(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 October 2012 (04.10.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/135774 A2

(51) International Patent Classification:
A23L 2/38 (2006.01) *A23L 2/52* (2006.01)
A23C 9/152 (2006.01) *A23L 2/72* (2006.01)

(21) International Application Number:
PCT/US2012/031707

(22) International Filing Date:
30 March 2012 (30.03.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
13/078,918 1 April 2011 (01.04.2011) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

WO 2012/135774 A2

(54) Title: PROTEIN BEVERAGE AND METHOD OF MAKING THE SAME

(57) Abstract: A protein beverage composition and a method of making it relate to a beverage including a protein essentially free of caseinate and derived from an aqueous protein isolate collected from membrane-filtration isolation of the protein and without substantial drying, wherein the protein beverage composition exhibits a pH ranging from about 2.0 to about 4.6. Substantial solubility of the protein is maintained in the beverage composition, and the protein beverage is essentially free of active microbes known to be harmful to human health, both at the time of packaging of the protein beverage and for a time period of at least one year after packaging.

PROTEIN BEVERAGE AND METHOD OF MAKING THE SAME

RELATED APPLICATIONS

This Application is related to U.S. Patent No. 7,205,018, filed August 30, 2005 as U.S. Patent Application No. 11/215,524, issued April 17, 2007, and entitled "Carbonated Protein Drink and Method of Making," which is related to U.S. Provisional Patent Application Serial No. 60/617,146, filed October 7, 2004, and entitled: "Carbonated Whey Protein Beverage;" U.S. Provisional Patent Application Serial No. 60/648,914, filed January 31, 2005, and entitled: "Carbonated Aqueous Whey Protein Beverage and Method of Making Same;" and, U.S. Provisional Patent Application Serial No. 60/648,974, filed January 31, 2005, and entitled: "Dry Carbonated Whey Protein Beverage and Method of Making Same"; U.S. Patent No. 7,897,192, filed March 10, 2006 as U.S. Patent Application Serial No. 11/373,412, issued March 1, 2011, and entitled "High Energy Carbonated Protein Drink and Method of Making", which is a Continuation-In-Part Patent Application of U.S. Patent No. 7,205,018; U.S. Patent No. 7,794,770, filed March 7, 2007 as U.S. Patent Application Serial No. 11/683,338, issued September 14, 2010, and entitled "Protein Beverage and Method of Making the Same", which is a Continuation-In-Part Patent Application of U.S. Patent No. 7,205,018; U.S. Patent No. 7,906,160, filed March 7, 2007 as U.S. Patent Application Serial No. 11/683,375, issued March 15, 2011, and entitled "Protein Beverage and Method of Making the Same", which is a Continuation-In-Part Patent Application of U.S. Patent No. 7,205,018; U.S. Patent No. 7,799,363, filed March 7, 2007 as U.S. Patent Application Serial No. 11/683,380, issued September 21, 2010, and entitled "Protein Beverage and Protein Beverage Concentrate and Methods of Making the Same", which is a Continuation-In-Part Patent Application of U.S. Patent No. 7,205,018; U.S. Patent No. 7,842,326, filed March 13, 2007 as U.S. Patent Application Serial No. 11/685,641, issued November 30, 2010, and entitled "Carbonated Protein Drink and Method of Making", which is a Continuation Application of U.S. Patent No. 7,205,018, which is related to U.S. Patent Application Serial No. 12/110,263, filed April 25, 2008, and entitled "Protein Beverage and Method of Making The Same," each of which is incorporated herein by reference in its entirety.

This Application claims priority to U.S. Patent Application Serial No. 13/078,918, filed April 1, 2011, and entitled "Protein Beverage And Method Of Making The Same", which is related and claims priority to U.S. Patent Application Serial No. 12/110,263, filed April 25, 2008, and entitled "Protein Beverage and Method of Making The Same", which is related to U.S.

Provisional Patent Application Serial No. 60/956,663, filed August 17, 2007, and entitled: "Protein Beverage and Method of Making the Same" and U.S. Provisional Patent Application Serial No. 60/975,500, filed September 26, 2007, and entitled "Protein Beverage and Method of Making the Same"; Each of these Patent Applications is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to a protein beverage, a protein beverage concentrate, and a protein composition for use in a protein beverage or a protein beverage concentrate, and to methods of making the protein beverage, protein beverage concentrate, and protein composition.

2. Brief Description of the Background Art

This section describes background subject matter related to the disclosed embodiments of the present invention. There is no intention, either express or implied, that the background art discussed in this section legally constitutes prior art. Moreover, this brief description is not intended to fully describe the subject matter of this art, the reader is invited to more thoroughly examine the background to better understand what is disclosed.

Milk contains two major protein fractions, casein, which may provide about 80% by weight of the total protein, and whey protein, which may provide about 20% by weight of the total protein. The whey protein fraction is the protein fraction which may remain soluble when the casein fraction is coagulated (such, for example, as by either enzyme or acid) and separated as cheese curd. Whey protein may include several protein fractions, including, for example, β-lactoglobulin, α-lactoglobulin, Lactalbumin, immunoglobulins (such as IgG1, IgG2, IgA, and IgM, for example), lactoferrin, glycomacropeptides, and lactoperoxidase.

Compared to casein and soy, whey proteins may be highly soluble. Whey proteins may be the least soluble at typically about pH 4.5 to about pH 5.5, which may be the isoelectric point (the pH at which the net electrical charge is zero) for whey protein. In higher acid systems with a pH less than about 4.5, such as in many carbonated beverages, the acid solubility of whey proteins may be especially important; however, protein precipitation may occur during the mixing period when the pH of the whey protein, which typically has a pH of about 6 to about 7,

transitions through the zone of isoelectric points. Protein solubility may be affected by heat, and therefore the elevated temperatures experienced during pasteurization may also negatively affect solubility and fluidity resulting in protein precipitation or gelation.

Whey protein may have a higher biological value and/or protein digestibility corrected amino acid score (PDCAAS) than casein. The physical properties of whey proteins in the digestive tract may be quite distinct from the properties of casein. Caseins may form curds within the stomach, which curds may be slow to exit from the stomach and which curds may increase their hydrolysis prior to entering the small intestine. Alternatively, whey proteins may reach the jejunum almost immediately; however their hydrolysis within the intestine may be slower than that of caseins, so their digestion and absorption may occur over a greater length of the intestine.

The protein efficiency ratio (PER) of a protein source measures the weight gain of young animals per gram of protein eaten over a given time period. Any protein having a PER of 2.5 is considered good quality. Whey protein is considered to be a nutritionally excellent protein, as it has a PER of 3.2. Casein has a PER of 2.5, while many commonly used proteins have a PER of less than 2.5, such as soy protein (PER 2.2), corn protein (PER 2.2), peanut protein (PER 1.8), and wheat gluten (PER 0.8). The higher PER of whey protein may be due in part to the high level of sulfur-containing amino acids in whey protein. Such higher level may contribute to whey protein's ability to enhance immune-function and antioxidant status.

Whey protein is a rich source of branched chain amino acids (BCAAs), containing the highest known levels of any natural food source. BCAAs are important for athletes, since, unlike the other essential amino acids, they are metabolized directly into muscle tissue and are the first amino acids used during periods of exercise and resistance training. Leucine may be important for athletes as it may play a key role in muscle protein synthesis and lean muscle support and growth. Research suggests that individuals who exercise benefit from diets high in leucine and may have more lean muscle tissue and less body fat than individuals whose diet contains lower levels of leucine. Whey protein isolate may have approximately 45% by weight more leucine than soy protein isolate.

Whey protein is available in several forms, with preparations which may range from about 1% to about 99% whey protein. Whey protein preparations may be in an aqueous form created by the removal of casein, but often takes several other forms, such as, for example, but

not by way of limitation, a whey protein extract, whey protein concentrate, whey protein isolate, or whey protein hydrolysate.

Whey protein concentrate may be prepared by removing sufficient non-protein constituents from whey by membrane filtration, so that the finished dry product may be selected to contain whey protein at a given concentration which may range from about 25% by weight to about 89.9% by weight protein. The proteins in cheese whey are concentrated by membrane filtration, vacuum evaporation and spray drying to form whey protein concentrate powder. The proteins are much more concentrated in whey protein concentrate powder than in whey, but the relative amounts of α-lactalbumin, β-lactoglobulin, immunoglobulin, bovine serum albumin, glycomacropeptide, lactoferrin, and lactoperoxidase are not significantly different.

Whey protein isolate may be obtained by removing sufficient non-protein constituents from whey by membrane filtration or ion exchange absorption , so that the finished dry product may contain about 90% by weight or more whey protein, and little, if any, fat, cholesterol, or carbohydrates (e.g., lactose). Prior to concentration and spray drying, aqueous whey protein isolate (WPIaq) may have a whey protein concentration of about 1% by weight to about 35% by weight, and may also be essentially free of fat, cholesterol, and carbohydrates.

Whey protein hydrolysate is a whey protein preparation which may have been subjected to enzymatic digestion with a protease enzyme or limited acid hydrolysis, or a suitable mechanical breakage of peptide bonds to form smaller peptides and polypeptides. The protein concentration of the whey protein hydrolysate may be dependent upon the starting material. For example, a whey protein hydrolysate prepared from an 80% by weight whey protein concentrate may have an 80% by weight protein concentration, and a whey protein hydrolysate prepared from a 90% by weight whey protein isolate may have a 90% by weight protein concentration. Not all hydrolyzed whey proteins may behave alike in a food formulation, and thus one hydrolyzed whey protein may not be interchangeable with another. The functional and biological properties of whey protein hydrolysates may vary depending upon factors, such as degree of hydrolysis and which protease enzyme is used for hydrolysis.

Although hydrolysis of whey protein may lead to increased solubility, it may also negatively impact the taste. Whey protein typically has a fresh, neutral taste which may allow it to be included in other foods without adversely affecting the taste. However, hydrolysis of whey protein may result in a very bitter taste, which may impose a practical limit on the amount of

whey protein hydrolysate that can be used in a food product. Therefore, a high protein beverage made with whey protein hydrolysate may require a large amount of sweeteners, or bitter masking agents to overcome the bitter taste. However, such a large amount of sweetener may not be desirable to many consumers or the bitter aftertaste of the high protein beverage may be difficult or impossible to mask to a satisfactory extent for some applications.

Whey protein contains all of the essential amino acids, and therefore, is a high quality, complete source of protein, where complete means that whey protein contains all the essential amino acids for growth of body tissues. Since whey protein is available in forms containing little fat and carbohydrates, it may be a particularly valuable source of nutrition for athletes and for individuals with special medical needs (e.g., lactose intolerant individuals), and may be a valuable component of a diet program. Further, since whey protein may contain biologically active proteins such as the immunoglobulins, lactoperoxidase, and lactoferrin, whey protein may provide advantages over other protein sources such as soy protein.

Milk serum protein are essentially the same as proteins found in cheese whey, except that they are removed directly from milk, without exposure to the cheese-making process, enzymatic or chemical reactions. Milk serum proteins are the proteins present in milk serum, principally α-lactoglobulin, α-lactalbumin, bovine serum albumin, lactoferrin, and immunoglobulins.

Milk and dairy based products may provide an excellent environment for the growth and propagation of a wide spectrum of microorganisms. Pasteurization, by the application of heat for a specific time, has been the traditional method used for more than 100 years to prevent or reduce the growth of microorganisms and to increase the shelf life of milk and dairy based products. Pasteurization may not kill all microorganisms in milk and dairy products. However, it does reduce their numbers so they are unlikely to cause illness in the people consuming those products. Non-sterile dairy products, including pasteurized dairy products, typically have a shelf life that is limited to a short period of time such as a few weeks due to spoilage from the growth of microorganisms which survived pasteurization or were introduced by post-processing microbial contamination.

The traditional method of pasteurization was vat pasteurization, which involved heating the liquid ingredients in a large vat or tank for at least 30 minutes. Variations on the traditional pasteurization methods have been developed, such as, high temperature short time (HTST) pasteurization, ultra pasteurization (UP) processing, and ultra high temperature (UHT)

pasteurization. These variations on the traditional pasteurization method use higher temperatures for shorter times, and may result in increased shelf lives which may exceed 3 months without refrigeration. However, regardless of the pasteurization method used, stabilizers and preservatives may often be needed to improve the stability of pasteurized products.

Thermal processing by any pasteurization method may have detrimental effects on the organoleptic and nutritional properties of milk and dairy based products. Thus, there may be a need for more non-thermal methods of extending shelf life, which will not significantly decrease or alter the organoleptic and nutritional properties of milk and dairy based products.

One alternative to pasteurization may be high pressure processing (HPP), which may be especially suited to high acid content foods. HPP is a food processing method where food products may be exposed to elevated pressures, in the presence or absence of heat, to inactivate microorganisms. HPP may also be known as high hydrostatic pressure processing (HPP) and ultra high-pressure processing (UHP).

Non-thermal HPP may be used to extend the shelf life of milk and dairy based products without detrimentally altering the organoleptic and nutritional properties of these products. Non-thermal HPP may eliminate thermal degradation, and may allow for the preservation of 'fresh' characteristics of foods. Shelf lives similar to those of pasteurized products may be achieved from HPP.

HPP of a milk or dairy based product may be achieved by placing the product in a container within a water (or other pressure-transmitting fluid) filled pressure vessel, closing the vessel, and increasing the pressure exerted upon the container by pumping more water into the pressure vessel by way of an external pressure intensifier. The elevated pressure may be held for a specific period of time, then it may be decreased. Pressure levels of about 600 MPa at 25 °C may typically be enough to inactivate vegetative forms of microorganisms, such as non-spore forming pathogens, vegetative bacteria, yeast and molds.

HPP is explained in more detail in U.S. Patent 6,635,223 B2 to Maerz, issued Oct. 21, 2003, entitled "Method for inactivating microorganisms using high pressure processing", wherein a method for inactivating microorganisms in a product using high pressure processing is disclosed. The method involves the steps of packing the product in a flexible container, heating the product to a pre-pressurized temperature, subjecting the product to a pressure at a pressurized temperature for a time period; and reducing the pressure after that time period. The method may

also further comprise an additional step of subjecting the product to a predetermined amount of oxygen for a time interval. These methods may be applied to food, cosmetic or pharmaceutical products.

Carbon dioxide (CO_2), a naturally occurring component of raw milk that decreases as raw milk is exposed to air or is pasteurized, is known to have antimicrobial properties. CO_2 results in minimal harm in foods. Therefore, it is a suitable agent for inhibiting food spoilage microorganisms. Currently, there are at least three general mechanisms known by which CO_2 inhibits microorganisms. These mechanisms, outlined briefly below, are discussed in more detail in an article by J. H. Hotchkiss et al., in Comprehensive Reviews in Food Science and Food Safety 2006; 5: 158-168, titled: "Addition of carbon dioxide to dairy products to improve quality: a comprehensive review".

One mechanism by which CO_2 may inhibit microbial growth may simply be by the displacement of O_2 by CO_2. Another mechanism by which CO_2 may inhibit microbial growth may be by lowering the pH of the food by the dissolution of CO_2 and formation of carbonic acid in the aqueous phase of the food by the following equilibrium reactions: $H_2O + CO_2 \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^- \leftrightarrow 2H^+ + CO_3^{2-}$. The third mechanism by which CO_2 may inhibit microbial growth is by a direct effect of CO_2 on the metabolism of microorganisms.

The last mentioned mechanism, the direct antimicrobial effect of CO_2 on the metabolism of microorganisms, may be the result of changes in membrane fluidity due to CO_2 dissolution, reductions in intracellular pH, and direct inhibition of metabolic pathways, including decarboxylation reactions and DNA replication. CO_2 is quite lipophilic, which may allow for it to concentrate within the lipid membrane of bacteria, or to pass through the lipid membrane and to concentrate within the bacterial cell lowering intracellular pH. CO_2 may also interfere directly with required enzymatic processes within microorganisms, such as gene expression.

Published European patent application. EP 0812544 A2 of Henzler et al., published Dec. 17, 1997, entitled "Method for preparing dairy products having increased shelf-life", describes a method for preparing dairy products having increased shelf-life by incorporating CO_2 into such products, comprising contacting a fluid milk fraction of a dairy foodstuff with CO_2, mixing the fluid milk fraction and CO_2 into a solution, and subjecting the solution to conditions sufficient to reach a steady state between the fluid milk fraction and dissolved CO_2. The patented method is

said to be adapted for consumer dairy products of a wide variety, increasing shelf-life to about 45 to about 60 days.

The interaction between HPP and CO_2 and their effects on food spoilage enzymes and microorganisms were described by Corwin and Shellhammer in Journal of Food Science 2002; 67: 697-701, entitled "Combined carbon dioxide and high pressure inactivation of pectin methylesterase, polyphenol oxidase, *Lactobacillus plantarum* and *Escherichia coli*." The enzymes studied were pectin methylesterase (PME) and polyphenol oxidase (PPO) and the microorganisms studied were *Lactobacillus plantarum* ATCC 8014 (*L. plantarum*), an acid tolerant, lactic acid producing, non-spore forming, Gram positive bacterium, and *Escherichia coli* K12 (*E. coli*), an acid sensitive, non-spore forming, Gram negative bacterium. The objective of the study was to determine the effect of CO_2 on increasing the efficacy of pressure processing to inactivate enzymes and microorganisms. CO_2 was added at approximately 0.2 molar % to solutions processed at 500 to 800 MPa in order to further inactivate PME, PPO, *L. plantarum*, and *E. coli*. A significant interaction was found between CO_2 and pressure at 25 °C and 50 °C for PME and PPO, respectively. Activity of PPO was said to be decreased by CO_2 at all pressure treatments. Survival of *L. plantarum* was said to be decreased by the addition of CO_2 at all pressures and the combination of CO_2 and high pressure had a significant interaction. CO_2 was said not to have a significant effect on the survival of *E. coli* under pressure.

U.S. Patent 7,041,327 B2 to Hotchkiss et al., issued May 9, 2006, entitled "Carbon dioxide as an aid in pasteurization", describes processes to inhibit or reduce the growth of bacteria and other pathogens in a liquid by adding CO_2 to the liquid, and thermally inactivating the bacteria and other pathogens, so that the CO_2 enhances the thermal inactivation process. The process is said to be applicable to a wide variety of fluids, liquids, semi-solids and solids. Prior to or simultaneously with thermal inactivation CO_2 is added to the product by sparging or bubbling, preferably to obtain levels of about 400-2000 ppm. At this level of CO_2, the amount of microbial death that occurs during heating in a normal pasteurization (HTST) process is said to be increased by 10% to 90% over thermal inactivation carried out without the addition of CO_2 prior to the thermal inactivation step. After completion of the thermal inactivation process, the free CO_2 is said to be removed.

