, and producing a slurry with the protein content of up to about 20 %, or preferably, 12 %,

2) performing the thermal processing at a temperature exceeding 60 °C,

3) proteolytically hydrolyzing the mixture produced in the step 2) with use of protease that can be produced by *B. licheniformis*, or preferably, Alcalase (trademark) and/or protease that can be produced by *B. subtilis*, preferably Neutrase (trademark) until the DH is between 15 and 35 % by a non-pH stat method,

4) separating the mixture produced in the step 3) on the ultrafiltration/microfiltration device having a cut-off value exceeding 10,000 such that the permeate constructs the protein hydrolysate, and then

5) completing the hydrolysis by inactivating the above-mentioned enzyme.

[0048] In the nutritional composition according to the present embodiment, the protein source can contain protein other than whey protein, peptide other than whey peptide and/or an amino acid. In this nutritional composition, the protein source may contain leucine, for example. The content of leucine in this nutritional composition can preferably be from 0.01 to 1.0 g/100kcal, and can more preferably be from 0.05 to 0.5 g/100 kcal.

[0049] In the nutritional composition according to the present embodiment, the protein source does not actually contain casein. Casein is likely to solidify as compared to whey protein and whey peptide. Casein is likely to

solidify especially under an acidic condition. The protein source does not actually contain casein in this nutritional composition, so that an occurrence of precipitation and the like are mostly or completely prevented, and physicality can be stabilized in this nutritional composition.

[0050] In the nutritional composition according to the present embodiment, the protein-energy ratio is preferably not less than 16 % and less than 50 %, and more preferably not less than 20 % and less than 30 %. That is, this nutrient composition is high in protein and promotes synthesis of muscle protein.

[0051] In the nutritional composition according to the present embodiment, the lipid source contains an n-3 fatty acid. The content of an n-3 fatty acid in this nutritional composition can preferably be from 10 to 100 mg/100 kcal, and can more preferably be from 30 to 80 mg/100 kcal.

[0052] In the nutritional composition according to the present embodiment, the n-3 fatty acid preferably contains Eicosapentaenoic acid (EPA) and/or Docosahexaenoic acid (DHA). EPA and DHA have an anti-inflammatory effect. When the n-3 fatty acid contains EPA, in order for the flavor of this nutritional composition to be favorable, the content of EPA in the nutritional composition according to the present embodiment can preferably be from 1 to 100 mg/100 kcal, and can more preferably be from 10 to 30 mg/100 kcal. When the n-3 fatty acid contains DHA, in order for the flavor of this nutritional composition to be favorable, the content of DHA in the nutritional composition can preferably be from 1 to 100 mg/100 kcal, and can more preferably be from 10 to 50 mg/100 kcal.

[0053] In the nutritional composition according to the present embodiment, fish oil may be used in at least part of the lipid source. Fish oil abundantly contains EPA and DHA. When fish oil is used as the lipid source in this nutritional composition, in order for the flavor of this nutritional composition to be favorable, the content of fish oil in this nutritional composition can preferably be 0.05 to 0.5 g/100 kcal, and can more preferably be 0.1 to 0.3 g/100 kcal.

[0054] When inflammation occurs, catabolism of muscle protein is enhanced, and cachexia accompanied by a decrease in muscle mass (secondary sarcopenia) or a weight loss, and the like are caused. Further, when inflammation persists, the patient loses appetite. However, when the lipid source contains an n-3 fatty acid, EPA and/or DHA, in particular, in the

nutritional composition according to the present embodiment, inflammation accompanying the disease of the patient can be reduced. Thus, the above-mentioned adverse effects caused by inflammation can be eased.

[0055] In the nutritional composition according to the present embodiment, the lipid source may contain a medium-chain triglyceride. The medium-chain triglyceride is digested and absorbed faster than a general long-chain triglyceride. The content of a medium-chain triglyceride in this nutritional composition can preferably be from 0.2 to 2.0 g/100 kcal, and can more preferably be from 0.4 to 0.8 g/100 kcal.

[0056] The nutritional composition according to the present embodiment preferably contains Vitamin C and/or Vitamin E. Vitamin C and Vitamin E have an antioxidative effect. The content of Vitamin C in this nutritional composition can preferably be from 1 to 1000 mg/100 kcal, and can more preferably be from 10 to 100 mg/100 kcal. The content of Vitamin E in this nutritional composition can preferably be from 0.1 to 100 mg/100 kcal, and can more preferably be from 1 to 10 mg/100 kcal.

[0057] The nutritional composition according to the present embodiment can contain Vitamins other than Vitamin C and Vitamin E. This nutritional composition can contain one type, or two or more types out of Vitamin B₁, Vitamin B₂, Vitamin B₆, Vitamin B₁₂, niacin, pantothenic acid and folic acid, for example.

[0058] The nutritional composition according to the present embodiment preferably contains zinc. Zinc has an anti-inflammatory effect and enhances the synthesis of muscle. The content of zinc in this nutritional composition can preferably be from 0.1 to 10 mg/100 kcal, and can more preferably be from 0.5 to 5 mg/100 kcal.

[0059] The nutritional composition according to the present embodiment can contain minerals other than zinc. This nutritional composition can contain one type, or two or more types of potassium, sodium, calcium, magnesium and iron, for example.

[0060] In the nutritional composition according to the present embodiment, the content of potassium is preferably from 20 to 500 mg/100 kcal, and more preferably from 20 to 300 mg/100 kcal. The content of sodium is preferably from 20 to 500 mg/100 kcal, and more preferably from 20 to 300 mg/100 kcal. The content of calcium is preferably from 20 to 300 mg/100 kcal, more preferably from 20 to 250 mg/100 kcal, and even more preferably from 20 to

150 mg/100 kcal. The content of magnesium is preferably from 5 to 300 mg/100 kcal, more preferably from 10 to 200 mg/100 kcal, and even more preferably from 10 to 100 mg/100 kcal. When the content of each mineral is within the above-mentioned range, appropriate amounts of minerals can be supplied to the patient in rehabilitation or the like. Further, suitability (dispersion) of the nutritional composition according to the present embodiment during manufacture can be improved, and precipitation of the fluid nutritional composition can be prevented during storage.

[0061] The nutritional composition according to the present embodiment may also contain a component other than the above-mentioned components. This nutritional composition can contain a component suitable for the disease, the nutrient state or the like of a patient at the required concentration.

[0062] The nutritional composition according to the present embodiment may contain carbohydrates such as saccharinity or dietary fiber. This nutritional composition can contain palatinose and/or dextrin, for example, as saccharinity. The content of the saccharinity such as palatinose and/or dextrin is preferably from 10 to 16 g/100 kcal, and more preferably from 12 to 14 g/100 kcal. The patients who require rehabilitation nutrition often have diabetes. As such, the nutritional composition according to the present embodiment preferably includes not less than 20 % by weight of palatinose with moderate sugar absorption of the total saccharinity. More preferably, not less than 50 % by weight of palatinose of the total saccharinity is used.