Protein precipitation and separation out of proteins in protein beverages during manufacturing, shipping, and storage, may be compounded when the beverage contains an additional component, such as juice. Methods are known in the art for attempting to overcome

the precipitation of protein from juice beverages. However, most of these methods involve the use of stabilizers.

Fiber or other carbohydrates may be added as a protein stabilizing agent, such as pectin, cellulose gum, xanthan gum, gum arabic, carageenan, guar gum, dextrin, dextrose monohydrate, and polydextrose. While stabilizers can help prevent protein precipitation, they may have the disadvantage of increasing the viscosity of the drink due to cross-linking with naturally present calcium cations. This increased viscosity may be undesirable as it may lead to a beverage having poor organoleptic properties for at least some applications. The range of amount of stabilizer which may be used may be quite narrow. For example, at a pectin concentration of below 0.06% by weight, sedimentation may be a significant problem, whereas above it, the viscosity of the beverage may be undesirably high. The ideal amount of stabilizer must be experimentally determined for each beverage formula, and may need to be adjusted from one batch to the next. Thus, a beverage formula which does not include a protein stabilizer but generates a beverage with good protein solubility is desirable for many applications.

U.S. Patent 7,101,585 B2, to Shen et al., issued Sept. 5, 2006, entitled: "Ultra High Pressure Homogenization Process for Making a Stable Protein Based Acid Beverage" describes a process for preparing a stable suspension of an acid beverage, wherein a hydrated protein stabilizing agent (A) and a flavoring material (B) are combined as a preblend (I) and combined with either a slurry of a homogenized protein material (C) or a homogenized preblend (II) of a hydrated protein stabilizing agent (A) and a slurry of a protein material (C) to form a blend and pasteurizing and homogenizing the blend. The homogenization of the blend is carried out in two stages comprising a high pressure stage of from 8000 - 30,000 pounds per square inch and a low pressure stage of from 300 - 1,000 pounds per square inch. The acid beverage composition has a pH of from 3.0 to 4.5. This beverage contains juice, but is not carbonated. Pectin is added as a stabilizer.

Published Patent Application US 2003/0099753 A1 of Yang, published May 29, 2003, describes a fruit juice based beverage composition containing a protein selected from the group consisting of whey protein isolate and a combination of whey protein isolate and whey protein hydrolysate; a carbohydrate selected from the group consisting of sucrose, fructose, high fructose corn syrup 42 (HFCS 42), HFCS 55, combination of sucrose, fructose, HFCS 42, and HFCS 55, and combinations of maltodextrin with another carbohydrate selected from the group consisting of sucrose, fructose, HFCS 42, and HFCS 55; an edible acid selected from the group consisting

of citric acid, phosphoric acid, combinations of citric acid and phosphoric acid, and combinations of malic acid with another edible acid selected from the group consisting of citric acid and phosphoric acid; a fruit juice or combinations of fruit juices; various vitamins and minerals; and optional fibers and flavors and a process for making such composition. The composition containing the above ingredients are asserted to be clear, have a pH of about 4.0 or less, and have a viscosity of less than about 40 centipoises. Protein stabilizing agents are used, including pectin.

U.S. Patent 4,478,858 to Dahlen et al., issued October 23, 1984, entitled: "Protein containing fruit drink and process for the manufacture thereof", discloses a protein containing fruit juice drink comprising a fruit juice portion of 10-85% containing a citrus juice portion, a milk raw material portion of 90-15% by weight in which the milk raw material portion comprises whey proteins in an amount of 0.5-10% by weight of the finished product, and, as a sweetener, a hydrolyzed lactose, made of substantially pure lactose prepared from whey or a permeate from ultrafiltration of milk or whey, containing pure glucose and galactose derivative, which is alleged to act as a binder of the protein even in fruit drinks containing a citrus juice portion. The fruit drink may be manufactured in a concentrated form from a protein concentrate, concentrated fruit juice and/or fruit aromas and a concentrated hydrolysed lactose. A polysaccharide containing stabilizer may be added to the concentrate.

DETAILED DESCRIPTION OF CERTAIN EMBODIMENTS

As a preface to the detailed description, it should be noted that, as used in this specification and the appended claims, the singular forms "a", "an", and "the" include plural referents, unless the context clearly dictates otherwise.

The terms "about" and "approximately" as used herein, indicate that the precision of the nominal value presented is ±10%.

The protein beverage composition of the disclosed embodiments of the present invention, produced using the method described below, provides a high protein content (relative to previously described drinks). In addition, while the protein drink may be heat treated to inactivate microbes, the final product exhibits storage shelf-stability which is unexpectedly long for such a product.

We have developed an improved protein beverage/drink, which contains a high protein concentration compared with protein concentrations of drinks previously known in the industry. The typical concentration of protein ranges from about 0.01% by weight to about 15% by weight, more typically the protein concentration ranges from about 2% by weight to about 15% by weight, with the most typical concentration ranging from about 2% by weight to about 5% by weight.

The protein may be whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof. The protein may be a protein isolate, a protein concentrate, a protein hydrolysate, or any combination thereof. The protein may be in liquid or powder form. When in powder form, the protein may be reconstituted in water or another suitable liquid to prepare a protein in liquid form. The pH of the liquid protein may be adjusted with a pH adjusting agent prior to the addition of the liquid protein to the beverage.

In certain embodiments, a protein beverage composition suitable for human consumption, comprising: protein essentially free of caseinate and derived from an aqueous protein isolate, which has been collected from membrane-filtration isolation of the protein and has never been dried; and, wherein said protein beverage composition exhibits a pH ranging from about 2.0 to about 4.6, whereby substantial solubility of the protein is maintained in the beverage composition, and wherein said protein beverage is essentially free of active microbes known to be harmful to human health, both at the time of packaging of the protein beverage and for a time period of at least 18 months after packaging. Typically, the protein beverage composition may contain about 0.01 % by weight to about 15 % by weight protein and a balance of water. More typically, the protein beverage composition may contain about 0.01 % by weight to about 8 % by weight protein and a balance of water. Most typically, the protein beverage composition may contain about 2 % by weight to about 8 % by weight protein and a balance of water. In some embodiments the protein may also be free of lactose and fat.

In other embodiments, a method of preparing a protein beverage, comprising: admixing an aqueous protein isolate, which has been collected from membrane-filtration isolation of the protein and has never been dried, with a pH adjusting agent to provide a pH of between about 2 and about 4.6, thereby obtaining an admixture. Typically, the protein beverage may contain

about 0.01 % by weight to about 15 % by weight protein and a balance of water. More typically, the protein beverage may contain about 0.01 % by weight to about 8 % by weight protein and a balance of water. Most typically, the protein beverage composition may contain about 2 % by weight to about 8 % by weight protein and a balance of water.

In one embodiment, the aqueous protein isolate has a protein concentration of about 0.01 % by weight to about 49 % by weight. The aqueous protein isolate may be whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof. The protein may be a protein isolate, a protein concentrate, a protein hydrolysate, or any combination thereof .

In one embodiment, the protein is essentially free from caseinate. Typically, the essentially caseinate free protein is whey protein, of the kind previously described herein. In some embodiments, the essentially caseinate free protein may have some caseinate or may be a whey protein which may be derived from whey protein isolate or whey protein concentrate, although other whey protein preparations may be used, such as, for example, but not by way of limitation, a whey protein extract or a whey protein hydrolysate. The whey protein isolate may typically be an aqueous whey protein isolate, with a whey protein concentration of about 1 % by weight to about 40 % by weight. The whey protein concentrate may typically be an aqueous whey protein concentrate, with a whey protein concentration of about 1 % by weight to about 40 % by weight. In addition, the total protein content can be increased by the addition of mixtures of proteins such as whey protein and other proteins such as soy proteins.

In certain embodiments, the protein beverage suitable for human consumption comprises: about 2 % by weight to about 8 % by weight protein, derived from an aqueous protein isolate, which has been collected from membrane-filtration isolation of the protein and has never been dried, and a balance of water; and, whereby said protein beverage exhibits a pH ranging from about 3.0 to about 6.0, whereby substantial solubility of the protein is maintained in the beverage composition, and wherein said protein beverage is essentially free of active microbes known to be harmful to human health, both at the time of packaging of the protein beverage and for a time period of at least 18 months after packaging. The protein beverage may optionally further contain about 0 % by weight to about 1.5 % by weight flavor, about 0 % by weight to about 0.5 % by weight sweetener, about 0 % by weight to about 0.5 % by weight acidulent, about 0 % by

weight to about 0.1 % by weight color, and about 0 % by weight to about 1.5 % by weight dietary fiber. In one embodiment, the aqueous protein isolate may be an aqueous whey protein isolate. In another embodiment, the aqueous protein isolate may be an aqueous soy protein isolate. In further embodiments, the aqueous protein isolate may be derived from one or more of edible aqueous proteins, such as, for example, but not limited to, whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof. The protein may be a protein isolate, a protein concentrate, a protein hydrolysate, or any combination thereof .

In certain embodiments, the protein beverage suitable for human consumption may be a flavored water beverage containing protein, which is comprised of about 2 % by weight to about 8 % by weight protein, derived from an aqueous protein isolate, which has been collected from membrane-filtration isolation of the protein and has never been dried, and a balance of water; and, wherein said protein beverage exhibits a pH ranging from about 3.0 to about 6.0, whereby substantial solubility of the protein is maintained in the beverage composition, and whereby said protein beverage is essentially free of active microbes known to be harmful to human health, both at the time of packaging of the protein beverage and for a time period of at least 18 months after packaging. The protein beverage may optionally further contain about 0 % by weight to about 1.5 % by weight flavor, about 0 % by weight to about 0.5 % by weight sweetener, about 0 % by weight to about 0.5 % by weight acidulent, about 0 % by weight to about 0.1 % by weight color, and about 0 % by weight to about 1.5 % by weight dietary fiber. In one embodiment, the aqueous protein isolate may be an aqueous whey protein isolate. In another embodiment, the aqueous protein isolate may be an aqueous soy protein isolate. In further embodiments, the aqueous protein isolate may be derived from one or more of edible aqueous proteins, such as, for example, but not limited to, whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof. The protein may be a protein isolate, a protein concentrate, a protein hydrolysate, or any combination thereof.

Whey protein is a protein fraction obtained from mammalian milk. Commercially available whey protein is typically derived from the milk of cows; however, whey protein may

be derived from the milk of any mammal, such as, for example, but not by way of limitation, the milk of goats, sheep, buffalo, camel, black bear, llama, deer, kangaroo, pig, dog, rabbit, elephant, dolphin, donkey, horse, seal, or human. Alternatively, whey protein may be prepared by recombinant DNA technology, using molecular biology techniques commonly known in the art.

In other embodiments, the protein may be any edible protein, other than whey protein or milk serum protein, such as, for example, but not by way of limitation, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof. The protein may be a protein isolate, a protein concentrate, a protein hydrolysate, or any combination thereof.

In another embodiment, the protein may be a combination of a whey protein and/or milk serum protein, of the kinds previously described herein, and an edible protein, other than whey protein or milk serum protein, such as, for example, but not by way of limitation, casein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, or potato protein .

In one embodiment the protein may be an aqueous soy protein isolate, with a soy protein concentration of about 0.01 % by weight to about 49 % by weight, or more typically of about 1 % by weight to about 20 % by weight. However, other aqueous protein isolates may be used.

Whey protein isolate may be obtained by removing sufficient non-protein constituents from whey by membrane filtration or ion exchange absorption , so that the finished dry product may contain about 90% by weight or more whey protein, and little, if any, fat, cholesterol, or carbohydrates (e.g., lactose). Prior to concentration and spray drying, the whey protein isolate is an aqueous whey protein isolate (WPIaq), which may have a whey protein concentration of about 0.01% by weight to about 49% by weight, and may also be essentially free of fat, cholesterol, and carbohydrates. This aqueous whey protein isolate may also be essentially free of caseinate and lactose.

Aqueous whey protein isolate (WPIaq) may be collected at a concentration by weight of about 20 % to about 35% actual whey protein.

WPIaq may be diluted with water to a protein concentration of about 1 % to about 24 %, representing a range from single-strength beverage protein level to a concentrate suitable for acidification, nutrient addition, transport to a beverage manufacturing facility and subsequent dilution, thermal processing, and containerization.

The distinct advantages of utilizing the aqueous protein stream from membrane filtration may include the absence of damage due to intense shear forces, heat, and dehydration which are inherent to traditional spray-dried protein powder ingredients. Additionally, there may be substantially lower microbial population, especially of yeasts, molds, and related spores which may be introduced into the ingredient during drying. Manufacturing economies are also afforded by obviating the need for spray drying the protein at the protein manufacturer and the re-hydration of protein powders as part of the beverage manufacturing process; time and labor savings as well as reduced protein foam interference may be among the benefits.

If not clouded by added ingredients, the flavor, odor, and clarity or transparency of the finished beverage may be generally superior to a beverage of identical nutrient composition which is produced using powdered whey protein isolate.

While not wishing to be bound by any present theory of action, it is presently believed that lowering the pH of the aqueous whey protein prior to addition to the beverage composition results in a protein beverage with superior organoleptic properties, by preventing or at least greatly reducing precipitation and gelling of the protein as it passes through the zone of isoelectric points. It is believed that prior art drinks did not attempt to move rapidly to the final pH and permitted the composition to dwell too long at low temperatures at or near the isoelectric point, thereby permitting much or all of the material to precipitate. With the inventors' discovery that this transient state of low solubility can be traversed before precipitation commences, practitioners can easily make these clear beverages with minimal testing.

Whey proteins have a high buffering capacity, and therefore this pH adjustment step tends to prevent the whey protein from buffering the acids of the beverage.

The pH adjustment step of the aqueous protein isolate and the final beverage may be done with any suitable acid that is known and apparent to those skilled in the art. These acids may include mineral acids, such as phosphoric acid, which is commonly used in the beverage industry, or hydrochloric acid. Although phosphoric acid is a food grade acid categorized by the FDA (U.S. Food and Drug Administration) as a GRAS substance (Generally Recognized as Safe

substance), it is sometimes considered, in some solutions, as not entirely a "natural" compound when used in food and beverages. Therefore, when preparing an "all natural" or a more natural beverage, an organic acid should be used in place of phosphoric acid, such as citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof. More typically, the organic acids will include, citric acid, malic acid, tartaric acid, or a combination of two or more thereof.

The particular acid or combination of acids used, as well as the amount of each acid used, will depend upon various factors, such as, the desired pH of the aqueous protein isolate, the targeted pH of the final beverage, the protein concentration of the aqueous protein isolate, the protein concentration of the final beverage, the other ingredients used in the final beverage, the targeted shelf life of the aqueous protein isolate, the desired shelf life of the final beverage, the desired flavor of the final beverage, and whether the final beverage is to be marketed as an "all natural" beverage or a more natural beverage.

The acids may be added to the aqueous protein isolate or the final beverage in the form of a dry (granular) acid or in solution form. The solution may be in a concentrated form or a dilute form. When it is desirable to adjust the pH of the aqueous protein isolate or the final beverage without significantly lowering the protein concentration, a dry (granular) acid or a high concentration solution thereof, should be used. When it is desirable to both adjust the pH of the aqueous protein isolate or the final beverage and significantly lower the protein concentration, a more dilute acid solution may be used.

The amount of acid used will vary depending upon which acid is used. As shown in Table 1, below, a smaller amount of tartaric acid is required to lower the pH of the aqueous protein isolate than is required when using citric acid or malic acid.

Table 1 Grams of dry acid (granular) added to reduce the pH of 100.0 g of a 25.0% aqueous protein isolate, wherein the initial pH of the protein is 6.65

pH of 25.0% by weight Aqueous Whey Protein Isolate	Citric Acid (g) added to reach pH	(g) Citric Acid / (kg) Whey Protein (Dry Weight Basis)	Malic Acid (g) added to reach pH	(g) Malic Acid / (kg) Whey Protein (Dry Weight Basis)	Tartaric Acid (g) added to reach pH	(g) Tartaric Acid / (kg) Whey Protein (Dry Weight Basis)
6.65	0.00	0	0.00	0	0.00	0
5.00	1.08	43.2	1.04	41.6	1.02	40.8
4.60	2.0	80	1.55	62	1.43	57.2
4.20	3.90	156	2.95	118	2.35	94
3.80	5.00	200	4.33	173.2	3.15	126
3.50	6.75	270	6.05	242	4.12	164.8
3.20	8.05	322	7.50	300	4.76	190.4

While there are several advantages to using an aqueous protein isolate derived from the protein stream from membrane filtration of the protein, some disadvantages may arise if the aqueous protein isolate needs to be transported from the membrane filtration site to the beverage production site. One disadvantage is that increased transportation time may result in increased microbial contamination of the aqueous protein isolate, due to the presence of microbes in the aqueous protein isolate from the protein stream from the membrane filtration. We have found that this disadvantage can be significantly reduced by inhibiting microbial growth in the aqueous protein isolate by acidification of the aqueous protein isolate, the addition of carbon dioxide to the aqueous protein isolate, or both.

Acids may also act as a preservative by destroying bacteria and inhibiting bacterial proliferation. Therefore, lowering the pH of an aqueous protein isolate may also extend the shelf life of the aqueous protein isolate, allowing for greater storage and/or transportation time of the aqueous protein isolate prior to its use in a protein beverage. The addition of a pH adjusting agent to the aqueous protein isolate allows for the aqueous protein isolate to be stored at room

temperature (about 21 °C) for about 10 days and under refrigeration (about 4 °C) for about a 30 days prior to adding the acidified aqueous protein isolate to the protein beverage.

Microbes may also be inhibited by the addition of carbon dioxide to the aqueous protein isolate. The CO_2 may inhibit microbial growth by the displacement of O_2 by CO_2, by lowering the pH of the aqueous protein isolate by the dissolution of CO_2 and formation of carbonic acid, and by a direct effect of CO_2 on the metabolism of microorganisms. Thus, the addition of carbon dioxide will allow for increased transportation distance and time of the aqueous protein isolate.