[0063] In the nutritional composition according to the present embodiment, indigestible dextrin that has an effect of preventing a rise in blood sugar level after meals and is unlikely to cause excessive viscosity during manufacture is preferably used as dietary fiber. The content of dietary fiber such as indigestible dextrin is preferably from 0.5 g to 3.0 g/100 kcal, and more preferably from 1.0 to 2.0 g/100 kcal.

[0064] [Method of Manufacturing Nutrient Composition]

Next, an example of a method of manufacturing the nutritional composition according to the present embodiment will be described. However, the method of manufacturing this nutritional composition is not limited to the below-mentioned method.

[0065] First, ingredients of the nutritional composition are mixed.

Specifically, 22,000 g of a solution water is added to (put into) a mixing tank (mixer). This solution water is a tap water, a purified water, an ion-exchanged water or a RO water that is produced when impurities are removed by a reverse osmotic (RO) film, for example. The temperature of this solution water can be set to about 40 to 80 °C. Then, 169 g of dextrin (a dextrin solution containing 75 % by weight of dextrin) is added to the mixing tank, and the solution water and dextrin are mixed (stirred).

[0066] Next, 0.08 g of ferrous sulfate and 26 g of a pH control agent are added to and mixed in the mixing tank. Then, 2,328 g of a fat-oil regulating liquid (2,200 g of vegetable oils and fats, and 128 g of animal oils and fats, for example) are added to and mixed in the mixing tank. Further, 2,640 g of whey peptide (a degradation product of whey protein), 3,000 g of a whey protein concentrate, 750 g of dietary fiber, 3,360 g of paratinose, 780 g of an emulsifier, 240 g of a branched chain amino acid and 3,360 g of a stabilizer are added and mixed. Then, 630 g of a calcium preparation, 90 g of magnesium phosphate, 2 g of a selenium yeast, 7 g of zinc gluconic acid, 0.36 g of copper gluconic acid, 96 g of salt and 42 g of potassium chloride are added and mixed.

[0067] As long as being edible, the pH control agent is not limited in particular. A single type out of organic acids and inorganic acids can be used, or two or more types out of organic acids and inorganic acids can be mixed and used, as the pH agent. For example, lactic acid, malic acid, citric acid, tartaric acid, ascorbic acid, gluconic acid, fumaric acid and their salts can be used as the organic acids. Hydrochloric acid, phosphoric acid and their salts, for example, can be used as the inorganic acids. While food additives can be used as the organic acids, naturally derived organic acids such as lemon juice or apple juice can also be used. As long as being edible, the fat-oil regulating liquid is not limited in particular. For example, a single type out of rapeseed oil, palm oil, fractionated palm oil, rice-bran oil, corn oil and fish oil can be used, or two or more types out of rapeseed oil, palm oil, fractionated palm oil, rice-bran oil, corn oil and fish oil, can be mixed and used, as the fat-oil regulating liquid. The temperature of the fat-oil regulating liquid can be set to about 50 to 60 °C.

[0068] While the above-mentioned components are mixed (stirred) in the mixing tank, the temperature of the above-mentioned components is maintained at 50 to 60 °C for 15 minutes or longer (15 to 60 minutes), for

example. Thus, mixing of the ingredients for the nutritional composition is completed.

[0069] Next, preheating processing and heat sterilization processing are performed on the liquid mixture (ingredients) that have been mixed in the mixing tank. In the preheating processing, the liquid mixture is heated to 75 to 85 °C with use of a plate-type heat exchanger or a tube-type heat exchanger, for example. In the heat sterilization processing, the preheated liquid mixture is heated with use of the plate-type heat exchanger, the tube-type heat exchanger, a steam injection heater or a steam infusion heater, for example, to 120 to 145 °C for one second to 10 seconds, for example.

[0070] Next, precooling processing and pre-homogenization processing are performed on the liquid mixture on which the heat sterilization processing has been performed. In the precooling processing, the liquid mixture is cooled to 70 to 80 °C with use of the plate-type heat exchanger or the tube-type heat exchanger, for example. In the pre-homogenization processing, the liquid mixture is homogenized (refined) with use of a homogenizer, for example, at 70 to 80 °C and 40 to 60 MPa. Then, the pre-homogenized liquid mixture is cooled to 5 to 25 °C, for example, with use of the plate-type heat exchanger or the tube-type heat exchanger, for example, and stored in an intermediate storage tank.

[0071] While being mixed (stirred) in the intermediate storage tank, the liquid mixture is maintained at 5 to 25 °C, for example. Vitamins (87g of Vitamin C and 9 g of Vitamin E, for example) are added to and mixed in the intermediate storage tank in which the liquid mixture is stored. Then, 258 g of flavoring and 18 g of sweetener are added to and mixed in the intermediate storage tank.

[0072] Next, preheating processing and homogenization processing are performed on the liquid mixture to which the Vitamins have been added. In the preheating processing, the liquid mixture is heated to 70 to 80 °C with use of the plate-type heat exchanger or the tube-type heat exchanger, for example. In the homogenization processing, the preheated liquid mixture is homogenized at 70 to 80 °C and 40 to 60 MPa, for example, with use of the homogenizer, for example. Then, the homogenized liquid mixture is cooled to 5 to 25 °C, for example, by the plate-type heat exchanger or the tube-type heat exchanger, for example, and stored in a final storage tank.

[0073] While the liquid mixture (an intermediate product of the nutritional composition) is mixed (stirred) in the final storage tank, the temperature of the liquid mixture is maintained at 5 to 25 °C. The liquid mixture is put in an appropriate container from the final storage tank in which the liquid mixture is stored. Thus, the nutritional composition (final product) according to the present embodiment is completed.

[0074] [Effects]

Since being acidic, the nutritional composition according to the present embodiment has refreshing and favorable flavor. That is, the patient or the like can taste refreshing and favorable flavor of the nutritional composition, and take this nutritional composition without reluctance. Thus, the patient in rehabilitation or the like who is likely to fall into a state of undernutrition, for example, can continuously and easily take the nutritional composition, and the nutrient state of the patient in rehabilitation or the like can be appropriately maintained.

[0075] In the nutritional composition according to the present embodiment, not less than 80 % by weight of the total weight of the protein source is whey protein and whey peptide. Whey protein and whey peptide are unlikely to solidify under an acidic condition as compared to casein. Therefore, in the nutritional composition, an occurrence of precipitation and the like are mostly or completely prevented, so that physicality can be stabilized.

[0076] The nutritional composition according to the present embodiment has the caloric density of not less than 100 kcal/100 ml and is constructed to be high in calories as compared to a general nutritional composition. Therefore, even when a patient or the like only takes a small amount of the nutritional composition, a nutrient state of a patient or the like can be appropriately maintained. Thus, a nutrient state of a patient with a loss of appetite, or the like can be improved effectively.

[0077] Because the nutritional composition according to the present embodiment is high in calories, the protein source included in this nutritional composition can be prevented from being used as an energy source in the body of a patient or the like. Thus, the protein source can more reliably contribute to the synthesis of muscle protein, and decomposition of muscle protein can be prevented. Therefore, when the nutritional composition according to the present embodiment is used for a patient in rehabilitation, for example, the patient can be rehabilitated

effectively. In this rehabilitation, QOL (Quality Of Life) of the patient in rehabilitation improves, and prevention of an increase in nursing case, prevention of degradation of the nursing care level, or the like can be expected.