Another disadvantage that may arise from using an aqueous protein isolate derived from the protein stream from membrane filtration of the protein is that gradual gelling of the aqueous protein isolate may result during transportation, which gelling will result in an aqueous protein isolate that is difficult to remove from the transportation tote and an aqueous protein isolate that is difficult or impossible to create a clear protein beverage from. We have found that this disadvantage may be overcome by acidification of the aqueous protein isolate, which will result in an aqueous whey protein isolate that remains in solution as a result of the pH of the aqueous protein isolate being adjusted to below the isoelectric point of the protein. Jellation may be avoided by having a protein concentration below about 25%.

In one embodiment of the invention a method of preparing a protein beverage is comprised of admixing an aqueous protein isolate, collected from membrane-filtration isolation of the protein without substantial drying with a pH adjusting agent to provide a pH of between about 2 and about 4.6, thereby obtaining an acidified protein admixture; storing the acidified protein admixture, at room temperature for up to about 10 days or with refrigeration for up to about a month, until the acidified protein mixture is needed for preparing the protein beverage; admixing the acidified protein mixture with at least one additional ingredient selected from the group consisting of water, juice, alcohol, carbonation, a concentrated plant extract, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a flavoring agent, a sweetener, a preservative, and a coloring agent.

In another embodiment of the invention a method of preparing a protein beverage is comprised of admixing an aqueous protein isolate, collected from membrane-filtration isolation of the protein without substantial drying with a pH adjusting agent to provide a pH of between about 2 and about 4.6, thereby obtaining an acidified protein admixture; transporting the acidified protein admixture, at room temperature for up to about 10 days or with refrigeration for

up to about a month, to another geographic location where the acidified protein mixture is needed for preparing the protein beverage; admixing the acidified protein mixture with at least one additional ingredient selected from the group consisting of water, juice, alcohol, carbonation, a concentrated plant extract, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a flavoring agent, a sweetener, a preservative, and a coloring agent.

In some embodiments the protein beverage may contain juice. The typical concentration of juice in the finished beverage ranges from about 0% by weight to about 100% by weight, more typically the juice concentration ranges from about 0% by weight to about 98% by weight, with the most typical concentration ranging from about 0% to about 25% by weight. Typically the juice source may be fruit juice, vegetable juice, or a combination thereof, and may be added in whole, as a liquid, a liquid concentrate, a puree, or in another modified form containing one or more juice components. More typically, the juice may be depectinized, having had most of the pectins removed by enzymatic digestion, chromatography, precipitation, or by another method of juice depectinization. One method by which the juice may be depectinized is by treating it with pectinase enzyme, as described in detail in U.S. Pat. No. 6,620,452 B1. A depectinized juice may typically be a juice with a pectin content of about 0.05 weight % to about 0.25 weight %.

A single fruit juice, a single vegetable juice, fruit juice blends, vegetable juice blends, or fruit and vegetable juice blends may be used. Examples of a few of the many specific juices which may be used may include juice from alfalfa sprouts, apples, apricots, avocados, bamboo shoots, bananas, beans, bean sprouts, beets, berries of all types, cabbage, carrots, celery, cherries, cucumbers, currants, dates, figs, grapefruits, grapes, guava, kiwi, kumquat, lemons, limes, lychee fruit, mandarin, mango, melons of all types, nectarines, noni, oranges, papaya, passion fruit, peaches, pears, pineapples, plums, pomegranates, prunes, radishes, rhubarbs, rutabagas, seaweed, squash, tangelo, tangerines, tomatoes, and/or turnips; however, any type of juice may be used.

In some embodiments the protein beverage may be carbonated. The amount of carbonation which has been achieved while maintaining stability of the carbonated drink is unexpectedly high in view of the amount of protein present, with the amount of carbonation ranging from about 0.1 volumes of carbonation (per volume of liquid present in the beverage) to about 6 volumes of carbonation. More typically, the amount of carbonation present ranges from about 1.6 volumes to about 3.5 volumes, with the most typical concentration ranging from about 1.7 volumes to about 3.0 volumes.

Additives may be combined with the basic high protein beverage formulation to provide a "high energy" high protein beverage. For example, caffeine may be added to increase the level of circulating fatty acids in the body of a consumer of the beverage. This increase in circulation has been shown to increase the oxidation of these fuels, enhancing fat oxidation in general. Caffeine is well known as a means of enhancing fatty acid metabolism.

Another additive which may be included is magnesium. Magnesium may affect energy level and may be needed for more than about 300 biochemical reactions in the body. Magnesium may help regulate blood sugar levels, may promote normal blood pressure, and may support energy metabolism and protein synthesis.

A third additive may be added to affect energy level. The third additive may be citrulline malate. Citrulline is an amino acid which may play a role in nitrogen balance and metabolic processes. Supplemental citrulline malate is a salt form of the amino acid. Citrulline malate may improve aerobic performance and capacity by influencing lactic acid metabolism and reducing fatigue.

One or more of these effects on metabolism have been supported by evidence of an increase in the rate of oxidative adenosine triphosphate (ATP), which is essentially a “molecular currency” of intracellular energy transfer, and an increase in energy production during the exercise of muscles. These three additives which assist in the generation of energy, and combinations thereof, have been formulated into the high protein beverages described herein with little or no adverse effect on manufacturability or shelf storage life of the product.

The citrulline malate energy generating additive may have a very bitter taste in free form. We were surprised to discover that citrulline malate employed in a protein beverage of the kind described herein, provides a pleasant tasting beverage without the need to make a major modification from the recipes which do not contain the citrulline malate.

In addition to the high protein concentration, the protein beverage is essentially free from biologically pathogenic microbes such as bacteria and other spoilage pathogens of the kind which are monitored by the food industry in general. Due to the method used to inactivate the biologically pathogenic microbes, the protein beverage is essentially free from these pathogenic microbes for more than 18 months after packaging of the protein beverage into individual containers or servings and storage under shelf conditions which are standard in the unrefrigerated beverage industry. In addition to absence of biologically pathogenic microbes, there is little or

no precipitation of protein, little or no thickening, flavor and color are maintained, and taste and mouth feel are maintained. In formulations which are designed to be transparent, without turbidity, the protein beverage is clear in color after this storage period. The recommended storage temperature is above freezing (32° F) to about 75° F. Storage of the protein beverage at temperatures in excess of 100° F for time periods of several months, such as about five months, are even possible without detriment to the taste and clarity.

In one embodiment, the protein drink may be treated to inactivate microbes in the presence of carbonation which may be used to provide taste and mouth feel for the drink, while maintaining the required minimal amount of carbonation to provide such taste and mouth feel.

The treatment to inactivate or remove microbes may include thermal processing by exposure to elevated temperature, aseptic packaging, carbonation, ozonation, radiation, ultra violet light, high pressure processing, filtration, membrane permeation, pulsed electric field, sonication, and combinations thereof. Typically, the treatment for microbe inactivation may be carried out in the individual serving package used for storage and handling of the carbonated protein drink. Testing has shown that for microbe inactivation carried out in the individual serving package, plate count for microbes is negligible and typically zero after a storage period of more than 18 months at temperatures ranging between 35° F and about 75° F.

In one embodiment, thermal processing is not used to inactivate microbes. In this embodiment the microbial inactivation is due to the addition of carbon dioxide to the protein drink. As previously described, the CO_2 may inhibit microbial growth by the displacement of O_2 by CO_2, by lowering the pH of the carbonated protein beverage by the dissolution of CO_2 and formation of carbonic acid, and by a direct effect of CO_2 on the metabolism of microorganisms.

In another embodiment, thermal processing is not used to inactivate microbes. In this embodiment the microbial inactivation is due to high pressure processing (HPP) of the protein drink. The HPP may be applied to the protein drink prior to carbonation and packaging, after carbonation and prior to packaging, or after carbonation and packaging. The HPP may also be used for a protein drink that is not carbonated. Various types of HPP equipment systems may be used, such as those produced by Avure Technologies of 22408 66th Avenue South, Kent, WA 98032, Elmhurst Research, Inc. of 60 Loudonville Rd., Albany, NY 12204, and NC Hyperbaric of 28760 Tres Cantos, Madrid, Spain.

The HPP may be achieved by placing the protein beverage in a container within a water (or other pressure-transmitting fluid) filled pressure vessel, closing the vessel, and increasing the pressure exerted upon the container by pumping more water into the pressure vessel by way of an external pressure intensifier. The elevated pressure may be held for a specific period of time, then it may be decreased. Pressure levels of about 600 MPa at 25 °C may typically be enough to inactivate vegetative forms of microorganisms, such as non-spore forming pathogens, vegetative bacteria, yeast and molds. The HPP may be carried out by the method described in U.S. Pat. No. 6,635,223 B2 to Maerz, issued Oct. 21, 2003, entitled "Method for inactivating microorganisms using high pressure processing".

In another embodiment, thermal processing is not used to inactivate microbes. In this embodiment the microbial inactivation is due to the combined effects of the addition of carbon dioxide to the protein drink and HPP of the carbonated protein drink. The HPP may be applied to the carbonated protein drink prior to packaging or after packaging.

In other embodiments, thermal processing is not used to inactivate microbes. In these embodiments the microbial inactivation may be due to carbonation, aseptic packaging, ozonation, radiation, ultra violet light, HPP, membrane permeation, pulsed electric field, sonication, combinations thereof and others.

In yet another embodiment of the invention, thermal processing is used to inactivate microbes. The bulk beverage is pasteurized in a manner common to the beverage and fruit juice industries known as "hot-fill", where product is thermally processed in a continuous flow with a maximum temperature of about 160 °F to about 200 °F with a holding time at that maximum temperature ranging from about 15 seconds to about 3 seconds. Product is cooled slightly to about 160°F to about 185 °F just prior to being filled into glass or plastic containers designed for hot-fill.

Continuous process method has several advantages over the vat method, the most important being time and energy saving. For most continuous processing, a high temperature short time (HTST) pasteurizer is used. The heat treatment is accomplished using a plate heat exchanger. This piece of equipment consists of a stack of corrugated stainless steel plates clamped together in a frame. There are several flow patterns that can be used. Gaskets are used to define the boundaries of the channels and to prevent leakage. The heating medium can be vacuum steam or hot water.

A protein beverage of an embodiment of the invention may further contain additional additives to: enhance the nutritional value (other than those particularly added for energy generation enhancement); aid in protection of the muscular system and joints during physical activity; add to the flavor value of the beverage; or, to provide a desired appearance of the beverage, provided that the additional agent is stable in the beverage. In an embodiment of the invention the protein beverage may be consumed as a meal replacement. Examples of additional agents which enhance nutritional value include nutrients such as vitamins, minerals (including calcium or a calcium derivative), herbal supplements, concentrated plant extracts, glucosamine, amino acids, fatty acids, and fiber. The examples include the following: vitamins such as vitamin A, vitamin C, vitamin D, and vitamin E, by way of example and not by way of limitation; minerals such as zinc, chromium, iron, calcium, magnesium (previously mentioned), and potassium, by way of example and not by way of limitation; herbal supplements such as ginseng, gingko biloba, saw palmetto, green tea, and hoodia gordonii, by way of example and not by way of limitation; amino acids, such as L-Glutamine, L-Arginine, Taurine, creatine, N-acetyl-cystine, N-acetyl-carnitine, L-Leucine, L-isoleucine and L-valine, by way of example and not by way of limitation; fatty acids such as docosahexaenonic acid (DHA), eicosapentaeonic acid (EPA), Omega 3's and Omega 6's, by way of example and not by way of limitation; and fiber such as oligofructopolysaccharides, corn fiber, oat fiber, and flax fiber, by way of example and not by way of limitation.

Concentrated plant extracts, which may be high in vitamins and nutrients, while low in calories, may be added. These extracts may be derived from fruits, herbs, vegetables, and other plants which may have high content of nutritional components. Production of the extracts may be carried out by conventional methods, such as those described in detail in U.S. Patent 6,620,452 B1; however, these extracts may be commercially available. One example of these extracts may be the extract derived from green tea, called Sunphenon 90M, from Taiyo International, Minneapolis, Minnesota 55416, USA.

An example of an additive to aid in protection of the muscular system and joints during physical activity may be a hyperimmune milk protein concentrate which works in combination with the edible nutritional protein already present in the protein beverage. The hyperimmune milk protein concentrate may be manufactured in the manner described in detail in U.S. Patent 5,650,175. One example of the hyperimmune milk protein is available from Stolle Milk Biologics of Chicago, Ill. under the trade name MicroLactin™ and distributed by Humanetics

Corporation of Eden Prairie, MN, by way of example and not by way of limitation. The hyperimmune milk protein concentrate may be derived from whey, such as a fractionization from whey. However, the hyperimmune milk protein concentrate may exhibit functional properties similar to casein. Use of a hyperimmune milk protein concentrate in the beverage formulation typically results in a beverage which exhibits turbidity.

The flavoring agent or agents may provide a fruit flavor, cola flavor, vanilla flavor, or a chocolate flavor, by way of example and not by way of limitation. Other flavorings, such as, by way of example, and not by way of limitation, Stevia leaf extract and Lo Han Guo. Sweeteners, natural or synthetic, such as sucrose, sucralose, aspartame, and/or acesulfame potassium, neotame, polydextrose, glycerin, sorbitol, high fructose corn syrup, corn syrup, saccharin, honey, molasses, maple syrup, and xylitol, may be used, by way of example and not by way of limitation. Coloring agents may be added. Agents such as citric acid, fumaric acid, adipic acid, tartaric acid, and in some instances lactic acid may be added to adjust for tartness.

Additional ingredients in the form of analgesics, such, for example, as aspirin may be added in specialized product applications. Mild stimulants other than the foregoing mentioned caffeine, such, for example, as green tea may be added. Relaxants, such, for example, as melatonin may also be added.

To provide stability, the protein drink may include an antifoaming agent such as dimethylpolysiloxane, and a pH adjusting agent such as phosphoric acid, hydrochloric acid, citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.. Typically, phosphoric acid will be used as the pH adjusting agent. However, if a "all natural" beverage or a more natural beverage is desired, then a natural acid, than a natural acid will be used. Typically, the natural acids used may include citric acid, malic acid, tartaric acid, or a combination thereof. The adjusted pH of the protein drink typically ranges from about 2.0 to about 5.5, more typically from about 2.0 to about 3.4. To further provide stability, the protein drink may be formulated to essentially exclude a component, which includes caseinate. Caseinate may not be stable at the pH of the protein beverage.

One or more preservatives may be added to the protein beverage, such as, for example, one or more chemical preservatives, one or more natural preservatives, a combination thereof, or others. Examples of chemical preservatives which may be used include, for example, a sorbate

or a benzoate. Examples of natural preservatives which may be used include, for example, nisin or natamycin, which may be obtained commercially from a food ingredient supplier, such as Danisco A/S Langebrogade 1 DK-1001 Copenhagen.

The protein drink may be prepared by admixing in water, an anti-foaming agent, an amount of a pH adjusting agent to provide a pH of about 2 to about 5.5 and an amount of protein sufficient to provide a final protein content in the beverage ranging from about 0.01% by weight to about 8% by weight protein.

The protein drink may be carbonated by adding carbon dioxide to the admixture in an amount sufficient to obtain a carbonated protein beverage where the amount of carbonation present in the beverage ranges from about 0.1 volumes to about 6 volumes per volume of liquid admixture. In some embodiments of the method, the carbon dioxide may be added in the form of sterile carbonated water. In other embodiments, sterile carbon dioxide is bubbled through the liquid admixture until the desired amount of carbon dioxide is present. In either embodiment, the final protein content of the beverage ranges from about 0.01% by weight to about 8% by weight, and the carbonation ranges from about 0.1 volumes to about 6 volumes. In other embodiments, the final protein content of the beverage ranges from about 2% by weight to about 8% by weight and the carbonation ranges from about 0.1 volumes to about 6 volumes.

The protein drink may be prepared by admixing in water, an anti-foaming agent, an amount of a pH adjusting agent to provide a pH of about 2 to about 4.6, an amount of juice to provide a final juice content in the beverage ranging from about 0% by weight to about 100% by weight juice, and an amount of protein sufficient to provide a final protein content in the beverage ranging from about 0.01% by weight to about 8% by weight protein; heating the admixture to a temperature ranging from about 140° F to about 188° F for a time period adequate to inactivate microbes which may be present in the admixture; cooling the admixture to a temperature of about 40° F or less.

The protein beverage may be carbonated by adding carbon dioxide to the admixture in an amount sufficient to obtain a carbonated protein beverage where the amount of carbonation present in the beverage ranges from about 0.1 volumes to about 6 volumes per volume of liquid admixture. In some embodiments of the method, the carbon dioxide is added in the form of sterile carbonated water. In other embodiments, sterile carbon dioxide is bubbled through the liquid admixture until the desired amount of carbon dioxide is present. In either embodiment,

the final juice content of the beverage ranges from about 0% by weight to about 100% by weight, the final protein content of the beverage ranges from about 0.01% by weight to about 8% by weight, and the carbonation ranges from about 0.1 volumes to about 6 volumes. In other embodiments, the final juice content of the beverage ranges from about 0% by weight to about 98% by weight, the final protein content of the beverage ranges from about 2% by weight to about 8% by weight, and the carbonation ranges from about 0.1 volumes to about 6 volumes.

The protein drink may also be prepared in a manner similar to that described above, with the additional step of HPP to inactivate microbes in the protein beverage. The HPP step may take place prior to the addition of carbon dioxide or after the addition of carbon dioxide. The carbonated protein beverage may be treated with HPP prior to packaging or after packaging in containers.

The protein drink may also be prepared in a manner similar to that described above, with the exception that the heating of the admixture may be carried out after addition of the carbonation rather than prior to addition of the carbonation. This requires that provisions be made to maintain the carbonation during the heating and cooling process. We have discovered that it is possible to maintain the carbonation if the carbonated protein beverage may be packaged in individual size containers and the containers of beverage may then be processed for microbe inactivation.

In another embodiment, the protein drink may include about 0% alcohol by volume to about 15% alcohol by volume. Typically, the percent alcohol by volume ranges from about 4% by volume to about 8% by volume. The alcohol used may be derived from malt based, fermented from grain.

In one embodiment, the invention is a protein composition for use in a protein beverage or a protein beverage concentrate. This protein composition is comprised of a protein essentially free of caseinate and derived from an aqueous protein isolate collected from membrane-filtration isolation of the protein and without substantial drying; and a pH adjusting agent in an amount to adjust the pH of the aqueous protein isolate to a pH of between about 2.0 and about 4.6. The protein composition may be treated with carbon dioxide to inhibit microbial growth. The protein composition may be stored or transported prior to use in a protein beverage or protein beverage concentrate. The protein composition may be stored or transported over a time period of up to about 10 days without refrigeration or up to about 30 days with refrigeration prior to use in a

protein beverage or protein beverage concentrate. Substantial solubility of the protein is maintained in the protein composition throughout the storage and transportation period, and the protein composition is essentially free of active microbes known to be harmful to human health throughout the storage and transportation period.

In another embodiment, the invention is a protein beverage, and method of making the protein beverage, that is comprised of about 0.01% by weight to about 15% by weight protein, that is essentially free of caseinate and derived from an aqueous protein isolate collected from membrane-filtration isolation of the protein and without substantial drying. The protein beverage composition exhibits a pH ranging from about 2.0 to about 4.6. Substantial solubility of the protein is maintained in the beverage composition, and the protein beverage is essentially free of active microbes known to be harmful to human health, both at the time of packaging of the protein beverage and for a time period of at least one year after packaging. The beverage may be carbonated. The beverage may contain at least one additional ingredient selected from the group consisting of a concentrated plant extract, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a flavoring agent, a sweetener, a preservative, a coloring agent, juice, and alcohol. The protein beverage is clear or transparent in color, exhibiting essentially no turbidity.

The essentially free from active microbe condition of the beverage may be created by the inactivation of microbes by pasteurization, aseptic packaging, carbonation, ozonation, radiation, ultra violet light, high pressure processing, membrane permeation, pulsed electric field, sonication, or combinations thereof.

The aqueous protein isolate used in the beverage may be freshly collected from membrane-filtration isolation or it may have been stored or transported after being collected from membrane-filtration isolation prior to being used in the beverage. The aqueous protein isolate may be stored or transported over a time period of up to about 10 days without refrigeration or up to about 30 days with refrigeration prior to use in a protein beverage. Substantial solubility of the protein is maintained in the protein composition throughout the storage and transportation period, and the protein composition is essentially free of active microbes known to be harmful to human health throughout the storage and transportation period. The pH of the aqueous protein isolate may be adjusted to a pH ranging from about 2.0 to about 4.6, using an acid, selected from the group consisting of phosphoric acid, hydrochloric acid, citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid,

glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof. Preferably, the pH of the aqueous protein is adjusted with the mineral acid phosphoric acid, or with a natural acid, such as citric acid, malic acid, tartaric acid, or a combination of two or more thereof. The aqueous protein isolate may be treated with carbon dioxide prior to storage or transport, to inhibit microbial growth during this time.

The aqueous protein isolate may be selected from the group consisting of whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof.

In another embodiment of the invention, the protein beverage is comprised of about 0.01 % by weight to about 15 % by weight protein, derived from an aqueous protein isolate collected from membrane-filtration isolation of the protein and without substantial drying, and a balance of water. Both at the time of packaging of the protein beverage and during any subsequent storage without refrigeration for a time period of at least 18 months after packaging, substantial solubility of the protein is maintained in the protein beverage and the protein beverage is substantially free of pathogenic microbes.

The essentially free from active microbe condition of the beverage may be created by the inactivation of microbes by pasteurization, aseptic packaging, carbonation, ozonation, radiation, ultra violet light, high pressure processing, membrane permeation, pulsed electric field, sonication, or combinations thereof.

The aqueous protein isolate used in the beverage may be freshly collected from membrane-filtration isolation or it may have been stored or transported after being collected from membrane-filtration isolation prior to being used in the beverage. The aqueous protein isolate may be stored or transported over a time period of up to about 10 days without refrigeration or up to about 30 days with refrigeration prior to use in a protein beverage. Substantial solubility of the protein is maintained in the protein composition throughout the storage and transportation period, and the protein composition is essentially free of active microbes known to be harmful to human health throughout the storage and transportation period. The pH of the aqueous protein isolate may be adjusted to a pH ranging from about 2.0 to about 4.6, using an acid, selected from the group consisting of phosphoric acid, hydrochloric acid,

citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof. Preferably, the pH of the aqueous protein is adjusted with the mineral acid phosphoric acid, or with a natural acid, such as citric acid, malic acid, tartaric acid, or a combination of two or more thereof. The aqueous protein isolate may be treated with carbon dioxide prior to storage or transport, to inhibit microbial growth during this time.

The aqueous protein isolate may be selected from the group consisting of whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof.

In another embodiment of the invention, the protein beverage is carbonated fruit flavored protein beverage comprised of about 0.01 % by weight to about 15 % by weight protein, which is essentially free of caseinate, with a pH ranging from about 2.5 to about 4.5. Both at the time of packaging of the protein beverage and during any subsequent storage without refrigeration for a time period of at least 18 months after packaging, substantial solubility of the protein is maintained in the protein beverage and the protein beverage is substantially free of pathogenic microbes. The protein beverage is clear or transparent in color, exhibiting essentially no turbidity.

The beverage may contain at least one additional ingredient selected from the group consisting of a concentrated plant extract, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a flavoring agent, a sweetener, a preservative, a coloring agent, juice, and alcohol. The fruit flavor of the beverage may be derived from a flavoring agent or from fruit juice.

The essentially free from active microbe condition of the beverage may be created by the inactivation of microbes by pasteurization, aseptic packaging, carbonation, ozonation, radiation, ultra violet light, high pressure processing, membrane permeation, pulsed electric field, sonication, or combinations thereof.

The protein may be selected from the group consisting of whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea

protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof.

The protein may be a powdered protein concentrate or a powdered protein isolate, or it may be derived from an aqueous protein isolate collected from membrane-filtration isolation of the protein and without substantial drying, and a balance of water. The protein may be intact or hydrolyzed.

The protein may be a protein concentrate or a protein isolate. When in powder form, the protein may be reconstituted in water or another suitable liquid to prepare a protein in liquid form. The pH of the liquid protein may be adjusted with a pH adjusting agent prior to the addition of the liquid protein to the beverage.

If the protein is an aqueous protein isolate, it may be freshly collected from membrane-filtration isolation or it may have been stored or transported after being collected from membrane-filtration isolation prior to being used in the beverage. The aqueous protein isolate may stored or transported over a time period of up to about 10 days without refrigeration or up to about 30 days with refrigeration prior to use in a protein beverage. Substantial solubility of the protein is maintained in the protein composition throughout the storage and transportation period, and the protein composition is essentially free of active microbes known to be harmful to human health throughout the storage and transportation period. The pH of the aqueous protein isolate may be adjusted to a pH ranging from about 2.0 to about 4.6, using an acid, selected from the group consisting of phosphoric acid, hydrochloric acid, citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof. Preferably, the pH of the aqueous protein is adjusted with the mineral acid phosphoric acid, or with a natural acid, such as citric acid, malic acid, tartaric acid, or a combination of two or more thereof. The aqueous protein isolate may be treated with carbon dioxide prior to storage or transport, to inhibit microbial growth during this time.

In another embodiment of the invention, the protein beverage is a carbonated chocolate or vanilla flavored protein beverage that resembles the classic American egg cream beverage. Egg cream beverages were chocolate and vanilla flavored carbonated milk beverages sold at New York soda fountains in the late 19th century, which contained chocolate or vanilla syrup, seltzer,

and whole milk. However, we have improved upon this American classic, by making a shelf stable high protein chocolate or vanilla flavored carbonated beverage that does not contain milk.

The carbonated chocolate or vanilla flavored protein beverage is comprised of about 0.01 % by weight to about 15 % by weight protein, which is essentially free of caseinate, with a pH ranging from about 4.5 to about 7.0. Both at the time of packaging of the protein beverage and during any subsequent storage without refrigeration for a time period of at least 18 months after packaging, substantial solubility of the protein is maintained in the protein beverage and the protein beverage is substantially free of pathogenic microbes. The protein beverage may be turbid, resembling the appearance of a milk-based beverage.

The carbonated chocolate or vanilla flavored protein beverage may contain at least one additional ingredient selected from the group consisting of a concentrated plant extract, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a flavoring agent, a sweetener, a preservative, a coloring agent, and alcohol.

The essentially free from active microbe condition of the carbonated chocolate or vanilla flavored protein beverage may be created by the inactivation of microbes by pasteurization, aseptic packaging, carbonation, ozonation, radiation, ultra violet light, high pressure processing, membrane permeation, pulsed electric field, sonication, or combinations thereof.

The protein used in the carbonated chocolate or vanilla flavored protein beverage may be selected from the group consisting of whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof.

The protein used in the carbonated chocolate or vanilla flavored protein beverage may be a powdered protein concentrate or a powdered protein isolate, or it may be derived from an aqueous protein isolate collected from membrane-filtration isolation of the protein and without substantial drying, and a balance of water. The protein may be intact or hydrolyzed.

The protein may be a protein concentrate or a protein isolate. When in powder form, the protein may be reconstituted in water or another suitable liquid to prepare a protein in liquid form. The pH of the liquid protein may be adjusted with a pH adjusting agent prior to the addition of the liquid protein to the beverage.

If the protein is an aqueous protein isolate, it may be freshly collected from membrane-filtration isolation or it may have been stored or transported after being collected from membrane-filtration isolation prior to being used in the beverage. The aqueous protein isolate may be stored or transported over a time period of up to about 10 days without refrigeration or up to about 30 days with refrigeration prior to use in a protein beverage. Substantial solubility of the protein is maintained in the protein composition throughout the storage and transportation period, and the protein composition is essentially free of active microbes known to be harmful to human health throughout the storage and transportation period. The pH of the aqueous protein isolate may be adjusted to a pH ranging from about 2.5 to about 7.0, using an acid, selected from the group consisting of phosphoric acid, hydrochloric acid, citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof. Preferably, the pH of the aqueous protein is adjusted with the mineral acid phosphoric acid, or with a natural acid, such as citric acid, malic acid, tartaric acid, or a combination of two or more thereof. The aqueous protein isolate may be treated with carbon dioxide prior to storage or transport, to inhibit microbial growth during this time.

In other embodiments, the protein drink may be prepared in concentrated forms, which may be diluted prior to consumption with a liquid, such as, for example, but not by way of limitation, water, fruit juice, vegetable juice, tea, alcohol, coffee, milk, soy milk, rice milk, almond milk, a combination thereof, or others. Certain embodiments include a liquid used for dilution, which may be a carbonated liquid or a still liquid. If a still liquid is used, the beverage may be carbonated with carbon dioxide gas after dilution.

An embodiment of a protein beverage concentrate may be a concentrated syrup, which may include about 0 % by weight to about 60 % by weight of juice concentrate, wherein said juice concentrate has a Brix value of about 20 °Brix to about 75 °Brix, and about 0.02 % by weight to about 75 % by weight protein. Another embodiment of a protein beverage concentrated syrup may include about 0 % by weight to about 60 % by weight of juice concentrate, wherein said juice concentrate has a Brix value of about 20 °Brix to about 75 °Brix, and about 4 % by weight to about 75 % by weight protein. Such protein beverage concentrated syrup may, at the time of packaging and during subsequent storage without refrigeration, maintain substantial solubility of the protein. Such embodiment of the protein beverage

concentrated syrup may also, at the time of packaging and during subsequent storage, be essentially free of pathogenic microbes known to be harmful to human health.

The protein beverage concentrated syrup may include about 0 % by weight of juice concentrate and about 0.01 % by weight to about 49 % by weight protein.

The juice concentrate used for the protein beverage concentrated syrup may be derived from a single fruit juice, a single vegetable juice, fruit juice blends, vegetable juice blends, or fruit and vegetable juice blends may be used. Examples of a few of the many specific juices which may be used may include, but are not limited to, juice from alfalfa sprouts, apples, apricots, avocados, bamboo shoots, bananas, beans, bean sprouts, beets, berries of all types, cabbage, carrots, celery, cherries, cucumbers, currants, dates, figs, grapefruits, grapes, guava, kiwi, kumquat, lemons, limes, lychee fruit, mandarin, mango, melons of all types, nectarines, noni, oranges, papaya, passion fruit, peaches, pears, pineapples, plums, pomegranates, prunes, radishes, rhubarbs, rutabagas, seaweed, squash, tangelo, tangerines, tomatoes, and/or turnips, as well as combinations thereof; however, any type of juice may be used.

The protein used for the protein beverage concentrated syrup embodiment may be essentially free from caseinate. In some embodiments, the essentially caseinate free protein may have some caseinate or may be a whey protein, of the kind previously described herein. An essentially caseinate free protein may be a whey protein which may be derived from whey protein isolate or whey protein concentrate, although other whey protein preparations may also be used, such as, for example, but not by way of limitation, a whey protein extract or a whey protein hydrolysate. The whey protein isolate may be an aqueous whey protein isolate, with a whey protein concentration of about 0.01 % by weight to about 49 % by weight. The whey protein concentrate may be an aqueous whey protein concentrate. In addition to being essentially free from caseinate, the protein may be essentially free of fat and lactose.

Whey protein isolate may be obtained by removing sufficient non-protein constituents from whey by membrane filtration or ion exchange absorption , so that the finished dry product may contain about 90% by weight or more whey protein, and little, if any, fat, cholesterol, or carbohydrates (e.g., lactose). Prior to concentration and spray drying, aqueous whey protein isolate (WPIaq) may have a whey protein concentration of about 0.01% by weight to about 49% by weight, and may also be essentially free of fat, cholesterol, and carbohydrates.

Aqueous whey protein isolate (WPIaq) is collected at a concentration by weight of about 20 % to about 35% actual whey protein.

WPIaq is diluted with water to a protein concentration of about 1 % to about 24 %, representing a range from single-strength beverage protein level to a concentrate suitable for acidification, nutrient addition, transport to a beverage manufacturing facility and subsequent dilution, thermal processing, and containerization.

The protein used for the protein beverage concentrated syrup may also include any edible protein, other than whey protein, such as, for example, but not by way of limitation, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof.

The protein used for the protein beverage concentrated syrup may also include a combination of a whey protein, of the kind previously described herein, and an edible protein, other than whey protein, such as for example, but not by way of limitation, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof.

Typically the pH of the aqueous protein (isolate or concentrate) may be adjusted with an appropriate pH adjusting agent to match the pH of the protein beverage concentrated syrup prior to mixing the protein with the beverage composition.

The pH adjustment step of the aqueous protein isolate and the protein beverage concentrated syrup may be done with any suitable acid that is known and apparent to those skilled in the art. These acids may include mineral acids, such as phosphoric acid, which is commonly used in the beverage industry, or hydrochloric acid. Although phosphoric acid is a food grade acid categorized by the FDA (U.S. Food and Drug Administration) as a GRAS substance (Generally Recognized as Safe substance), it is often considered an artificial compound when used in food and beverages. Therefore, when preparing an "all natural" or a more natural protein beverage or protein beverage concentrated syrup, a natural acid should be used in place of phosphoric acid, such as citric acid, malic acid, tartaric acid, fumaric acid, lactic

acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof. More typically, the natural acids will include, citric acid, malic acid, tartaric acid, or a combination of two or more thereof.

The particular acid or combination of acids used, as well as the amount of each acid used, will depend upon various factors, such as, the desired pH of the aqueous protein isolate, the desired pH of the protein beverage concentrated syrup, the protein concentration of the aqueous protein isolate, the protein concentration of the protein beverage concentrated syrup, the other ingredients used in the protein beverage concentrated syrup, the desired shelf life of the aqueous protein isolate, the desired shelf life of the protein beverage concentrated syrup, the desired flavor of the final beverage made from the protein beverage concentrated syrup, and whether the protein beverage concentrated syrup or the final beverage made from the protein beverage concentrated syrup is to be marketed as an "all natural" beverage or a more natural syrup or beverage.

The acids may be added to the aqueous protein isolate or the protein beverage concentrated syrup in the form of a dry (granular) acid or in solution form. The solution may be in a concentrated form or a dilute form. When it is desirable to adjust the pH of the aqueous protein isolate or the protein beverage concentrated syrup without significantly lowering the protein concentration, a dry (granular) acid or a concentrated acid solution should be used. When it is desirable to both adjust the pH of the aqueous protein isolate or the protein beverage concentrated syrup and significantly lower the protein concentration, a more dilute acid solution may be used.

The protein beverage concentrated syrup may further include about 0 % by weight to about 100 % by weight filler, wherein the filler may be water, a sweetener, a flavoring agent, a coloring agent, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a concentrated plant extract, a preservative, combinations thereof, or others.

The protein beverage concentrated syrup may be treated to inactivate microbes by pasteurization, aseptic packaging, carbonation, ozonation, radiation, ultraviolet light, high pressure processing, membrane permeation, pulsed electric field, sonication, combinations thereof, or other microbial inactivation treatments.

The protein beverage concentrated syrup may range from about a two-fold syrup to about a twenty-five-fold syrup. A further embodiment of the protein beverage concentrated syrup may be prepared as about a five-fold syrup, wherein one part protein beverage concentrated syrup may be diluted with four parts liquid to prepare a protein beverage. The liquid may be any suitable liquid for human consumption, such as, for example, but not by way of limitation, water, fruit juice, vegetable juice, tea, alcohol, coffee, milk, soy milk, rice milk, almond milk, combinations thereof, or others.

In some embodiments the protein beverage made from the protein beverage concentrated syrup may be a carbonated beverage. The carbonation of the protein beverage may range from about 1.0 volumes to about 3.5 volumes per volume of beverage, preferably, about 1.6 to about 3.5 volumes per volumes of beverage; more preferably, about 1.6 to about 3.0 volumes per volume of beverage.

The carbonation may be added in the form of carbonated liquid, such as, for example, but not by way of limitation, carbonated water. The carbonation may be added by bubbling sterile carbon dioxide through the protein beverage until the desired amount of carbon dioxide is present. The carbonation may also be added by the addition of any edible carbonation source, such as, for example, but not by way of limitation, a carbonate material capable of reacting with an acid or mixture of acids to effect the release of carbon dioxide upon contact with water. See U.S. Patent Application Publication No. 20020136816, the disclosure of which is incorporated herein by reference.