[0078] While the present embodiment has been described above, the present disclosure is not limited to the above-mentioned embodiment. The above-mentioned embodiment can be modified as appropriate without departing the spirit of the present invention.

Examples

[0079] Each example will be described below. However, the present disclosure is not limited to each below-mentioned

[0080] [Experiment 1. Evaluation Test of Nutritional Composition with use of Animal Model of Chronic Obstructive Pulmonary Disease (COPD)]
(Method of Producing Animal Model of COPD)

24 male mice (three weeks old) of C57BL/6J series were used. The mice were fed general feed (standard purified feed (AIN93G)) for 7 days (one week) for acclimatization, divided into three groups with their weight as an index, and then fed test feed for 14 days (2 weeks) for rearing.

[0081] Group Exposed to Tobacco Smoke (Smoke)

Mice were fed the test feed for 14 days (2 weeks) for rearing, and then exposed to tobacco smoke continuously for 10 days. Also during the exposure to tobacco smoke, the mice were fed the test feed. A method of exposing the mice to tobacco smoke is as described below.

[0082] The mice were put in a chamber for exposure, main streams of smoke (tobacco smoke: air = 1:5, the flow rate is 1.05L/min) of tobacco (PEACE, manufactured by Japan Tobacco Inc., 28 mg of tar/cigarette, 2.3 mg of nicotine/cigarette) are generated with use of a tobacco main stream generation device (INH06-CIGR02A, manufactured by M.I.P.S Co., Ltd.), and main streams of tobacco were sent into the chamber. In this exposure, the mice were exposed to tobacco smoke of 20 cigarettes in about 1.5 hour per day.

[0083] Group Not Exposed to Tobacco Smoke (Group Exposed to Air) (Air)

Mice were fed the test feed for 14 days (2 weeks) for rearing, and then exposed to air continuously for 10 days. Also during the exposure to air, the mice were fed the test feed. A method of exposing the mice to air included

putting the mice in a chamber for exposure to air and sending air into the chamber using an air pump.

[0084] (Test Method)

Example 1

8 mice in the group exposed to tobacco smoke were continuously allowed to freely take lyophilized powder of the mixture (the nutritional composition: a general liquid diet = 70:30 (weight ratio)) of the nutritional composition according to the present disclosure and the general liquid diet (Meibalance HP, manufactured by Meiji Co., Ltd.) as the test feed for 24 days (the rearing period: 14 days, and the tobacco smoke exposure period: 10 days). The compositions of the nutritional composition used in the example 1 are shown in the Table 1.

[0085] [Table 1]

TABLE 1

	WEIGHT(/100kcal)
PROTEIN(g)	5.1
WHEY PEPTIDE (g)	2.3
WHEY PROTEIN (g)	2.5
VALINE (g)	0.05
LEUCINE (g)	0.1
ISOLEUCINE (g)	0.05
LIPID(g)	2.8
VEGETABLE OILS AND FATS (g)	1.9
MEDIUM - CHAIN TRIGLYCERIDE (g)	0.6
FISH OIL (g)	0.14
DERIVED FROM OTHER MATERIALS (g)	0.16
SACCHARINITY - CARBOHYDRATES (g)	13.5
SACCHARINITY	
PALATINOSE (g)	7.1
DEXTRION (g)	4.9
DERIVED FROM WHEY PROTEIN (g)	0.3
DERIVED FROM OTHER MATERIALS (g)	0.4
ORGANIC ACID (g)	0.8
DIETARY FIBER(g)	
INDIGESTIBLE DEXTRIN OR THE LIKE (g)	1.2
VITAMINS	
VITAMIN A (μg RE)	153
VITAMIN D (μg)	0.76
VITAMIN E (mg)	5.1
VITAMIN B ₁ (mg)	0.25
VITAMIN B ₂ (mg)	0.31
VITAMIN B ₆ (mg)	0.31
VITAMIN B ₁₂ (μg)	0.61
NIACIN(mg)	3.1
PANTOTHENIC ACID(mg)	1.2
FOLIC ACID(μg)	51
VITAMIN C(mg)	51
MINERALS	
POTASSIUM (mg)	82
SODIUM (mg)	71
CALCIUM (mg)	82
MAGNESIUM (mg)	20
IRON (mg)	1.0
ZINC (mg)	1.0

[0086] The pH of the nutritional composition shown in the Table 1 is 4.1. The caloric density of this nutritional composition is 160 kcal/100 ml. The protein-energy ratio of this nutritional composition is 20 %. The protein source of this nutritional composition includes 2.5 g/100 kcal of whey protein and 2.3 g/100 kcal of whey peptide. The ratio of the sum of the weight of whey protein and whey peptide to the total weight of the protein source in this nutritional composition is 96 % by weight. This nutritional composition includes 0.10 g/100 kcal of EPA and 0.04 g/100 kcal of DHA.

[0087] Comparative Example 1

8 mice in the group exposed to tobacco smoke were continuously allowed to freely take lyophilized powder of the general liquid diet (Meibalance HP, manufactured by Meiji Co., Ltd.) as the test feed for 24 days (the rearing period:14 days, and the tobacco smoke exposure period:10 days).

[0088] Contrast Example 1

8 mice in the group not exposed to tobacco smoke were continuously allowed to freely take the lyophilized powder of the general liquid diet (Meibalance HP, manufactured by Meiji Co., Ltd.) used as the test feed for 24 days (the rearing period:14 days, and the tobacco smoke exposure period:10 days).

[0089] (Evaluation)

As indices of inflammation in the alveoli, the concentration of Monocyte Chemoattractant Protein-1 (MCP-1), the concentration of Keratinocyte-derived Chemokine (KC) that is neutrophil chemokine, the concentration of Matrix Metalloproteinase 9 (MMP-9), the concentration of Neutrophil Elastase (NE) and the neutrophils count were used. Here, the measurement value of each index was evaluated by means $\pm$ standard deviation. Further, in statistical analysis, the Dunnett's test or the Steel's test was used with the comparative example 1 as a control group.

[0090] In the comparative example 1, when the measurement value of each index was high as compared to the contrast example 1, inflammation was elicited in the comparative example 1. On the other hand, when the measurement value of each index was low in the example 1 as compared to the comparative example 1, inflammation was reduced in the example 1.

[0091] In the measurement of each index, all blood was taken from each mouse, and the mice have died of a loss of blood, after the exposure to tobacco smoke or air ended. Then, the alveoli was cleaned with PBS three times (1

mL each time), and the cleaning liquid for the alveolus was collected. After that, the collected cleaning liquid for the alveolus was separated by centrifugal separation, and the supernatant of this cleaning liquid for the alveoli was used for the measurement of the MCP-1 concentration, the KC concentration, the MMP-9 concentration and the NE concentration. On the other hand, the precipitate of this cleaning liquid for the alveoli was suspended in PBS, and the suspension of the precipitate of this cleaning liquid was used for the measurement of the neutrophils count.