In some embodiments the protein beverage concentrated syrup may be used by an individual, and may be packaged in single use servings or in small bottles, such as, for example, but not by way of limitation 50 ml - 1500 ml bottles suitable for household use. In other embodiments the protein beverage concentrated syrup may be packaged in larger containers suitable for use in a food services beverage dispenser or in a restaurant or bar beverage dispenser. In yet other embodiments the protein beverage concentrated syrup may be produced in large batches for use in the preparation of a protein beverage at a bottling plant or other commercial beverage preparation facility.

The protein beverage concentrated syrup may be prepared by admixing a juice concentrate having a Brix value of about 20 °Brix to about 75 °Brix, to achieve a percent by weight of juice concentrate of about 0 % by weight to about 60 % by weight and a protein to

achieve a percent by weight of protein in the admixture of about 0.05 % by weight to about 60 % by weight, thereby obtaining an admixture. The protein beverage concentrated syrup may be packaged in a container which may be stored at room temperature.

In one embodiment the protein beverage concentrate may be a concentrated powder, which may be prepared as a dry preparation, such as, for example, but not by way of limitation, a powder, granular, crystal, or other type of dry particle preparations. The dry preparations may be prepared by mixing the various ingredients as described above to form a concentrated syrup, then drying the syrup to a dry powder form by conventional drying methods, such as, for example, but not by way of limitation, lyophilization (freeze drying), spray drying, fluid bed drying, drum drying, combinations thereof, or others.

In many of the Examples described below, the protein used is whey protein, since this protein provides the taste and offers other nutritional advantages of the kind previously discussed. However, one skilled in the art will understand that by adjusting the pH to extend to higher or lower pH ranges and/or producing a carbonated protein drink having a protein content at other positions in the range of about 0.01% to about 15%, other proteins such as milk protein, soy protein, lactalbumin, serum albumin, glycomacropeptide, rice protein, pea protein, canola protein, wheat protein, hemp protein, zein, flax protein, egg white protein, ovalbumin, gelatin, combinations thereof, or others, by way of example and not by way of limitation, may also be used, alone or in combination, to create the present protein beverage. Hydrolysates and derivatives of these common protein sources may also be used in embodiments contemplated by this disclosure.

In most of the Examples described below, the method used to inactivate microbes is pasteurization, however other methods may be used, such as aseptic packaging, carbonation, ozonation, radiation, ultra violet light, high pressure processing, membrane permeation, pulsed electric field, sonication, combinations thereof, or others.

EXAMPLES

Example One

The following example describes use of the aqueous protein ingredient for the production of approximately 10,000 liters of a fruit-flavored protein beverage with a whey protein

concentration of 3.33%, approximately equal to the total protein concentration in bovine milk. The weight of the batch is approximately 10,350 kg.

Temperature should be maintained in the range of 40-50 degrees Fahrenheit during the acidification process.

1035 kg of Aqueous Whey Protein at 33.3% (w/w) total protein is diluted by addition and slow mixing of an equal weight of purified water to yield 2070 kg of aqueous 16.65% whey protein.

Approximately 50 kg of 85% phosphoric acid is added at a rate of about 5 kg/minute with constant mixing with the endpoint being a target pH of 3.2 ± 0.2.

Acidified aqueous protein is transferred into two bulk totes designed for palletized food-grade liquid transport. The totes typically have a capacity of 250 – 300 gallons, and in this case the totes contain a total of about 450 gallons.

Bulk transport should be conducted in a manner by which temperature can be maintained at 40-60 degrees.

After arrival at a beverage manufacturing facility, the protein is transferred to a batch mixing tank of appropriate volume (in this example, 3,000-5,000 gallon capacity).

Additional water is added to reach approximately 99% of finished volume, after which flavors, colors, sweeteners, and other desired ingredients are added. Final pH of 3.2 ± 0.2 is achieved by addition of a single organic acid such as citric acid, malic acid, tartaric acid, a combination thereof, or other organic acids.

The bulk beverage is pasteurized in a manner common to the beverage and fruit juice industries known as “hot-fill”, where product is thermally processed in a continuous flow with a maximum temperature of 160 – 200 °F with a holding time at that maximum temperature ranging from 15 seconds to about 3 seconds. Product is cooled slightly to 160-185 °F just prior to being filled into glass or plastic containers designed for hot-fill.

Example Two

An alternate method of producing such a beverage can be performed by the full dilution and ingredient addition being conducted at the site of protein production, followed by bulk

transport of finished beverage to the beverage processor/bottler. This method is considered to be more costly due to transport of additional water and would generally be avoided unless the beverage processor was unable to complete the batch preparation.

Example Three

Another alternate method of producing such a beverage consists of transport of the highly concentrated aqueous protein in its undiluted and unacidified state, after which these steps are performed at the site of beverage processing and container filling.

Example Four

A fourth example involves the use of the aqueous protein stream from membrane-filtration isolation of soy protein. In this example, addition of antimicrobial agents at the beginning of the process is recommended, as the aqueous soy protein would not be acidified either as a concentrate or as a finished beverage due to its insolubility in acid solutions. Temperature should be maintained at 30-42 °F until final beverage processing using aseptic technology for sterilization and container filling.

Example Five

The following example describes use of the aqueous protein ingredient for the production of approximately 385 liters of a water based, fruit-flavored protein beverage with a whey protein concentration of about 3.35%, approximately equal to the total protein concentration in bovine milk. The weight of the batch is approximately 387 kg.

Temperature should be maintained in the range of 40-50 degrees Fahrenheit during the acidification process.

Approximately 3.6 kg of dietary fiber (such as VitaSugar™ brand fiber, from Bio Neutra, located in Edmonton, Canada) is diluted by addition and slow mixing into approximately 316.3 kg of purified water. Alternatively, a small amount, such as approximately 1 kg or less, of the dietary fiber may be reserved to make a "premix" with other dry ingredients that are added in small amounts of less than 1 kg.

Approximately 64.8 kg of an aqueous whey protein isolate (such as the aqueous whey protein isolate available from Trega, located in Wisconsin) at about 20.0% (w/w) total protein is

diluted by addition and slow mixing to the water and fiber admixture. The admixture is mixed well, however care is taken to prevent air incorporation into the admixture, which causes the undesirable effect of foaming. Note that the concentration of whey protein in the aqueous whey protein preparation may vary between batches and/or manufacturers, and thus the amount of aqueous whey protein isolate and water added should be adjusted accordingly to achieve the desired final protein concentration in the finished beverage.

The pH of the admixture is checked, and if higher than 3.22 phosphoric acid is added at a rate of about 5 kg/minute with constant mixing with the endpoint being a target pH of about 3.2.

Approximately 0.39 kg of malic acid and approximately 0.39 kg of citric acid are added to the admixture and the pH is recorded after mixing well.

Approximately 81.24 grams of sucralose and approximately 154.75 grams of color, such as red color 2479 are added to the admixture. Alternatively, the sucralose and color may be premixed with approximately 1 kg or less of dietary fiber (mentioned above) to aid in dispersion and wetting of the sucralose and color.

Approximately 386.87 grams of natural pomegranate flavor (such as the natural pomegranate flavor available from Virginia Dare of Brooklyn, New York) and approximately 773.74 grams of natural fruit punch flavor (such as the natural fruit punch flavor available from Virginia Dare of Brooklyn, New York) are added to the admixture. After mixing well the pH is again recorded.

The bulk beverage is pasteurized in a manner common to the beverage and fruit juice industries known as "hot-fill", where product is thermally processed in a continuous flow with a maximum temperature of 160 – 200 °F with a holding time at that maximum temperature ranging from 15 seconds to about 3 seconds. Product is cooled slightly to 160-185 °F just prior to being filled into glass or plastic containers designed for hot-fill.

Example Six

The following example describes use of the aqueous protein ingredient for the production of approximately 385 liters of a water based, fruit-flavored protein beverage with a whey protein concentration of about 3.35%, approximately equal to the total protein concentration in bovine milk. The weight of the batch is approximately 387 kg.

Temperature should be maintained in the range of 40-50 degrees Fahrenheit during the acidification process.

Approximately 3.6 kg of dietary fiber (such as VitaSugar™ brand fiber, from Bio Neutra, located in Edmonton, Canada) is diluted by addition and slow mixing into approximately 315.6 kg of purified water. Alternatively, a small amount, such as approximately 1 kg or less, of the dietary fiber may be reserved to make a "premix" with other dry ingredients that are added in small amounts of less than 1 kg.

Approximately 64.8 kg of an aqueous whey protein isolate (such as the aqueous whey protein isolate available from Trega, located in Wisconsin) at about 20.0% (w/w) total protein is diluted by addition and slow mixing to the water and fiber admixture. The admixture is mixed well, however care is taken to prevent air incorporation into the admixture, which causes the undesirable effect of foaming. Note that the concentration of whey protein in the aqueous whey protein preparation may vary between batches and/or manufacturers, and thus the amount of aqueous whey protein isolate and water added should be adjusted accordingly to achieve the desired final protein concentration in the finished beverage.

The pH of the admixture is checked, and if higher than 3.22 phosphoric acid is added at a rate of about 5 kg/minute with constant mixing with the endpoint being a target pH of about 3.2.

Approximately 0.39 kg of malic acid and approximately 0.39 kg of citric acid are added to the admixture and the pH is recorded after mixing well.

Approximately 81.24 grams of sucralose and approximately 96.72 grams of color, such as purple color 2748 are added to the admixture. Alternatively, the sucralose and color may be premixed with approximately 1 kg or less of dietary fiber (mentioned above) to aid in dispersion and wetting of the sucralose and color.

Approximately 1160.6 grams of natural blueberry flavor (such as the natural blueberry flavor available from Virginia Dare of Brooklyn, New York) and approximately 773.74 grams of natural raspberry flavor (such as the natural raspberry flavor available from Virginia Dare of Brooklyn, New York) are added to the admixture. After mixing well the pH is again recorded.

The bulk beverage is pasteurized in a manner common to the beverage and fruit juice industries known as "hot-fill", where product is thermally processed in a continuous flow with a

maximum temperature of 160 – 200 °F with a holding time at that maximum temperature ranging from 15 seconds to about 3 seconds. Product is cooled slightly to 160-185 °F just prior to being filled into glass or plastic containers designed for hot-fill.

Example Seven

The following example describes use of the aqueous protein ingredient for the production of approximately 385 liters of a water based, green tea-flavored protein beverage with a soy protein concentration of about 3.35. The weight of the batch is approximately 387 kg.

Temperature should be maintained in the range of 40-50 degrees Fahrenheit during the acidification process.

Approximately 3.6 kg of dietary fiber (such as VitaSugar™ brand fiber, from Bio Neutra, located in Edmonton, Canada) is diluted by addition and slow mixing into approximately 301.7 kg of purified water. Alternatively, a small amount, such as approximately 1 kg or less, of the dietary fiber may be reserved to make a "premix" with other dry ingredients that are added in small amounts of less than 1 kg.

Approximately 77.6 kg of an aqueous soy protein isolate at about 16.7% (w/w) total protein is diluted by addition and slow mixing to the water and fiber admixture. The admixture is mixed well, however care is taken to prevent air incorporation into the admixture, which causes the undesirable effect of foaming. Note that the concentration of soy protein in the aqueous soy protein preparation may vary between batches and/or manufacturers, and thus the amount of aqueous soy protein isolate and water added should be adjusted accordingly to achieve the desired final protein concentration in the finished beverage.

The pH of the admixture is checked, and if higher than 6.0 phosphoric acid is added at a rate of about 5 kg/minute with constant mixing with the endpoint being a target pH of about 5.75.

Approximately 0.39 kg of citric acid is added to the admixture and the pH is recorded after mixing well.

Approximately 127.7 grams of Lo Han Guo sweetener is added to the admixture. Alternatively, the Lo Han Guo sweetener may be premixed with approximately 1 kg or less of dietary fiber (mentioned above) to aid in dispersion and wetting of the Lo Han Guo.

Approximately 2.32 kg of natural green tea flavor (such as the natural green tea flavor available from Virginia Dare of Brooklyn, New York), approximately 773.74 grams of natural black tea flavor (such as the natural black tea flavor available from Virginia Dare of Brooklyn, New York), and approximately 386.87 grams of natural lemongrass flavor (such as the natural lemongrass flavor available from Virginia Dare of Brooklyn, New York) are added to the admixture. After mixing well the pH is again recorded.

The bulk beverage is pasteurized in a manner common to the beverage and fruit juice industries known as "hot-fill", where product is thermally processed in a continuous flow with a maximum temperature of 160 – 200 °F with a holding time at that maximum temperature ranging from 15 seconds to about 3 seconds. Product is cooled slightly to 160-185 °F just prior to being filled into glass or plastic containers designed for hot-fill.

Example Eight

The following example describes use of the aqueous protein ingredient for the production of approximately 19400 kilograms of an orange and mango flavored water based protein beverage with a whey protein concentration of approximately 5%.

Temperature should be maintained in the range of 20-25 degrees Celsius during the acidification process.

4811.24 kg of Trega Pre-acidified Aqueous Whey Protein Isolate at 20% (w/w) total protein was diluted by addition and slow mixing of 14492.42 kg of water.

Approximately 4.85 kg malic acid was added with constant mixing.

Flavors, colors, preservative, and sweeteners were added as follows: 4074.04 g sucralose sweetener, 291 g Sensient #8006 Dry Yellow #6 (orange color), 11.64 kg potassium benzoate, 15520.14 g VDare Orange PB26 natural flavor, and 31040.28 g VDare Mango SW45 natural flavor.

Final pH of 2.95 to 3.10 was achieved by addition of approximately 29.10 kg citric acid.

The bulk beverage was pasteurized in a manner common to the beverage and fruit juice industries known as "hot-fill", where product is thermally processed in a continuous flow with a maximum temperature of 160-200 degrees Fahrenheit with a holding time at that maximum

temperature ranging from about 15 seconds to about 3 seconds. Product is cooled slightly to 160-185 degrees Fahrenheit just prior to being filled into glass or plastic containers designed for hot-fill.

Example Nine

The following example describes use of the aqueous protein ingredient for the production of approximately 19400 kilograms of a grape flavored water based protein beverage with a whey protein concentration of approximately 5%.

Temperature should be maintained in the range of 20-25 degrees Celsius during the acidification process.

4811.24 kg of Trega Pre-acidified Aqueous Whey Protein Isolate at 20% (w/w) total protein was diluted by addition and slow mixing of 14522.49 kg of water.

Approximately 19.4 kg tartaric acid was added with constant mixing.

Flavors, colors, preservative, and sweeteners were added as follows: 4074.04 g sucralose sweetener, 232.80 g Sensient #7700 Dry Red #40 (red color), 11.64 kg potassium benzoate, 21340.19 g VDare Grape CS10 flavor, and 58.20 g Sensient #5601 Dry Blue #1 (blue color).

Final pH of 3.0 to 3.10 was achieved by addition of approximately 9.70 kg citric acid.

The bulk beverage was pasteurized in a manner common to the beverage and fruit juice industries known as “hot-fill”, where product is thermally processed in a continuous flow with a maximum temperature of 160-200 degrees Fahrenheit with a holding time at that maximum temperature ranging from about 15 seconds to about 3 seconds. Product is cooled slightly to 160-185 degrees Fahrenheit just prior to being filled into glass or plastic containers designed for hot-fill.

Example Ten

The following example describes use of the aqueous protein ingredient for the production of approximately 19400 kilograms of a tropical fruit flavored water based protein beverage with a whey protein concentration of approximately 5%.

4811.24 kg of Trega Pre-acidified Aqueous Whey Protein Isolate at 20% (w/w) total protein was diluted by addition and slow mixing of 14519.67 kg of water.

Flavors, colors, preservative, and sweeteners were added as follows: 4074.04 g sucralose sweetener, 194 g Sensient #7700 Dry Red #40 (red color), 11.64 kg potassium benzoate, 14550.13 g VDare Punch AN28 liquid natural flavor, and 9700.09 g VDare Punch AN27 dry flavor.

Final pH of 2.95 to 3.10 was achieved by addition of approximately 29.10 kg citric acid.

The bulk beverage was pasteurized in a manner common to the beverage and fruit juice industries known as "hot-fill", where product is thermally processed in a continuous flow with a maximum temperature of 160-200 degrees Fahrenheit with a holding time at that maximum temperature ranging from about 15 seconds to about 3 seconds. Product is cooled slightly to 160-185 degrees Fahrenheit just prior to being filled into glass or plastic containers designed for hot-fill.

Example Eleven

The following example describes use of the aqueous protein ingredient for the production of approximately 3880 kilograms of an orange and mango flavored water based protein beverage with a whey protein concentration of approximately 3.3%.

Temperature should be maintained in the range of 20-25 degrees Celsius during the acidification process.

604.56 kg of Trega Aqueous Whey Protein Isolate at 21.50% (w/w) total protein was diluted by addition and slow mixing of 3218.57 kg of water.

Approximately 1.164 kg malic acid was added with constant mixing.

Flavors, colors, preservative, fiber, and sweeteners were added as follows: 795.41 g sucralose sweetener, 232.80 g Colormaker Orange 2733 annatto powder, 2716.02 g potassium benzoate, 36.86 kg VitaSugar fiber, 3104.03 g VDare Orange PB26 natural flavor, and 6208.06 g VDare Mango SW45 natural flavor.

Final pH of 2.95 to 3.05 was achieved by addition of approximately 5.82 kg citric acid.

The bulk beverage was pasteurized in a manner common to the beverage and fruit juice industries known as "hot-fill", where product is thermally processed in a continuous flow with a maximum temperature of 160-200 degrees Fahrenheit with a holding time at that maximum temperature ranging from about 15 seconds to about 3 seconds. Product is cooled slightly to 160-185 degrees Fahrenheit just prior to being filled into glass or plastic containers designed for hot-fill.

Example Twelve

The following example describes use of the aqueous protein ingredient for the production of approximately 3880 kilograms of a pomegranate flavored water based protein beverage with a whey protein concentration of approximately 3.3%.

Temperature should be maintained in the range of 20-25 degrees Celsius during the acidification process.

604.56 kg of Trega Aqueous Whey Protein Isolate at 21.50% (w/w) total protein was diluted by addition and slow mixing of 3216.11 kg of water.

Approximately 2.716 kg malic acid was added with constant mixing.