[0092] A Cytometric Bead Array (CBA) Mouse Inflammation kit manufactured by Japan Becton, Dickinson and Company was used for the measurement of the MCP-1 concentration. A Mouse KC Quantikine ELISA Kit manufactured by R&D Inc. was used for the measurement of the KC concentration. A Mouse Total MMP-9 Quantikine ELISA kit manufactured by R&D Inc. was used for the measurement of the MMP-9 concentration. A Neutrophil Elastase ELISA kit manufactured by CUSABIO TECHNOLOGY LLC was used for the measurement of the NE concentration.

[0093] The MCP-1 concentration of the cleaning liquid for the alveoli in the example 1, the comparative example 1 and the contrast example 1 is shown in Fig. 1. As shown in Fig. 1, the MCP-1 concentration was significantly high in the comparative example 1 as compared to the contrast example 1. The MCP-1 concentration was significantly low in the example 1 as compared to the comparative example 1.

[0094] The KC concentration of the cleaning liquid for the alveoli in the example 1, the comparative example 1 and the contrast example 1 is shown in Fig. 2. As shown in Fig. 2, the KC concentration was significantly high in the comparative example 1 as compared to the contrast example 1. The KC concentration was significantly low in the example 1 as compared to the comparative example 1.

[0095] The MMP-9 concentration of the cleaning liquid for the alveoli in the example 1, the comparative example 1 and the contrast example 1 is shown in Fig. 3. As shown in Fig. 3, the MMP-9 concentration was significantly high in the comparative example 1 as compared to the contrast example 1. The MMP-9 concentration was significantly low in the example 1 as compared to the comparative example 1.

[0096] The NE concentration of the cleaning liquid for the alveoli in the example 1, the comparative example 1 and the contrast example 1 is shown

in Fig. 4. As shown in Fig. 4, the NE concentration was significantly high in the comparative example 1 as compared to the contrast example 1. The NE concentration was significantly low in the example 1 as compared to the comparative example 1.

[0097] The neutrophils count of the cleaning liquid for the alveoli in the example 1, the comparative example 1 and the contrast example 1 is shown in Fig. 5. As shown in Fig. 5, the neutrophils count was significantly high in the comparative example 1 as compared to the contrast example 1. The neutrophils count was significantly low in the example 1 as compared to the comparative example 1.

[0098] (Study)

In the comparative example 1, the measurement value of each index was high as compared to the contrast example 1. From this result, it is found that inflammation is elicited by exposure to tobacco smoke. On the other hand, in the example 1, the measurement value of each index was low as compared to the comparative example 1. That is, when mice took the nutritional composition shown in the Table 1, even though the mice were exposed to tobacco smoke, each index value indicated a low value. From this result, it is found that the nutritional composition according to the present disclosure lowers the concentration of various inflammatory mediators elicited by COPD, and controls an increase in number of inflammatory cells (the neutrophils count). Further, it is found that the nutritional composition according to the present disclosure reduces a secretion volume of various enzymes that cause damage to alveolar tissues. That is, it was confirmed that the nutritional composition according to the present disclosure is effective for reducing inflammation (anti-inflammatory).

[0099] [Experiment 2. Evaluation Test of Whey Protein, Whey Peptide and Fish Oil with use of Animal Model of Chronic Obstructive Pulmonary Disease (COPD)]

(Method of Producing Animal Model of COPD)

30 female mice (six weeks old) of C57BL/6J series were used. The mice were fed the general feed (the standard purified feed (AIN93G)) for 7 days (one week) for acclimatization, divided into four groups with their weight as an index, and then fed the test feed for 14 days (2 weeks) for

rearing.

[0100] Group Exposed to Tobacco Smoke (Smoke)

Mice were fed the test feed for 14 days (2 weeks) for rearing, and then exposed to tobacco smoke continuously for 3 days. Also during the exposure to tobacco smoke, the mice were fed the test feed. The method of exposing the mice to tobacco smoke is as described below.

[0101] The mice were put in a chamber for exposure, main streams of smoke (tobacco smoke:air = 1:5, the flow rate is 600 ml/min) of tobacco (PEACE, manufactured by Japan Tobacco Inc., 28 mg of tar/cigarette, 2.3 mg of nicotine/cigarette) were generated with use of a peristaltic pump, and main streams of tobacco were sent into the chamber. In this exposure, the mice were exposed to tobacco smoke for 3 hours on the first day, and 4 hours each on the second and third days.

[0102] Group Not Exposed to Tobacco Smoke (Group Exposed to Air)(Air)

Mice were fed the test feed for 14 days (2 weeks) for rearing, and then were exposed to air continuously for 3 days. Also during the exposure to air, the mice were fed the test feed. In the method of exposing the mice to air, the mice were put in a chamber for the exposure to air, and air were sent into the chamber with use of the air pump.

[0103] (Test Method)

Example 2-1

The total amount of the protein source of the standard purified feed (AIN93G) was replaced with whey protein and whey peptide (whey protein:whey peptide = 1:1 (weight ratio)), whereby a whey meal was prepared. The 6 mice in the group exposed to tobacco smoke were continuously allowed to freely take the whey meal as the test feed for 17 days (the rearing period after the switch to the whey meal: 14 days, and the tobacco smoke exposure period: 3 days)

[0104] Example 2-2

The half amount (50 % by weight) of the lipid source of the standard purified feed (AIN93G) was replaced with fish oil, whereby a fish oil meal was prepared. The 6 mice in the group exposed to the tobacco smoke were continuously allowed to freely take the fish oil meal as the test feed for 17 days (the rearing period after the switch to the fish oil meal: 14 days, and the tobacco smoke exposure period: 3 days)

[0105] Example 2-3

The total amount of the protein source of the standard purified feed (AIN93G) was replaced with whey protein and whey peptide (whey protein:whey peptide = 1:1 (weight ratio)), the half amount (50 % by weight) of the lipid source was replaced with fish oil, whereby a whey-fish oil meal was prepared. The 6 mice in the group exposed to tobacco smoke were continuously allowed to freely take the whey-fish meal used as the test feed for 17 days (the rearing period after the switch to the whey-fish oil meal: 14 days, and the tobacco smoke exposure period: 3 days)

[0106] Comparative Example 2

6 mice in the group exposed to tobacco smoke were continuously allowed to freely take the standard purified feed (AIN93G) as the test feed for 17 days (the rearing period with the standard purified feed: 14 days, and the tobacco smoke exposure period: 3 days).

[0107] Contrast Example 2

6 mice in the group not exposed to tobacco smoke were continuously allowed to freely take the standard purified feed (AIN93G) as the test feed for 17 days (the rearing period with the standard purified feed: 14 days, and the tobacco smoke exposure period: 3 days).

[0108] (Evaluation)

As indices of inflammation of the alveoli, the neutrophil chemokine (KC) concentration, the Matrix Metalloproteinase 9 (MMP-9) concentration and the neutrophils count were used. Here, the measurement value of each index was evaluated by means $\pm$ standard deviation. Further, in statistical analysis, the Dunnett's test or the Steel's test was used with the comparative example 2 as a control group.