Flavors, colors, preservative, fiber, and sweeteners were added as follows: 776.01 g sucralose sweetener, 388.0 g Colormaker Purple Carrot 2748 powder, 1552 g Colormaker Red Cabbage 2714 powder, 2716.02 g potassium benzoate, 36.86 kg VitaSugar fiber, 3880.04 g VDare Pomegranate natural flavor, and 7760.07 g VDare Fruit Punch natural flavor.

Final pH of 2.95 to 3.05 was achieved by addition of approximately 2.716 kg citric acid.

The bulk beverage was pasteurized in a manner common to the beverage and fruit juice industries known as "hot-fill", where product is thermally processed in a continuous flow with a maximum temperature of 160-200 degrees Fahrenheit with a holding time at that maximum temperature ranging from about 15 seconds to about 3 seconds. Product is cooled slightly to 160-185 degrees Fahrenheit just prior to being filled into glass or plastic containers designed for hot-fill.

Example Thirteen

The following example describes use of the aqueous protein ingredient for the production of approximately 3880 kilograms of a blueberry and raspberry flavored water based protein beverage with a whey protein concentration of approximately 3.3%.

Temperature should be maintained in the range of 20-25 degrees Celsius during the acidification process.

604.56 kg of Trega Aqueous Whey Protein Isolate at 21.50% (w/w) total protein was diluted by addition and slow mixing of 3210.67 kg of water.

Approximately 1.552 kg malic acid was added with constant mixing.

Flavors, colors, preservative, fiber, and sweeteners were added as follows: 776.01 g sucralose sweetener, 1940.02 g Colormaker Red Cabbage 2714 powder, 2716.02 g potassium benzoate, 36.86 kg VitaSugar fiber, 11640.11 g VDare Blueberry natural flavor, and 7760.07 g VDare Raspberry natural flavor.

Final pH of 3.05 to 3.15 was achieved by addition of approximately 1.552 kg citric acid.

The bulk beverage was pasteurized in a manner common to the beverage and fruit juice industries known as "hot-fill", where product is thermally processed in a continuous flow with a maximum temperature of 160-200 degrees Fahrenheit with a holding time at that maximum temperature ranging from about 15 seconds to about 3 seconds. Product is cooled slightly to 160-185 degrees Fahrenheit just prior to being filled into glass or plastic containers designed for hot-fill.

Example Fourteen

The following example describes use of the aqueous protein ingredient for the production of approximately 3860 kilograms of a cranberry and apple flavored water based protein beverage with a whey protein concentration of approximately 1.04%.

Temperature should be maintained in the range of 20-25 degrees Celsius during the acidification process.

200.778 kg of Trega Aqueous Whey Protein Isolate at 20.0% (w/w) total protein was diluted by addition and slow mixing of 3589.67 kg of water.

Approximately 2.317 kg malic acid was added with constant mixing.

Flavors, colors, fiber, and sweeteners were added as follows: 772.22 g sucralose sweetener, 3861.11 g Mastertast freeze-dried Cranberry Fruit powder, 772.22 g Colormaker Purple Carrot 2748 powder, 772.22 g Colormaker Red Cabbage 2714 powder, 44.40 kg VitaSugar fiber, 11583.32 g VDare Cranberry BX09 natural flavor, and 5019.44 g VDare Apple AU02 natural flavor.

Final pH of 3.05 to 3.15 was achieved by addition of approximately 1158.33 g Ascorbic acid.

The bulk beverage was pasteurized in a manner common to the beverage and fruit juice industries known as "hot-fill", where product is thermally processed in a continuous flow with a maximum temperature of 160-200 degrees Fahrenheit with a holding time at that maximum temperature ranging from about 15 seconds to about 3 seconds. Product is cooled slightly to 160-185 degrees Fahrenheit just prior to being filled into glass or plastic containers designed for hot-fill.

Example Fourteen

The following example describes use of the aqueous protein ingredient for the production of approximately 3880 kilograms of an orange and mango flavored water based protein beverage with a whey protein concentration of approximately 3.3%.

Temperature should be maintained in the range of 20-25 degrees Celsius during the acidification process.

604.56 kg of Trega Aqueous Whey Protein Isolate at 21.50% (w/w) total protein was diluted by addition and slow mixing of 3218.57 kg of water.

Approximately 1.164 kg malic acid was added with constant mixing.

Flavors, colors, preservative, fiber, and sweeteners were added as follows: 795.41 g sucralose sweetener, 232.80 g Colormaker Orange 2733 annatto powder, 2716.02 g potassium benzoate, 36.86 kg VitaSugar fiber, 3104.03 g VDare Orange PB26 natural flavor, and 6208.06 g VDare Mango SW45 natural flavor.

Final pH of 2.95 to 3.05 was achieved by addition of approximately 5.82 kg citric acid.

The bulk beverage was pasteurized in a manner common to the beverage and fruit juice industries known as "hot-fill", where product is thermally processed in a continuous flow with a maximum temperature of 160-200 degrees Fahrenheit with a holding time at that maximum temperature ranging from about 15 seconds to about 3 seconds. Product is cooled slightly to 160-185 degrees Fahrenheit just prior to being filled into glass or plastic containers designed for hot-fill.

Example Fifteen

The following example describes use of the aqueous protein ingredient for the production of approximately 3860 kilograms of blueberry and raspberry flavored water based protein beverage with a whey protein concentration of approximately 1.04%.

Temperature should be maintained in the range of 20-25 degrees Celsius during the acidification process.

186.77 kg of Trega Aqueous Whey Protein Isolate at 21.50% (w/w) total protein was diluted by addition and slow mixing of 3600.98 kg of water.

Approximately 1.544 kg malic acid was added with constant mixing.

Flavors, colors, fiber, and sweeteners were added as follows: 772.22 g sucralose sweetener, 3861.11 g Mastertaste freeze dried Raspberry Fruit 705353 powder, 1930.55 g Colormaker Red Cabbage 2714 powder, 44.403 kg VitaSugar fiber, 11583.32 g VDare Blueberry natural flavor, and 7722.22 g VDare Raspberry natural flavor.

Final pH of 3.05 to 3.15 was achieved by addition of approximately 1.544 kg citric acid.

The bulk beverage was pasteurized in a manner common to the beverage and fruit juice industries known as "hot-fill", where product is thermally processed in a continuous flow with a maximum temperature of 160-200 degrees Fahrenheit with a holding time at that maximum temperature ranging from about 15 seconds to about 3 seconds. Product is cooled slightly to 160-185 degrees Fahrenheit just prior to being filled into glass or plastic containers designed for hot-fill.

[0001] While particular embodiments of the present invention have been disclosed, it is to be understood that various different modifications are possible and are contemplated within

the true spirit and scope of the appended claims. There is no intention, therefore, of limitations to the exact abstract, examples, or disclosure herein presented.

CLAIMS

We claim:

1. A method of preparing a protein beverage, comprising:

admixing an aqueous protein isolate, collected from membrane-filtration isolation of the protein without substantial drying with a pH adjusting agent to provide a pH of between about 2 and about 4.6, thereby obtaining an acidified protein admixture;

storing said acidified protein admixture, at room temperature for up to about 10 days or with refrigeration for up to about 30 days, until said acidified protein mixture is needed for preparing said protein beverage;

admixing said acidified protein mixture with at least one additional ingredient selected from the group consisting of water, juice, alcohol, carbonation, a concentrated plant extract, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a flavoring agent, a sweetener, a preservative, and a coloring agent.

2. A method of preparing a protein beverage, comprising:

admixing an aqueous protein isolate, collected from membrane-filtration isolation of the protein without substantial drying with a pH adjusting agent to provide a pH of between about 2 and about 4.6, thereby obtaining an acidified protein admixture;

transporting said acidified protein admixture, at room temperature for up to about 10 days or with refrigeration for up to about 30 days, to another geographic location where said acidified protein mixture is needed for preparing said protein beverage;

admixing said acidified protein mixture with at least one additional ingredient selected from the group consisting of water, juice, alcohol, carbonation, a concentrated plant extract, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a flavoring agent, a sweetener, a preservative, and a coloring agent.

3. A protein composition for use in a protein beverage or a protein beverage concentrate, comprising:

a protein essentially free of caseinate and derived from an aqueous protein isolate collected from membrane-filtration isolation of the protein and without substantial drying; and

a pH adjusting agent in an amount to adjust the pH of the aqueous protein isolate to a pH of between about 2.0 and about 4.6.

4. A protein composition in accordance with claim 3, wherein said protein composition is treated with carbon dioxide to inhibit microbial growth.

5. A protein composition in accordance with claim 3 or claim 4, wherein said protein composition may be stored or transported prior to use in a protein beverage or protein beverage concentrate.

6. A protein composition in accordance with claim 5, wherein the protein composition is stored or transported over a time period of up to about 10 days without refrigeration or up to about 30 days with refrigeration prior to use in a protein beverage or protein beverage concentrate; and whereby substantial solubility of the protein is maintained in the protein composition throughout the storage and transportation period, and whereby said protein composition is essentially free of active microbes known to be harmful to human health throughout the storage and transportation period.

7. A protein beverage composition suitable for human consumption, comprising: protein essentially free of caseinate and derived from an aqueous protein isolate collected from membrane-filtration isolation of the protein and without substantial drying; and, whereby said protein beverage composition exhibits a pH ranging from about 2.0 to about 4.6, whereby substantial solubility of the protein is maintained in the beverage composition, and whereby said protein beverage is essentially free of active microbes known to be harmful to human health, both at the time of packaging of the protein beverage and for a time period of at least one year after packaging.

8. A protein beverage composition in accordance with claim 7, wherein said aqueous protein isolate has been freshly collected from membrane-filtration isolation or has been stored or transported after being collected from membrane-filtration isolation.

9. A protein beverage composition in accordance with claim 8, wherein said aqueous protein isolate is stored or transported over a time period of up to about 10 days without refrigeration or up to about 30 days with refrigeration prior to use in a protein beverage; and whereby substantial solubility of the protein is maintained in the

protein composition throughout the storage and transportation period, and whereby said protein composition is essentially free of active microbes known to be harmful to human health throughout the storage and transportation period.

10. A protein beverage composition in accordance with claim 8, wherein the pH of said aqueous protein isolate has been adjusted to a pH ranging from about 2.0 to about 4.6.

11. A protein beverage composition in accordance with claim 10, wherein said pH of said aqueous protein isolate is adjusted with an acid, selected from the group consisting of phosphoric acid, hydrochloric acid, citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.

12. A protein beverage composition in accordance with claim 11, wherein said acid is a mineral acid, selected from phosphoric acid, hydrochloric acid, or a combination thereof.

13. A protein beverage composition in accordance with claim 11, wherein said acid is a natural acid, selected from the group consisting of citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.

14. A protein beverage composition in accordance with claim 13, wherein said acid is a natural acid, selected from the group consisting of citric acid, malic acid, tartaric acid, or a combination of two or more thereof.

15. A protein beverage composition in accordance with claim 8 or claim 10, wherein said aqueous protein isolate has been treated with carbon dioxide to inhibit microbial growth.

16. A protein beverage composition in accordance with claim 7, wherein said protein beverage composition is carbonated.

17. A protein beverage composition in accordance with claim 7, or claim 8, wherein said beverage comprises at least one additional ingredient selected from the group consisting of a concentrated plant extract, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a flavoring agent, a sweetener, a preservative, a coloring agent, juice, and alcohol.

18. A protein beverage composition in accordance with claim 17, wherein said protein beverage composition contains about 0% to about 98% juice.

19. A protein beverage composition in accordance with claim 17, wherein said protein beverage composition contains about 0% alcohol by volume to about 15% alcohol by volume.

20. A protein beverage composition in accordance with claim 17, wherein said energy-generating additive is selected from the group consisting of caffeine, citrulline malate, a magnesium-containing compound, and combinations thereof.

21. A protein beverage composition in accordance with claim 20, wherein said magnesium-containing compound is selected from the group consisting of magnesium aspartate, magnesium oxide, magnesium lactate, magnesium citrate, magnesium carbonate, magnesium gluconate, magnesium orotate, magnesium chloride, magnesium hydroxide, magnesium phosphate, magnesium sulfate, and combinations thereof.

22. A protein beverage composition in accordance with claim 7 or claim 8, wherein said aqueous protein isolate is selected from the group consisting of whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein , and combinations thereof.

23. A protein beverage composition in accordance with claim 22, wherein said aqueous protein isolate is whey protein.

24. A protein beverage composition in accordance with claim 7 or claim 8, wherein said protein beverage is clear or transparent in color, exhibiting essentially no turbidity.

25. A protein beverage composition in accordance with claim 7 or claim 8, wherein said protein beverage contains about 0.01% by weight to about 15% by weight protein and a balance of water.

26. A protein beverage composition in accordance with claim 7, wherein said essentially free from active microbe condition is created by the inactivation of microbes by pasteurization, aseptic packaging, carbonation, ozonation, radiation, ultra violet light, high pressure processing, membrane permeation, pulsed electric field, sonication, or combinations thereof.

27. A method of preparing a protein beverage, comprising: admixing an aqueous protein isolate, collected from membrane-filtration isolation of the protein without substantial drying and with a pH adjusting agent to provide a pH of between about 2 and about 4.6, thereby obtaining an admixture.

28. A method in accordance with claim 27, wherein said aqueous protein isolate has been freshly collected from membrane-filtration isolation or has been stored or transported after being collected from membrane-filtration isolation.

29. A method in accordance with claim 28, wherein said aqueous protein isolate is stored or transported over a time period of up to about 10 days without refrigeration or up to about 30 days with refrigeration prior to use in a protein beverage; and whereby substantial solubility of the protein is maintained in the protein composition throughout the storage and transportation period, and whereby said protein composition is essentially free of active microbes known to be harmful to human health throughout the storage and transportation period.

30. A method in accordance with claim 28, wherein the pH of said aqueous protein isolate has been adjusted to a pH ranging from about 2.0 to about 4.6.

31. A method in accordance with claim 30, wherein said pH of said aqueous protein isolate is adjusted with an acid, selected from the group consisting of phosphoric acid, hydrochloric acid, citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.

32. A method in accordance with claim 31, wherein said acid is a mineral acid, selected from phosphoric acid, hydrochloric acid, or a combination thereof.

33. A method in accordance with claim 31, wherein said acid is a natural acid, selected from the group consisting of citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.

34. A method in accordance with claim 33, wherein said acid is a natural acid, selected from the group consisting of citric acid, malic acid, tartaric acid, or a combination of two or more thereof.

35. A method in accordance with claim 28 or claim 30, wherein said aqueous protein isolate has been treated with carbon dioxide to inhibit microbial growth.

36. A method in accordance with claim 27, wherein said protein beverage composition is carbonated.

37. A method in accordance with claim 27, or claim 28, wherein said beverage comprises at least one additional ingredient selected from the group consisting of a concentrated plant extract, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an

energy-generating additive, an herbal supplement, a flavoring agent, a sweetener, a preservative, a coloring agent, juice, and alcohol.

38. A method in accordance with claim 37, wherein said protein beverage composition contains about 0% to about 98% juice.

39. A method in accordance with claim 37, wherein said protein beverage composition contains about 0% alcohol by volume to about 15% alcohol by volume.

40. A method in accordance with claim 37, wherein said energy-generating additive is selected from the group consisting of caffeine, citrulline malate, a magnesium-containing compound, and combinations thereof.

41. A method in accordance with claim 40, wherein said magnesium-containing compound is selected from the group consisting of magnesium aspartate, magnesium oxide, magnesium lactate, magnesium citrate, magnesium carbonate, magnesium gluconate, magnesium orotate, magnesium chloride, magnesium hydroxide, magnesium phosphate, magnesium sulfate, and combinations thereof.

42. A method in accordance with claim 27 or claim 28, wherein said aqueous protein isolate is selected from the group consisting of whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein , and combinations thereof.

43. A method in accordance with claim 42, wherein said aqueous protein isolate is whey protein.

44. A method in accordance with claim 27 or claim 28, wherein said carbonated protein beverage is clear or transparent in color, exhibiting essentially no turbidity.

45. A method in accordance with claim 27 or claim 28, wherein said protein beverage contains about 0.01% by weight to about 15% by weight protein and a balance of water.

46. A method in accordance with claim 27, wherein an essentially free from active microbe condition is created in the protein beverage by the inactivation of microbes by pasteurization, aseptic packaging, carbonation, ozonation, radiation, ultra violet light, high pressure processing, membrane permeation, pulsed electric field, sonication, or combinations thereof.

47. A protein beverage concentrate composition suitable for dilution to generate a beverage suitable for human consumption, comprising:

about 0 % by weight to about 60 % by weight juice concentrate, wherein said juice concentrate has a Brix value of about 20 °Brix to about 75 °Brix;

about 0.02 % by weight to about 75 % by weight protein, derived from an aqueous protein isolate collected from membrane-filtration isolation of the protein and without substantial drying; and

whereby both, at the time of packaging of the protein beverage concentrate and during subsequent storage without refrigeration, substantial solubility of the protein is maintained in the protein beverage concentrate, and whereby said protein beverage concentrate is essentially free of pathogenic microbes known to be harmful to human health, both at the time of packaging of the protein beverage concentrate and during subsequent storage.

48. A protein beverage concentrate composition in accordance with claim 47, wherein said aqueous protein isolate has been freshly collected from membrane-filtration isolation or has been stored or transported after being collected from membrane-filtration isolation.

49. A protein beverage concentrate composition in accordance with claim 48, wherein said aqueous protein isolate is stored or transported over a time period of up to about 10 days without refrigeration or up to about 30 days with refrigeration prior to use in a protein beverage concentrate; and whereby substantial solubility of the protein is maintained in the protein composition throughout the storage and transportation period, and whereby said protein composition is essentially free of active microbes known to be harmful to human health throughout the storage and transportation period.

50. A protein beverage concentrate composition in accordance with claim 48, wherein the pH of said aqueous protein isolate has been adjusted to a pH ranging from about 2.0 to about 4.6.

51. A protein beverage concentrate composition in accordance with claim 50, wherein said pH of said aqueous protein isolate is adjusted with an acid, selected from the group consisting of phosphoric acid, hydrochloric acid, citric acid, malic acid, tartaric acid,

fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.

52. A protein beverage concentrate composition in accordance with claim 51, wherein said acid is a mineral acid, selected from phosphoric acid, hydrochloric acid, or a combination thereof.

53. A protein beverage concentrate composition in accordance with claim 51, wherein said acid is a natural acid, selected from the group consisting of citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.