[0109] When the measurement value of each index is high in the comparative example 2 as compared to the contrast example 1, inflammation was elicited in the comparative example 1. On the other hand, in the examples 2-1 to 2-3, when the measurement value of each index is low as compared to the comparative example 2, inflammation is reduced in the examples 2-1 to 2-3. The method similar to that of the experiment 1 was used in the measurement of each index.

[0110] The KC concentration of the cleaning liquid for the alveoli in the examples 2-1 to 2-3, the comparative example 2 and the contrast example 2 is shown in Fig. 6. As shown in Fig. 6, the KC concentration was significantly high in the comparative example 2 as compared to the contrast

example 2. In the example 2-1, the KC concentration had a tendency to be low as compared to the comparative example 2. In the example 2-2, the KC concentration was significantly low as compared to the comparative example 2. In the example 2-3, the KC concentration had a tendency to be low as compared to the comparative example 2. Further, the KC concentration was about the same level of a numeric value in the example 2-3 as the example 2-2.

[0111] The MMP-9 concentration of the cleaning liquid for the alveoli in the examples 2-1 to 2-3, the comparative example 2 and the contrast example 2 is shown in Fig. 7. As shown in Fig. 7, the MMP-9 concentration was significantly high in the comparative example 2 as compared to the contrast example 2. The MMP-9 concentration had a tendency to be low in the example 2-1 as compared to the comparative example 2. The MMP-9 concentration was significantly low in the example 2-2 as compared to the comparative example 2. The MMP-9 concentration had a tendency to be low in the example 2-3 as compared to the comparative example 2.

[0112] The neutrophils count of the cleaning liquid for the alveoli in the examples 2-1 to 2-3, the comparative example 2 and the contrast example 2 is shown in Fig. 8. As shown in Fig. 8, the neutrophils count was significantly high in the comparative example 2 as compared to the contrast example 2. The neutrophils count had a tendency to be low in the example 2-1 as compared to the comparative example 2. The neutrophils count was significantly low in the example 2-2 as compared to the comparative example 2. The neutrophils count was significantly low in the example 2-3 as compared to the comparative example 2.

[0113] (Study)

In the comparative example 2, the measurement value of each index was high as compared to the contrast example 2. From this result, it is found that inflammation is elicited by exposure to tobacco smoke. On the other hand, in the examples 2-1 to 2-3, the measurement value of each index was low as compared to the comparative example 2. That is, when mice took the nutritional composition to which whey protein and whey peptide were added, and the nutritional composition to which the fish oil was added, even though the mice were exposed to tobacco smoke, each index value indicated a low value. From this result, it is found that the nutritional composition according to the present disclosure lowers the concentration of

neutrophil chemokine elicited by COPD, and controls an increase in number of inflammatory cells (neutrophils count). Further, it is found that the nutritional composition according to the present disclosure reduces a secretion volume of enzymes that is discharged from inflammatory cells and cause damage to alveolar tissues. That is, it was confirmed that the nutritional composition according to the present disclosure, whey protein, whey peptide and fish oil are effective for reducing inflammation (anti-inflammatory effect).

[0114] [Experiment 3. Evaluation Test (1) of Nutritional Composition with use of Animal Model of Hepatitis]

(Method of Producing Animal Model of Hepatitis)

17 male mice (six weeks old) of C57BL/6J series were used.

[0115] (Test Method)

Example 3

8 mice were continuously allowed to freely take the nutritional composition (Table 1) that is the same as the nutritional composition used in the experiment 1 as the test feed for 14 days (2 weeks). Then, 11 mg of Concanavalin A (ConA)/kg (11 mg per 1 kg of the weight of a mouse) was administered to each mouse through its tail vein, and hepatitis was induced.

[0116] Comparative Example 3

9 mice were continuously allowed to freely take the general liquid diet (Meibalance HP, manufactured by Meiji Co., Ltd.) as the test feed for 14 days (2 weeks). Then, 11 mg of Concanavalin A (ConA)/kg (11 mg per 1 kg of the weight of a mouse) was administered to each mouse through its tail vein, and hepatitis was induced.

[0117] (Evaluation)

As indices of hepatitis, plasma aspartic acid aminotransferase (AST) activity and plasma alanine aminotransferase (ALT) activity were used. As indices of the nutrient state, plasma albumin and plasma total protein were used. As indices of inflammation, plasma TNF- α , plasma IL-6 and plasma MCP-1 were used. The measurement value of each index of hepatitis, the nutrient state and inflammation was evaluated by means $\pm$ standard deviation. In the statistical analysis, the Student-t test was used in the case of homoscedasticity, and the Mann-Whitney test was used in the case of heteroscedasticity, with the comparative 3 as a control group.

[0118] When the measurement value of each index of hepatitis is low in the example 3 as compared to the comparative example 3, hepatitis is controlled in the example 3. On the other hand, when the measurement value of each index of the nutrient state is high in the example 3 as compared to the comparative example 3, deterioration of the nutrient state is prevented or eased. When the measurement value of each index of inflammation is low in the example 3 as compared to the comparative example 3, inflammation is reduced.

[0119] Blood was collected from the tail vein of each mouse when 2 hours and 4 hours have elapsed since the administration of Con A to each mouse through its tail vein, and this blood was used in the measurement of plasma TNF- α , plasma IL-6 and plasma MCP-1. On the other hand, blood was collected from the aorta in the abdomen of each mouse under ether anesthesia when 24 hours has elapsed since the administration of ConA to each mouse through its tail vein, and this blood was used in the measurement of plasma AST activity, plasma ALT activity, plasma albumin and plasma total protein.

[0120] In the measurement of plasma AST activity, plasma ALT activity, plasma albumin and plasma total protein, an exclusive slide chip (FUJI DRY-CHEM NX 500, manufactured by Fujifilm Corporation) was used. In the measurement of plasma TNF- α , plasma IL-6 and plasma MCP-1, the Cytometric Bead Array (CBA) Mouse Inflammation kit (Japan Becton, Dickinson and Company) manufactured by Japan Becton, Dickinson and Company was used.

[0121] [Evaluation Result of Hepatitis]

The plasma AST activity obtained when 24 hours has elapsed since ConA was administered to the mouse through its tail vein in each of the example 3 and the comparative example 3 is shown in Fig. 9. As shown in Fig. 9, the plasma AST activity was significantly low in the example 3 as compared to the comparative example 3.

[0122] The plasma ALT activity obtained when 24 hours has elapsed since ConA was administered to the mouse through its tail vein in each of the example 3 and the comparative example 3 is shown in Fig. 10. As shown in Fig. 10, the plasma ALT activity was significantly low in the example 3 as compared to the comparative example 3.

[0123] [Evaluation Result of Nutrient State]

The concentration of plasma albumin and the concentration of plasma total protein obtained when 24 hours has elapsed since ConA was administered to the mouse through its tail vein in the example 3 and the comparative example 3 are shown in the Table 2. As shown in the Table 2, the concentration of the plasma albumin and the concentration of the plasma total protein had a tendency to be high in the example 3 as compared to the comparative example 3.

[0124] [Table 2]

TABLE 2

	UNIT	EXAMPLE 3 (n=8)	COMPARATIVE EXAMPLE 3 (n=9)
PLASMA ALBUMIN	g/dl	1.96±0.09	1.88±0.17
PLASMA TOTAL PROTEIN	g/dl	4.18±0.18	4.17±0.31

n: number of mice

[0125] Note that, it is generally considered that, when ConA is administered to a mouse through its tail vein, and hepatitis is induced, the concentration of the plasma albumin is lowered.

[0126] [Evaluation Result of Inflammation]

Each concentration of plasma TNF- α obtained when 2 hours and 4 hours have elapsed since ConA is administered to a mouse through its tail vein in the example 3 and the comparative example 3 is shown in Fig. 11. As shown in Fig. 11, the concentration of the plasma TNF- α was significantly low in the example 3 as compared to the comparative example 3.

[0127] Each concentration of plasma IL-6 obtained when 2 hours and 4 hours have elapsed since ConA was administered to a mouse through its tail vein in the example 3 and the comparative example 3 is shown in Fig. 12. As shown in Fig. 12, the concentration of plasma IL-6 was significantly low in the example 3 as compared to the comparative example 3.

[0128] Each concentration of each plasma MCP-1 obtained when 2 hours and 4 hours have elapsed since ConA was administered to a mouse through its tail vein in the example 3 and the comparative example 3 is shown in Fig.

13. As shown in Fig. 13, the concentration of plasma MCP-1 was significantly low in the example 3 as compared to the comparative example 3.

[0129] (Study)

The measurement value of each index was low in the example 3 (the mice that have orally taken the nutritional composition shown in the Table 1) as compared to the comparative example 3 (the mice that did not orally take the nutritional composition shown in the Table 1). From this result, it is found that the nutritional composition according to the present disclosure prevents and/or eases hepatitis, deterioration of the nutrient state and the inflammation that are elicited by hepatitis over time. That is, it was confirmed that the nutritional composition according to the present disclosure is effective for reducing inflammation (anti-inflammatory).

[0130] [Experiment 4. Evaluation Test (2) of Nutritional Composition with use of Animal Model of Hepatitis]

19 male mice (six weeks old) of C57BL/6J series were used.

[0131] (Test Method)

Example 4-1

7 mice were continuously allowed to freely take the mixture of the fluid nutritional composition according to the present disclosure and the general liquid diet (Meibalance HP manufactured by Meiji Co., Ltd.) (the nutritional composition:the liquid diet = 50:50 (weight ratio)) as the test feed for 14 days. Then, 12 mg of Concanavalin A (ConA)/kg (12 mg per 1 kg of the weight of a mouse) was administered to each mice through its tail vein, and hepatitis was induced. The composition of the nutritional composition used in the examples 4-1 and 4-2 is shown in the Table 3.

[0132] [Table 3]

TABLE 3

	WEIGHT(/100kcal)
PROTEIN(g)	5.1
WHEY PEPTIDE (g)	4.2
WHEY PROTEIN (g)	0.6
VALINE (g)	0.05
LEUCINE (g)	0.10
ISOLEUCINE (g)	0.05
LIPID(g)	2.8
VEGETABLE OILS AND FATS (g)	1.9
MEDIUM - CHAIN TRIGLYCERIDE (g)	0.6
FISH OIL (g)	0.13
DERIVED FROM OTHER MATERIALS (g)	0.16
SACCHARINITY -CARBOHYDRATES(g)	13.6
SACCHARINITY	
PALATINOSE (g)	7.2
DEXTRION (g)	3.4
DERIVED FROM WHEY PROTEIN (g)	0.3
DERIVED FROM OTHER MATERIALS (g)	0.4
ORGANIC ACID (g)	2.7
DIETARY FIBER(g)	
INDIGESTIBLE DEXTRIN OR THE LIKE (g)	1.2
VITAMINS	
VITAMIN A (μ g RE)	154
VITAMIN D (μ g)	0.77
VITAMIN E (mg)	5.1
VITAMIN B ₁ (mg)	0.26
VITAMIN B ₂ (mg)	0.31
VITAMIN B ₆ (mg)	0.31
VITAMIN B ₁₂ (μ g)	0.62
NIACIN(mg)	3.0
PANTOTHENIC ACID(mg)	1.2
FOLIC ACID(μ g)	51
VITAMIN C(mg)	51
MINERALS	
POTASSIUM(mg)	82
SODIUM (mg)	72
CALCIUM (mg)	82
MAGNESIUM (mg)	21
IRON (mg)	1.0
ZINC (mg)	1.0

[0133] The pH of the nutritional composition shown in the Table 3 is 4.1. The caloric density of this nutritional composition is 159 kcal/100 ml. The protein-energy ratio of this nutritional composition is 20 %. The protein source of this nutritional composition includes 4.2 g/100 kcal of whey protein and 0.6 g/100 kcal of whey peptide. The ratio of the sum of the weight of whey protein and whey peptide to the total weight of the protein source of this nutritional composition is 96 % by weight. This nutritional composition includes 0.098 g/100 kcal of EPA and 0.035 g/100 kcal of DHA.

[0134] Example 4-2

6 mice with hepatitis were continuously allowed to freely take the nutritional composition (Table 3) that is the same as the example 4-1 as the test feed for 14 days.

[0135] Comparative Example 4

6 mice with hepatitis were continuously allowed to freely take the general liquid diet (Meibalance HP, manufactured by Meiji Co., Ltd.) as the test feed for 14 days.

[0136] (Evaluation)

As the indices of hepatitis, the plasma AST activity and the plasma ALT activity were used. As the indices of the nutrient state, the plasma albumin and plasma total protein were used. As the indices of inflammation, the plasma TNF- α and the plasma IL-6 were used. The measurement value of each index of the hepatitis, the nutrient state and the inflammation were evaluated by means $\pm$ standard deviation. In the statistical analysis, the Student-t test was used in the case of homoscedasticity, and the Mann-Whitney test was used in the case of heteroscedasticity, with the comparative example 4 as a control group. The method similar to the method used in the experiment 3 was used in the measurement of each index.

[0137] Evaluation Result of Hepatitis

The plasma AST activity obtained when 24 hours has elapsed since ConA was administered to the mouse through its tail vein in the examples 4-1 to 4-2 and the comparative example 4 is shown in Fig. 14. As shown in Fig. 14, the plasma AST activity was significantly low in the examples 4-1 and 4-2 as compared to the comparative example 4.

[0138] The plasma ALT activity obtained when 24 hours has elapsed since ConA was administered to the mouse through its tail vein in the examples

4-1 to 4-2, and the comparative example 4 is shown in Fig. 15. As shown in Fig. 15, the plasma ALT activity was significantly low in the examples 4-1 and 4-2 as compared to the comparative example 4.