54. A protein beverage concentrate composition in accordance with claim 53, wherein said acid is a natural acid, selected from the group consisting of citric acid, malic acid, tartaric acid, or a combination of two or more thereof.

55. A protein beverage concentrate composition in accordance with claim 48 or claim 50, wherein said aqueous protein isolate has been treated with carbon dioxide to inhibit microbial growth.

56. A protein beverage concentrate in accordance with claim 47 or claim 48, wherein said protein beverage concentrate ranges from about a two-fold concentrate to about a twenty-five-fold concentrate.

57. A protein beverage concentrate in accordance with claim 56, wherein said protein beverage concentrate is about a five-fold concentrate.

58. A protein beverage concentrate in accordance with claim 56, wherein one part of said protein beverage concentrate is diluted with four parts liquid to prepare a protein beverage suitable for human consumption.

59. A protein beverage concentrate in accordance with claim 58, wherein said liquid is water, fruit juice, vegetable juice, tea, alcohol, coffee, milk, soy milk, rice milk, almond milk, or combinations thereof.

60. A protein beverage concentrate in accordance with claim 58, wherein said liquid contains carbonation.

61. A protein beverage concentrate in accordance with claim 58, wherein said protein beverage contains carbonation.

62. A protein beverage concentrate in accordance with claim 47 or claim 48, wherein said aqueous protein isolate is derived from whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein , and combinations thereof.

63. A protein beverage concentrate in accordance with claim 47, wherein said essentially free from active microbe condition is created by the inactivation of microbes by pasteurization, aseptic packaging, carbonation, ozonation, radiation, ultra violet light, high pressure processing, membrane permeation, pulsed electric field, sonication, or combinations thereof.

64. A protein beverage concentrate in accordance with claim 47, further comprising about 0 % by weight to about 100 % by weight filler.

65. A protein beverage concentrate in accordance with claim 64, wherein said filler comprises at least one additional ingredient selected from the group including water, a sweetener, a flavoring agent, a coloring agent, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a concentrated plant extract, a preservative, and alcohol.

66. A protein beverage concentrate in accordance with claim 65, wherein said energy generating additive is caffeine, citrulline malate, a magnesium-containing compound, or a combination thereof.

67. A protein beverage concentrate in accordance with claim 47, wherein said protein beverage concentrate may be used by an individual, in a food services beverage dispenser, or in a bottling plant.

68. A protein beverage concentrate in accordance with claim 47, wherein said protein beverage concentrate is a protein beverage concentrated syrup.

69. A protein beverage concentrate in accordance with claim 47, wherein said protein beverage concentrate is dried to form a protein juice beverage concentrated powder by lyophilization (freeze drying), spray drying, fluid bed drying, drum drying, or combinations thereof.

70. A method of making a protein beverage concentrate composition suitable for dilution to generate a beverage suitable for human consumption, comprising:

admixing a juice concentrate having a Brix value of about 20 °Brix to about 75 °Brix, to achieve a percent by weight of juice concentrate of about 0 % by weight to about 60 % by weight juice, and a protein, derived from an aqueous protein isolate collected from membrane-filtration isolation of the protein and without substantial drying, to achieve a percent by weight of protein in the admixture of about 0.02 % by weight to about 75 % by weight, thereby obtaining an admixture; and

packaging said protein beverage concentrate in a container which may be stored at room temperature.

71. A method in accordance with claim 70, wherein said aqueous protein isolate has been freshly collected from membrane-filtration isolation or has been stored or transported after being collected from membrane-filtration isolation.

72. A method in accordance with claim 71, wherein said aqueous protein isolate is stored or transported over a time period of up to about 10 days without refrigeration or up to about 30 days with refrigeration prior to use in a protein beverage concentrate; and whereby substantial solubility of the protein is maintained in the protein composition throughout the storage and transportation period, and whereby said protein composition is essentially free of active microbes known to be harmful to human health throughout the storage and transportation period.

73. A method in accordance with claim 71, wherein the pH of said aqueous protein isolate has been adjusted to a pH ranging from about 2.0 to about 4.6.

74. A method in accordance with claim 73, wherein said pH of said aqueous protein isolate is adjusted with an acid, selected from the group consisting of phosphoric acid, hydrochloric acid, citric acid, malic acid, tartaric acid, fumaric acid, lactic acid,

ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.

75. A method in accordance with claim 74, wherein said acid is a mineral acid, selected from phosphoric acid, hydrochloric acid, or a combination thereof.

76. A method in accordance with claim 74, wherein said acid is a natural acid, selected from the group consisting of citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.

77. A method in accordance with claim 75, wherein said acid is a natural acid, selected from the group consisting of citric acid, malic acid, tartaric acid, or a combination of two or more thereof.

78. A method in accordance with claim 70 or claim 71, wherein said aqueous protein isolate has been treated with carbon dioxide to inhibit microbial growth.

79. A method in accordance with claim 70, wherein said protein beverage concentrate ranges from about a two-fold concentrate to about a twenty-five-fold concentrate.

80. A method in accordance with claim 79, wherein said protein beverage concentrate is about a five-fold concentrate.

81. A method in accordance with claim 70, wherein one part of said protein beverage concentrate is diluted with four parts liquid to prepare a protein beverage suitable for human consumption.

82. A method in accordance with claim 81, wherein said liquid is water, fruit juice, vegetable juice, tea, alcohol, coffee, milk, soy milk, rice milk, almond milk, or combinations thereof.

83. A method in accordance with claim 81, wherein said liquid contains carbonation.

84. A method in accordance with claim 81, wherein said protein beverage contains carbonation.

85. A method in accordance with claim 70, wherein said aqueous protein isolate is derived from whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice

protein, wheat protein, hemp protein, zein protein, potato protein , and combinations thereof.

86. A method in accordance with claim 70, further comprising admixing a filler to achieve a percent by weight of filler in the admixture of about 0 % by weight to about 100 %.

87. A method in accordance with claim 86, wherein said filler comprises at least one additional ingredient selected from the group including water, a sweetener, a flavoring agent, a coloring agent, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a concentrated plant extract, a preservative, and alcohol.

88. A method in accordance with claim 87, wherein said energy generating additive is caffeine, citrulline malate, a magnesium-containing compound, or a combination thereof.

89. A method in accordance with claim 70, wherein said protein beverage concentrate may be used by an individual, in a food services beverage dispenser, or in a bottling plant.

90. A method in accordance with claim 70, wherein said protein beverage concentrate is a protein beverage concentrated syrup.

91. A method in accordance with claim 70, wherein said protein beverage concentrate is dried to form a protein juice beverage concentrated powder by lyophilization (freeze drying), spray drying, fluid bed drying, drum drying, or combinations thereof.

92. A method in accordance with claim 70, wherein said protein beverage concentrate is diluted with a liquid to prepare a protein beverage suitable for human consumption.

93. A method in accordance with claim 92, wherein said liquid is water, fruit juice, vegetable juice, tea, alcohol, coffee, milk, soy milk, rice milk, almond milk, or combinations thereof.

94. A method in accordance with claim 92, wherein said liquid contains carbonation.

95. A method in accordance with claim 92, wherein said protein beverage contains carbonation.

96. A protein beverage comprising:

about 0.01 % by weight to about 15 % by weight protein, derived from an aqueous protein isolate collected from membrane-filtration isolation of the protein and without substantial drying, and a balance of water;

whereby both at the time of packaging of the protein beverage and during any subsequent storage without refrigeration for a time period of at least 18 months after packaging, substantial solubility of the protein is maintained in said protein beverage and said protein beverage is substantially free of pathogenic microbes.

97. A protein beverage composition in accordance with claim 96, wherein said aqueous protein isolate has been freshly collected from membrane-filtration isolation or has been stored or transported after being collected from membrane-filtration isolation.

98. A protein beverage composition in accordance with claim 97, wherein said aqueous protein isolate is stored or transported over a time period of up to about 10 days without refrigeration or up to about 30 days with refrigeration prior to use in a protein beverage; and whereby substantial solubility of the protein is maintained in the protein composition throughout the storage and transportation period, and whereby said protein composition is essentially free of active microbes known to be harmful to human health throughout the storage and transportation period.

99. A protein beverage composition in accordance with claim 97, wherein the pH of said aqueous protein isolate has been adjusted to a pH ranging from about 2.0 to about 4.6.

100. A protein beverage composition in accordance with claim 99, wherein said pH of said aqueous protein isolate is adjusted with an acid, selected from the group consisting of phosphoric acid, hydrochloric acid, citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.

101. A protein beverage composition in accordance with claim 100, wherein said acid is a mineral acid, selected from phosphoric acid, hydrochloric acid, or a combination thereof.

102. A protein beverage composition in accordance with claim 100, wherein said acid is a natural acid, selected from the group consisting of citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.

103. A protein beverage composition in accordance with claim 100, wherein said acid is a natural acid, selected from the group consisting of citric acid, malic acid, tartaric acid, or a combination of two or more thereof.

104. A protein beverage composition in accordance with claim 96 or claim 97, wherein said aqueous protein isolate has been treated with carbon dioxide to inhibit microbial growth.

105. A protein beverage composition in accordance with claim 96 or claim 97, wherein said aqueous protein isolate is selected from the group consisting of whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein , and combinations thereof.

106. A protein beverage composition in accordance with claim 105, wherein said aqueous protein isolate is whey protein.

107. A carbonated fruit flavored protein beverage for human consumption, comprising: about 0.01 % by weight to about 15 % by weight protein, which is essentially free of caseinate; and, whereby said carbonated fruit flavored protein beverage exhibits a pH ranging from about 2.5 to about 4.5, whereby substantial solubility of the protein is maintained in the beverage composition, and whereby said protein beverage is essentially free of active microbes known to be harmful to human health, both at the time of packaging of the protein beverage and for a time period of at least one year after packaging.

108. A carbonated fruit flavored protein beverage in accordance with claim 107, wherein said protein beverage is clear or transparent in color, exhibiting essentially no turbidity.

109. A carbonated fruit flavored protein beverage in accordance with claim 107, wherein said protein beverage contains at least one additional ingredient selected from the group consisting of a concentrated plant extract, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a flavoring agent, a sweetener, a preservative, a coloring agent, juice, and alcohol.

110. A carbonated fruit flavored protein beverage in accordance with claim 107, wherein the essentially free from active microbe condition of the beverage is created by

the inactivation of microbes by pasteurization, aseptic packaging, carbonation, ozonation, radiation, ultra violet light, high pressure processing, membrane permeation, pulsed electric field, sonication, or combinations thereof.

111. A carbonated fruit flavored protein beverage in accordance with claim 107, wherein said protein is a powdered protein concentrate, a powdered protein isolate.

112. A carbonated fruit flavored protein beverage in accordance with claim 111, wherein said powdered protein is reconstituted to prepare a protein in liquid form.

113. A carbonated fruit flavored protein beverage in accordance with claim 107, wherein said protein is an aqueous protein isolate collected from membrane-filtration isolation of the protein without substantial drying.

114. A carbonated fruit flavored protein beverage in accordance with claim 112 or claim 113, wherein the pH of said protein is adjusted with a pH adjusting agent to a pH ranging from about 2.5 to about 4.5 prior to addition to the carbonated fruit flavored protein beverage.

115. A carbonated fruit flavored protein beverage in accordance with claim 114, wherein the pH adjusting agent is selected from the group consisting of phosphoric acid, hydrochloric acid, citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.

116. A carbonated fruit flavored protein beverage in accordance with claim 107, wherein said protein is hydrolyzed.

117. A carbonated fruit flavored protein beverage in accordance with claim 107, wherein said protein is selected from the group consisting of whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof.

118. A carbonated chocolate flavored protein beverage for human consumption, comprising

about 0.01 % by weight to about 15 % by weight protein, which is essentially free of caseinate, and whereby said carbonated chocolate flavored beverage has a pH ranging from about 4.5 to about 7.0, whereby substantial solubility of the protein is maintained in the beverage composition, and whereby said protein

beverage is essentially free of active microbes known to be harmful to human health, both at the time of packaging of the protein beverage and for a time period of at least one year after packaging.

119. A carbonated chocolate flavored protein beverage in accordance with claim 118, wherein said carbonated chocolate flavored protein beverage is turbid.

120. A carbonated chocolate flavored protein beverage in accordance with claim 118, wherein said carbonated chocolate flavored protein beverage contains at least one additional ingredient selected from the group consisting of a concentrated plant extract, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a flavoring agent, a sweetener, a preservative, a coloring agent, and alcohol.

121. A carbonated chocolate flavored protein beverage in accordance with claim 118, wherein said essentially free from active microbe condition of the beverage is created by the inactivation of microbes by pasteurization, aseptic packaging, carbonation, ozonation, radiation, ultra violet light, high pressure processing, membrane permeation, pulsed electric field, sonication, or combinations thereof.

122. A carbonated chocolate flavored protein beverage in accordance with claim 118, wherein said protein is a powdered protein concentrate, a powdered protein isolate.

123. A carbonated chocolate flavored protein beverage in accordance with claim 122, wherein said powdered protein is reconstituted to prepare a protein in liquid form.

124. A carbonated chocolate flavored protein beverage in accordance with claim 118, wherein said protein is an aqueous protein isolate collected from membrane-filtration isolation of the protein without substantial drying.

125. A carbonated chocolate flavored protein beverage in accordance with claim 123 or claim 124, wherein the pH of said protein is adjusted with a pH adjusting agent to a pH ranging from about 2.5 to about 7.0 prior to addition to the carbonated chocolate flavored protein beverage.

126. A carbonated chocolate flavored protein beverage in accordance with claim 125, wherein the pH adjusting agent is selected from the group consisting of phosphoric acid, hydrochloric acid, citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.

127. A carbonated chocolate flavored protein beverage in accordance with claim 118, wherein said protein is hydrolyzed.

128. A carbonated chocolate flavored protein beverage in accordance with claim 118, wherein said protein is selected from the group consisting of whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof.

129. A carbonated vanilla flavored protein beverage for human consumption, comprising about 0.01 % by weight to about 15 % by weight protein, which is essentially free of caseinate, and whereby said carbonated vanilla flavored beverage has a pH ranging from about 4.5 to about 7.0, whereby substantial solubility of the protein is maintained in the beverage composition, and whereby said protein beverage is essentially free of active microbes known to be harmful to human health, both at the time of packaging of the protein beverage and for a time period of at least one year after packaging.

130. A carbonated vanilla flavored protein beverage in accordance with claim 129, wherein said carbonated vanilla flavored protein beverage is turbid.

131. A carbonated vanilla flavored protein beverage in accordance with claim 129, wherein said carbonated vanilla flavored protein beverage contains at least one additional ingredient selected from the group consisting of a concentrated plant extract, an anti-foaming agent, a nutrient, calcium or a calcium derivative, an energy-generating additive, an herbal supplement, a flavoring agent, a sweetener, a preservative, a coloring agent, and alcohol.

132. A carbonated vanilla flavored protein beverage in accordance with claim 129, wherein said essentially free from active microbe condition of the beverage is created by the inactivation of microbes by pasteurization, aseptic packaging, carbonation, ozonation, radiation, ultra violet light, high pressure processing, membrane permeation, pulsed electric field, sonication, or combinations thereof.

133. A carbonated vanilla flavored protein beverage in accordance with claim 129, wherein said protein is a powdered protein concentrate, a powdered protein isolate.

134. A carbonated vanilla flavored protein beverage in accordance with claim 133, wherein said powdered protein is reconstituted to prepare a protein in liquid form.

135. A carbonated vanilla flavored protein beverage in accordance with claim 129, wherein said protein is an aqueous protein isolate collected from membrane-filtration isolation of the protein without substantial drying.

136. A carbonated vanilla flavored protein beverage in accordance with claim 134 or claim 135, wherein the pH of said protein is adjusted with a pH adjusting agent to a pH ranging from about 2.5 to about 7.0 prior to addition to the carbonated vanilla flavored protein beverage.

137. A carbonated vanilla flavored protein beverage in accordance with claim 136, wherein the pH adjusting agent is selected from the group consisting of phosphoric acid, hydrochloric acid, citric acid, malic acid, tartaric acid, fumaric acid, lactic acid, ascorbic acid, cinnamic acid, glutaric acid, gluconic acid, succinic acid, maleic acid, adipic acid, or a combination of two or more thereof.