[0139] [Evaluation Result of Nutrient State]

The concentration of plasma albumin and the concentration of plasma total protein obtained when 24 hours has elapsed since ConA was administered to the mouse through its tail vein in the examples 4-1 to 4-2, and the comparative example 4 are shown in the Table 4. As shown in the Table 4, the concentration of the plasma albumin had a tendency to be high in the example 4-1 as compared to the comparative example 4. The concentration of the plasma albumin was significantly high in the example 4-2 as compared to the comparative example 4. The concentration of plasma total protein had a tendency to be high in the examples 4-1 to 4-2 as compared to the comparative example 4.

[0140] [Table 4]

TABLE 4

	UNIT	EXAMPLE 4-1 (n=7)	EXAMPLE 4-2 (n=6)	COMPARATIVE EXAMPLE 4 (n=6)
PLASMA ALBUMIN	g/dl	1.99±2.13 ^{ab}	2.13±0.10 ^b	1.87±0.08 ^a
PLASMA TOTAL PROTEIN	g/dl	4.44±0.24	4.25±0.26	4.08±0.39

n: number of mice

[0141] [Evaluation Result of Inflammation]

Each concentration of plasma TNF- α obtained when 2 hours and 4 hours have elapsed since ConA was administered to the mouse through its tail vein in the examples 4-1 to 4-2 and the comparative example 4 is shown in Fig. 16. As shown in Fig. 16, the concentration of plasma TNF- α was significantly low in the examples 4-1 to 4-2 as compared to the comparative example 4.

[0142] Each concentration of plasma IL-6 obtained when 2 hours and 4 hours have elapsed since ConA was administered to the mouse through its tail vein in the examples 4-1 to 4-2, and the comparative example 4 is shown in Fig. 17. As shown in Fig. 17, the concentration of plasma IL-6 was significantly low in the examples 4-1 to 4-2 as compared to the comparative example 4.

[0143] (Study)

The measurement value of each index was low in the examples 4-1 to 4-2 (the mice that have orally taken the nutritional composition shown in the Table 3) as compared to the comparative example 4 (the mice that did not orally taken the nutritional composition shown in the Table 3). From this result, it is found that the nutritional composition according to the present disclosure prevents and/or eases hepatitis, and deterioration of the nutrient state and inflammation that are elicited by hepatitis over time. That is, it was confirmed that the nutritional composition according to the present disclosure is effective for reducing inflammation (anti-inflammatory).

[0144] [Experiment 5. Evaluation Test of Flavor and Physicality of Fresh Nutritional Composition and Stored Nutritional Composition]

The flavor and physicality of the fresh nutritional composition and the stored nutritional composition shown in the Table 5 were evaluated.

[0145] [Table 5]

TABLE 5

	WEIGHT(/100kcal)
PROTEIN(g)	
WHEY PEPTIDE (g)	3.7
WHEY PROTEIN (g)	3.8
LEUCINE (g)	0.40
DERIVED FROM OTHER MATERIALS (g)	0.07
LIPID(g)	
VEGETABLE OILS AND FATS (g)	3.10
MEDIUM - CHAIN TRIGLYCERIDE (g)	0.82
FISH OIL (g)	0.21
DERIVED FROM OTHER MATERIALS (g)	0.38
SACCHARINITY -CARBOHYDRATES(g)	
SACCHARINITY	
PALATINOSE (g)	5.6
DEXTRION (g)	12.7
DERIVED FROM OTHER MATERIALS (g)	1.8
ORGANIC ACID (g)	1.6
DIETARY FIBER(g)	
INDIGESTIBLE DEXTRIN OR THE LIKE (g)	1.6
DERIVED FROM OTHER MATERIALS (g)	0.1
VITAMINS	
VITAMIN A (μ g RE)	240
VITAMIN D (μ g)	1.20
VITAMIN E (mg)	8.0
VITAMIN B ₁ (mg)	0.40
VITAMIN B ₂ (mg)	0.48
VITAMIN B ₆ (mg)	0.48
VITAMIN B ₁₂ (μ g)	0.96
NIACIN(mg)	6.4
PANTOTHENIC ACID(mg)	1.9
FOLIC ACID(μ g)	80
VITAMIN C(mg)	80
MINERALS	
POTASSIUM (mg)	128
SODIUM (mg)	112
CALCIUM (mg)	128
MAGNESIUM (mg)	32
IRON (mg)	1.6
ZINC (mg)	1.6

[0146] The pH of the nutritional composition shown in the Table 5 is 4.1. The caloric density of this nutritional composition is 151 kcal/100 ml. The protein-energy ratio of this nutritional composition is 21 %. The protein source of this nutritional composition includes 2.4 g/100 kcal of whey protein and 2.5 g/100 kcal of whey peptide. The ratio of the sum of the weight of whey protein and whey peptide to the total weight of the protein source of this nutritional composition is 96 % by weight. This nutritional composition includes 0.157 g/100 kcal of EPA and 0.056 g/100 kcal of DHA.

[0147] The manufacturing conditions of the nutritional composition shown in the Table 5 are that the melting temperature of the liquid mixture (ingredients) is 50 to 60 °C (target temperature:55 °C), the pasteurization temperature and the pasteurization time period of the liquid mixture are 124 °C and 5 seconds, the homogenizing pressure of the sanitizer solution is 40 MPa (pre-homogenization) and 25 MPa (main-homogenization), and the shape and capacity of the container are a brick carton package (manufactured by Tetra Pak) and 125 ml. Each nutritional composition shown in the Table 1 and the Table 3 were manufactured under the similar manufacturing conditions.

[0148] (Test Method)

The fresh nutritional composition and the stored nutritional composition (stored for 3 months, and stored for 6 months) shown in the Table 5 were evaluated.

[0149] Flavor

[0150] As for the flavor of the fresh nutritional composition and the stored nutritional composition, sensory evaluation on a scale of 1 to 5 (5:excellent, 4:good, 3:average, 2:below average, 1:poor) was carried out by a panel of 10 experts.

[0151] Physicality

The physicality of each of the fresh nutritional composition and the stored nutritional composition was evaluated by the specific gravity, the pH, the viscosity, the particle size distribution, the amount of precipitation by centrifugation and the creaming rate.

[0152] In the measurement of the specific gravity of each of the fresh nutritional composition and the stored nutritional composition, the feed was adjusted to 20 °C, and then a specific gravity meter (DA-130N, manufactured by Kyoto Electronics Manufacturing Co., LTD.) was used.

[0153] In the measurement of pH of each of the fresh nutritional composition and the stored nutritional composition, the feed was adjusted to 20 °C, and a pH meter (F-53, manufactured by HORIBA Ltd.) was used.

[0154] In the measurement of the viscosity of each of the fresh nutritional composition and the stored nutritional composition, the feed was adjusted to 20 °C, and a B-type rotational viscometer (TVB10, manufactured by TOKI SANGYO CO., LTD.) was used. The operation conditions for this viscometer were that the rotation speed was 60 rpm, and the retention time was 60 seconds.

[0155] In the measurement of the particle size distribution of each of the fresh nutritional composition and the stored nutritional composition, a reflective laser-type particle diameter distribution measuring device (SALD-2200, manufactured by SHIMADZU Corporation) was used. The index was a median diameter (median).

[0156] In the measurement of the amount of precipitation by centrifugation of each of the fresh nutritional composition and the stored nutritional composition, the following method was used. First, the weight of a glass centrifuge tube (a transparent centrifuge tube with a capacity of 50 ml, a round bottom and a horizontal line at 1/2 of the total height and a position that is spaced apart from the top by 5 cm) is measured, and 50 g of each feed (an amount of feed) is precisely weighed. Subsequently, the glass centrifuge tube (with the feed) is centrifuged (1800 g, 30 minutes), and then the liquid layer is gently removed by decantation. Further, the glass centrifuge tube (with precipitation) is placed in an inverted state and left for 30 minutes. After that, the inner peripheral surface of the glass centrifuge tube from the top to the horizontal line is wiped off by a Kimwipe, and then the weight of the glass centrifuge tube (with the residue) is measured. Then, the amount of precipitation by centrifugation is calculated by the following formula (1).

[0157] The amount of precipitation by centrifugation [% by weight] = (the weight of the centrifuge tube (with the residue) [g] – the weight of the centrifuge tube (tare) [g])/the weight of the feed [g]× 100 …(1)

In the measurement of the creaming rate of each of the fresh nutritional composition and the stored nutritional composition, the following method was used. First, the weight of a glass centrifuge tube (a transparent centrifuge tube with a capacity of 50 ml, a round bottom and a horizontal line at 1/2 of the total height and a position that is spaced apart

from the top by 5 cm) is measured, and 50 g of each feed (an amount of feed) is precisely weighed. Subsequently, the glass centrifuge tube (with the feed) is centrifuged (1800 g, 30 minutes), and then the cream layer (the upper portion) is moved to another glass centrifuge tube by a spatula. Further, the glass centrifuge tube (with the cream layer) is placed in an inverted state and left for 30 minutes. After that, the inner surface of the glass centrifuge tube from the top to the horizontal line is wiped off by a Kimwipe, and then the weight of the glass centrifuge tube (with the residue) is measured.

Then, the creaming rate is calculated by the following formula (2).

[0158] The creaming rate [% by weight] = (the weight of the centrifuge tube (with the residue) [g] – the weight of the centrifuge tube (tare) [g])/the weight of the feed [g] × 100 …(2)

(Evaluation)

The evaluation standards for the flavor and the physicality, and the evaluation values of each of the fresh nutritional composition and the stored nutritional composition (Table 5) (stored for 3 months and 6 months) used in the experiment 5 are shown in the Table 6. When each evaluation value of the fresh nutritional composition and the stored nutritional composition meets each evaluation standard, it means that the flavor and physicality of the nutritional composition are good.

[0159] [Table 6]

TABLE 6

EVALUATION ITEM	UNIT	EVALUATION STANDARDS	FRESH	STORED FOR 3 MONTHS	STORED FOR 6 MONTHS
FLAVOR		NOT LESS THAN 3	5	5	4
SPECIFIC GRAVITY	g/cm ³	1.1-1.2	1.12	1.12	1.12
pH		3.0-5.0	4.0	4.0	4.0
VISCOSITY	mPs/·s	10-100	31	33	29
PARTICLE SIZE DISTRIBUTION (MEDIAN DIAMETER)	μm	not more than 10	2.1	2.2	1.7
AMOUNT OF PRECIPITATION BY CENTRIFUGATION	% BY WEIGHT	NOT MORE THAN 3	0.4	0.4	0.3
CREAMING RATE	% BY WEIGHT	NOT MORE THAN 5	0.9	0.9	1.3

[0160] The specific gravity of the nutritional composition is preferably 1.1 to 1.2 g/cm³ in order for a large amount of energy to be consumable when a small amount of the nutritional composition is eaten or drank. The pH of the nutritional composition is preferably 3 to 5 in order for a moderate sterile condition to be settable and for an appropriate level of acidity (flavor) to be acquired. The viscosity of the nutritional composition is preferably 10 to 100 mPa·s in order for burns and the like in manufacturing equipment to be mostly or completely preventable and for good fluidity to be acquired. The particle size distribution (median diameter) of the nutritional composition is preferably not more than 10 μm in order for emulsion stability to improve. The amount of precipitation by centrifugation of the nutritional composition is preferably not more than 3 % by weight in order for emulsion stability to improve. The creaming rate of the nutritional composition is preferably not more than 5 % by weight in order for good physicality and good quality to be maintained.

[0161] Flavor

[0162] As shown in the Table 6, the flavor of each of the fresh nutritional composition and the stored nutritional composition (storage condition: 25 °C, stored for 3 months) was evaluated and judged to be excellent. The flavor of the stored nutritional composition (storage condition: 25 °C, stored for 6 months) was evaluated and judged to be good.

[0163] Physicality

As shown in the Table 6, the specific gravity, the pH, the viscosity, the particle size distribution, the amount of precipitation by centrifugation and the creaming rate of the fresh nutritional composition and the stored nutritional composition (storage condition: 25 °C, stored for 3 months, and storage condition: 25 °C, stored for 6 months) met the evaluation standards. That is, even when the nutritional composition according to the present disclosure was stored at room temperature for a long period of time, the physicality of the nutritional composition hardly changed.

[0164] (Study)

It was confirmed that the flavor and the physicality of not only the fresh nutritional composition but also the stored nutritional composition (storage condition: 25 °C, stored for 3 months, and storage condition 25 °C, stored for 6 months) shown in the Table 5 were good. That is, even though the nutritional composition according to the present disclosure includes the

component that influences the flavor and the physicality such as fish oil (DHA and EPA), it was confirmed that the flavor was good, and the physicality was stable even when the nutritional composition was stored at room temperature for a long period of time.

CLAIMS

1. A nutritional composition having fluidity, containing a protein source that includes whey protein and whey peptide, wherein
a ratio of a sum of a weight of the whey protein and a weight of the whey peptide to a total weight of the protein source is not less than 80 % by weight,
a protein energy ratio is not less than 16 % and less than 50 %, and
the nutritional composition
has a caloric density of not less than 100 kcal/100 ml, and
is acidic.
2. The nutritional composition according to claim 1, wherein
a ratio of the weight of the whey protein to the weight of the whey peptide is from 5 : 1 to 1: 10.
3. The nutritional composition according to claim 1 or 2, wherein
a pH of the nutritional composition is not less than 3 and not more than 5.
4. The nutritional composition according to claim 3, further
containing zinc.
5. The nutritional composition according to claim 3, wherein
the protein source further includes leucine.
6. The nutritional composition according to claim 3, further
containing a lipid source including an n-3 fatty acid.
7. The nutritional composition according to any one of claims 1 to 6,
being used for rehabilitation nutrition.
8. The nutritional composition according to any one of claims 1 to 6,
being used to prevent and/or remedy Chronic Obstructive Pulmonary Disease.

9. The nutritional composition according to any one of claims 1 to 6, being used to reduce inflammation.