138. A carbonated vanilla flavored protein beverage in accordance with claim 129, wherein said protein is hydrolyzed.

139. A carbonated vanilla flavored protein beverage in accordance with claim 129, wherein said protein is selected from the group consisting of whey protein, milk serum protein, lactalbumin, serum albumin, glycomacropeptide, egg white protein, ovalbumin, gelatin, hydrolyzed gelatin, hydrolyzed collagen, soy protein, canola protein, rapeseed protein, pea protein, rice protein, wheat protein, hemp protein, zein protein, potato protein, or any combination thereof.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 October 2012 (04.10.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/135774 A3

(51) **International Patent Classification**:
A23L 2/38 (2006.01) *A23L 2/52* (2006.01)
A23C 9/152 (2006.01) *A23L 2/72* (2006.01)

(21) **International Application Number**:
PCT/US2012/031707

(22) **International Filing Date**:
30 March 2012 (30.03.2012)

(25) **Filing Language**: English

(26) **Publication Language**: English

(30) **Priority Data**:
13/078,918 1 April 2011 (01.04.2011) US

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(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) **Date of publication of the international search report**:
27 December 2012

(54) **Title**: PROTEIN BEVERAGE AND METHOD OF MAKING THE SAME

(57) **Abstract**: A protein beverage composition and a method of making it relate to a beverage including a protein essentially free of caseinate and derived from an aqueous protein isolate collected from membrane-filtration isolation of the protein and without substantial drying, wherein the protein beverage composition exhibits a pH ranging from about 2.0 to about 4.6. Substantial solubility of the protein is maintained in the beverage composition, and the protein beverage is essentially free of active microbes known to be harmful to human health, both at the time of packaging of the protein beverage and for a time period of at least one year after packaging.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/031707

A. CLASSIFICATION OF SUBJECT MATTER

A23L 2/38(2006.01)i, A23C 9/152(2006.01)i, A23L 2/52(2006.01)i, A23L 2/72(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A23L 2/38; A23L 2/66; A23L 2/52; A23L 1/05; A23L 2/00; A23C 9/00; A23C 9/156

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: protein, caseinate, beverage, drink, power, dietary drink, healthy drink, pH adjusting agent, storage period

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008-0206415 A1 (SHERWOOD SHAWN et al.) 28 August 2008 See the claims 1, 13, 25, 40, 58, 67	3,4,7,16,17-26,27,36,37-46,47,56-70,78,79-96,104-106
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☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search	Date of mailing of the international search report
30 OCTOBER 2012 (30.10.2012)	**01 NOVEMBER 2012 (01.11.2012)**

Name and mailing address of the ISA/KR

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Facsimile No. 82-42-472-7140

Authorized officer

Lee Yoon A

Telephone No. 82-42-481-3372

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International application No.
PCT/US2012/031707

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(12)发明专利申请

(10)申请公布号 CN 103747694 A
(43)申请公布日 2014.04.23

(21)申请号 201280025275.X
(22)申请日 2012.03.30
(30)优先权数据
13/078,918 2011.04.01 US
(85)PCT国际申请进入国家阶段日
2013.11.25
(86)PCT国际申请的申请数据
PCT/US2012/031707 2012.03.30
(87)PCT国际申请的公布数据
WO2012/135774 EN 2012.10.04
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(51)Int.Cl.
A23L 2/38(2006.01)
A23C 9/152(2006.01)
A23L 2/52(2006.01)
A23L 2/72(2006.01)

权利要求书10页 说明书29页

(54)发明名称

蛋白质饮料及其制造方法

(57)摘要

一种蛋白质饮料组合物和一种制造它的方法涉及包含一种蛋白质的一种饮料，该蛋白质基本上不含酪蛋白酸盐并且源自一种从蛋白质的膜过滤分离过程收集并且没有进行大幅度干燥的水性蛋白质分离物，其中该蛋白质饮料组合物展现出范围从约2.0至约4.6的pH。该蛋白质的巨大溶解度在该饮料组合物中得以维持，并且在包装该蛋白质饮料时及包装后至少一年的时期内该蛋白质饮料基本上不含已知对人类健康有害的活性微生物。

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1. 一种制备一种蛋白质饮料的方法，该方法包括：

将一种从蛋白质的膜过滤分离过程收集的没有进行大幅度干燥的水性蛋白质分离物与一种 pH 调节剂混合，以提供在约 2 与约 4.6 之间的 pH，由此获得一种酸化的蛋白质混合物；

将所述酸化的蛋白质混合物在室温储存最多约 10 日或采用冷藏时储存最多约 30 日，直至需要将所述酸化的蛋白质混合物用于制备所述蛋白质饮料；

将所述酸化的蛋白质混合物与至少一种选自下组的额外成分混合，该组由以下各项组成：水、汁液、醇、碳酸化、浓缩的植物提取物、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、调味剂、增甜剂、防腐剂和着色剂。

2. 一种制备一种蛋白质饮料的方法，该方法包括：

将一种从蛋白质的膜过滤分离过程收集的没有进行大幅度干燥的水性蛋白质分离物与一种 pH 调节剂混合，以提供在约 2 与约 4.6 之间的 pH，由此获得一种酸化的蛋白质混合物；

将所述酸化的蛋白质混合物在室温持续最多约 10 日或采用冷藏时持续最多约 30 日运输至另一个地理位置，在该另一个地理位置处需要将所述酸化的蛋白质混合物用于制备所述蛋白质饮料；

将所述酸化的蛋白质混合物与至少一种选自下组的额外成分混合，该组由以下各项组成：水、汁液、醇、碳酸化、浓缩的植物提取物、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、调味剂、增甜剂、防腐剂和着色剂。

3. 用于在一种蛋白质饮料或一种蛋白质饮料浓缩物中使用的一种蛋白质组合物，该蛋白质组合物包含：

一种蛋白质，该蛋白质基本上不含酪蛋白酸盐并且源自一种从蛋白质的膜过滤分离过程收集并且没有进行大幅度干燥的水性蛋白质分离物；和

处于可将该水性蛋白质分离物的 pH 调节至约 2.0 与约 4.6 之间 pH 的量的一种 pH 调节剂。

4. 根据权利要求 3 所述的蛋白质组合物，其中所述蛋白质组合物是用二氧化碳来处理以抑制微生物生长。

5. 根据权利要求 3 或权利要求 4 所述的蛋白质组合物，其中可以将所述蛋白质组合物在用于一种蛋白质饮料或蛋白质饮料浓缩物中之前进行储存或运输。

6. 根据权利要求 5 所述的蛋白质组合物，其中将该蛋白质组合物在用于一种蛋白质饮料或蛋白质饮料浓缩物中之前在不采用冷藏时历经最多约 10 日或采用冷藏时历经最多约 30 日的时期进行储存或运输；并且由此在整个储存和运输期间维持该蛋白质在该蛋白质组合物中的巨大溶解度，并且由此在整个储存和运输期间所述蛋白质组合物基本上不含已知对人类健康有害的活性微生物。

7. 一种适于人消费的蛋白质饮料组合物，包含：基本上不含酪蛋白酸盐并且源自一种水性蛋白质分离物的蛋白质，该水性蛋白质分离物从蛋白质的膜过滤分离过程收集并且没有进行大幅度干燥；并且，由此所述蛋白质饮料组合物展现出范围从约 2.0 至约 4.6 的 pH，由此维持了该蛋白质在该饮料组合物中的巨大溶解度，并且由此在包装该蛋白质饮料时及包装后至少一年的时期内所述蛋白质饮料基本上不含已知对人类健康有害的活性微生物。

8. 根据权利要求 7 所述的蛋白质饮料组合物，其中所述水性蛋白质分离物已经从膜过滤分离过程新鲜收集或已经在从膜过滤分离过程收集后储存或运输。

9. 根据权利要求 8 所述的蛋白质饮料组合物，其中将所述水性蛋白质分离物在用于蛋白质饮料中之前在不采用冷藏时历经最多约 10 日或采用冷藏时历经最多约 30 日的时期进行储存或运输；并且由此在整个储存和运输期间维持该蛋白质在该蛋白质组合物中的巨大溶解度，并且由此在整个储存和运输期间所述蛋白质组合物基本上不含已知对人类健康有害的活性微生物。

10. 根据权利要求 8 所述的蛋白质饮料组合物，其中所述水性蛋白质分离物的 pH 已经被调节至范围从约 2.0 至约 4.6 的 pH。

11. 根据权利要求 10 所述的蛋白质饮料组合物，其中所述水性蛋白质分离物的所述 pH 是用一种选自下组的酸来调节，该组由以下各项组成：磷酸、氢氯酸、柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。

12. 根据权利要求 11 所述的蛋白质饮料组合物，其中所述酸是一种矿物酸，该矿物酸选自磷酸、氢氯酸或其组合。

13. 根据权利要求 11 所述的蛋白质饮料组合物，其中所述酸是一种选自下组的天然酸，该组由以下各项组成：柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。

14. 根据权利要求 13 所述的蛋白质饮料组合物，其中所述酸是一种选自下组的天然酸，该组由以下各项组成：柠檬酸、苹果酸、酒石酸或其两者或更多者的组合。

15. 根据权利要求 8 或权利要求 10 所述的蛋白质饮料组合物，其中所述水性蛋白质分离物已经用二氧化碳处理以抑制微生物生长。

16. 根据权利要求 7 所述的蛋白质饮料组合物，其中所述蛋白质饮料组合物被碳酸化。

17. 根据权利要求 7 或权利要求 8 所述的蛋白质饮料组合物，其中所述饮料包含至少一种选自下组的额外成分，该组由以下各项组成：浓缩的植物提取物、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、调味剂、增甜剂、防腐剂、着色剂、汁液和醇。

18. 根据权利要求 17 所述的蛋白质饮料组合物，其中所述蛋白质饮料组合物包含约 0% 至约 98% 的汁液。

19. 根据权利要求 17 所述的蛋白质饮料组合物，其中所述蛋白质饮料组合物包含按体积计约 0% 的醇至按体积计约 15% 的醇。

20. 根据权利要求 17 所述的蛋白质饮料组合物，其中所述能量生成添加物选自下组，该组由以下各项组成：咖啡因、瓜氨酸苹果酸盐、含镁化合物及它们的组合。

21. 根据权利要求 20 所述的蛋白质饮料组合物，其中所述含镁化合物选自下组，该组由以下各项组成：天冬氨酸镁、氧化镁、乳酸镁、柠檬酸镁、碳酸镁、葡糖酸镁、乳清酸镁、氯化镁、氢氧化镁、磷酸镁、硫酸镁及它们的组合。

22. 根据权利要求 7 或权利要求 8 所述的蛋白质饮料组合物，其中所述水性蛋白质分离物选自下组，该组由以下各项组成：乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白及它们的组合。

23. 根据权利要求 22 所述的蛋白质饮料组合物，其中所述水性蛋白质分离物是乳清蛋白。

24. 根据权利要求 7 或权利要求 8 所述的蛋白质饮料组合物，其中所述蛋白质饮料是在颜色上澄清或透明的，基本上不展现浊度。

25. 根据权利要求 7 或权利要求 8 所述的蛋白质饮料组合物，其中所述蛋白质饮料含有按重量计约 0.01% 至按重量计约 15% 的蛋白质和余量的水。

26. 根据权利要求 7 所述的蛋白质饮料组合物，其中所述基本上不含活性微生物的条件是通过巴斯德消毒法、无菌包装、碳酸化、臭氧化、辐射、紫外光、高压处理、膜渗透、脉冲电场、超声波处理或它们的组合灭活微生物来创造的。

27. 一种制备一种蛋白质饮料的方法，该方法包括：将一种从蛋白质的膜过滤分离过程收集的没有进行大幅度干燥的水性蛋白质分离物与一种 pH 调节剂混合，以提供在约 2 与约 4.6 之间的 pH，由此获得一种混合物。

28. 根据权利要求 27 所述的方法，其中所述水性蛋白质分离物已经从膜过滤分离过程新鲜收集或已经在从膜过滤分离过程收集后储存或运输。

29. 根据权利要求 28 所述的方法，其中将所述水性蛋白质分离物在用于一种蛋白质饮料中之前在不采用冷藏时历经最多约 10 日或采用冷藏时历经最多约 30 日的时期进行储存或运输；并且由此在整个储存和运输期间维持该蛋白质在该蛋白质组合物中的巨大溶解度，并且由此在整个储存和运输期间所述蛋白质组合物基本上不含已知对人类健康有害的活性微生物。

30. 根据权利要求 28 所述的方法，其中所述水性蛋白质分离物的 pH 已经被调节至范围从约 2.0 至约 4.6 的 pH。

31. 根据权利要求 30 所述的方法，其中所述水性蛋白质分离物的所述 pH 是用选自下组的酸来调节，该组由以下各项组成：磷酸、氢氯酸、柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。

32. 根据权利要求 31 所述的方法，其中所述酸是一种矿物酸，该矿物酸选自磷酸、氢氯酸或其组合。

33. 根据权利要求 31 所述的方法，其中所述酸是一种选自下组的天然酸，该组由以下各项组成：柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。

34. 根据权利要求 33 所述的方法，其中所述酸是一种选自下组的天然酸，该组由以下各项组成：柠檬酸、苹果酸、酒石酸或其两者或更多者的组合。

35. 根据权利要求 28 或权利要求 30 所述的方法，其中所述水性蛋白质分离物已经用二氧化碳处理以抑制微生物生长。

36. 根据权利要求 27 所述的方法，其中所述蛋白质饮料组合物被碳酸化。

37. 根据权利要求 27 或权利要求 28 所述的方法，其中所述饮料包含至少一种选自下组的额外成分，该组由以下各项组成：浓缩的植物提取物、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、调味剂、增甜剂、防腐剂、着色剂、汁液和醇。

38. 根据权利要求 37 所述的方法，其中所述蛋白质饮料组合物包含约 0% 至约 98% 的汁液。

39. 根据权利要求37所述的方法，其中所述蛋白质饮料组合物包含按体积计约0%的醇至按体积计约15%的醇。

40. 根据权利要求37所述的方法，其中所述能量生成添加物选自下组，该组由以下各项组成：咖啡因、瓜氨酸苹果酸盐、含镁化合物及它们的组合。

41. 根据权利要求40所述的方法，其中所述含镁化合物选自下组，该组由以下各项组成：天冬氨酸镁、氧化镁、乳酸镁、柠檬酸镁、碳酸镁、葡糖酸镁、乳清酸镁、氯化镁、氢氧化镁、磷酸镁、硫酸镁及它们的组合。

42. 根据权利要求27或权利要求28所述的方法，其中所述水性蛋白质分离物选自下组，该组由以下各项组成：乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白及它们的组合。

43. 根据权利要求42所述的方法，其中所述水性蛋白质分离物是乳清蛋白。

44. 根据权利要求27或权利要求28所述的方法，其中所述蛋白质碳酸饮料是在颜色上澄清或透明的，基本上不展现浊度。

45. 根据权利要求27或权利要求28所述的方法，其中所述蛋白质饮料包含按重量计约0.01%至按重量计约15%的蛋白质和余量的水。

46. 根据权利要求27所述的方法，其中一种基本上不含活性微生物的条件是通过巴斯德消毒法、无菌包装、碳酸化、臭氧化、辐射、紫外光、高压处理、膜渗透、脉冲电场、超声波处理或它们的组合灭活微生物而在该蛋白质饮料中创造的。

47. 一种蛋白质饮料浓缩组合物，适合稀释以产生适于人消费的一种饮料，该蛋白质饮料浓缩组合物包含：

按重量计约0%至按重量计约60%的汁液浓缩物，其中所述汁液浓缩物具有约20° Brix至约75° Brix的Brix值；

按重量计约0.02%至按重量计约75%的蛋白质，该蛋白质源自一种从蛋白质的膜过滤分离过程收集的并且没有进行大幅度干燥的水性蛋白质分离物；以及

由此在包装该蛋白质饮料浓缩物时和在不采用冷藏时后续储存期间，该蛋白质的巨大溶解度在该蛋白质饮料浓缩物中得以维持，并且由此在包装该蛋白质饮料浓缩物时及在后续储存期间所述蛋白质饮料浓缩物基本上不含已知对人类健康有害的致病微生物。

48. 根据权利要求47所述的蛋白质饮料浓缩组合物，其中所述水性蛋白质分离物已经从膜过滤分离过程新鲜收集或已经在从膜过滤分离过程收集后储存或运输。

49. 根据权利要求48所述的蛋白质饮料浓缩组合物，其中将所述水性蛋白质分离物在用于一种蛋白质饮料浓缩物中之前在不采用冷藏时历经最多约10日或采用冷藏时历经最多约30日的时期进行储存或运输；并且由此在整个储存和运输期间维持该蛋白质在该蛋白质组合物中的巨大溶解度，并且由此在整个储存和运输期间所述蛋白质组合物基本上不含已知对人类健康有害的活性微生物。

50. 根据权利要求48所述的蛋白质饮料浓缩组合物，其中所述水性蛋白质分离物的pH已经被调节至范围从约2.0至约4.6的pH。

51. 根据权利要求50所述的蛋白质饮料浓缩组合物，其中所述水性蛋白质分离物的所述pH是用一种选自下组的酸来调节，该组由以下各项组成：磷酸、氢氯酸、柠檬酸、苹果酸、

酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。

52. 根据权利要求 51 所述的蛋白质饮料浓缩组合物，其中所述酸是一种矿物酸，该矿物酸选自磷酸、氢氯酸或其组合。

53. 根据权利要求 51 所述的蛋白质饮料浓缩组合物，其中所述酸是一种选自下组的天然酸，该组由以下各项组成：柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。

54. 根据权利要求 53 所述的蛋白质饮料浓缩组合物，其中所述酸是一种选自下组的天然酸，该组由以下各项组成：柠檬酸、苹果酸、酒石酸或其两者或更多者的组合。

55. 根据权利要求 48 或权利要求 50 所述的蛋白质饮料浓缩组合物，其中所述水性蛋白质分离物已经用二氧化碳处理以抑制微生物生长。

56. 根据权利要求 47 或权利要求 48 所述的蛋白质饮料浓缩物，其中所述蛋白质饮料浓缩物范围是从约两倍浓缩物至约二十五倍浓缩物。

57. 根据权利要求 56 所述的蛋白质饮料浓缩物，其中所述蛋白质饮料浓缩物是约五倍浓缩物。

58. 根据权利要求 56 所述的蛋白质饮料浓缩物，其中将一份所述蛋白质饮料浓缩物用四份液体稀释以制备一种适于人消费的蛋白质饮料。

59. 根据权利要求 58 所述的蛋白质饮料浓缩物，其中所述液体是水、果汁、蔬菜汁、茶、醇、咖啡、乳、豆浆、米浆、杏仁乳或它们的组合。

60. 根据权利要求 58 所述的蛋白质饮料浓缩物，其中所述液体包含碳酸化。

61. 根据权利要求 58 所述的蛋白质饮料浓缩物，其中所述蛋白质饮料包含碳酸化。

62. 根据权利要求 47 或权利要求 48 所述的蛋白质饮料浓缩物，其中所述水性蛋白质分离物源自乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白及它们的组合。

63. 根据权利要求 47 所述的蛋白质饮料浓缩物，其中所述基本上不含活性微生物的条件是通过巴斯德消毒法、无菌包装、碳酸化、臭氧化、辐射、紫外光、高压处理、膜渗透、脉冲电场、超声波处理或它们的组合灭活微生物来创造的。

64. 根据权利要求 47 所述的蛋白质饮料浓缩物，进一步包含按重量计约 0% 至按重量计约 100% 的填料。

65. 根据权利要求 64 所述的蛋白质饮料浓缩物，其中所述填料包含至少一种选自下组的额外成分，该组包括水、增甜剂、调味剂、着色剂、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、浓缩的植物提取物、防腐剂和醇。

66. 根据权利要求 65 所述的蛋白质饮料浓缩物，其中所述能量生成添加物是咖啡因、瓜氨酸苹果酸盐、含镁化合物或其组合。

67. 根据权利要求 47 所述的蛋白质饮料浓缩物，其中所述蛋白质饮料浓缩物可以由个人使用、在餐食服务饮料分配器中或在装瓶厂中使用。

68. 根据权利要求 47 所述的蛋白质饮料浓缩物，其中所述蛋白质饮料浓缩物是一种蛋白质饮料浓缩糖浆。

69. 根据权利要求 47 所述的蛋白质饮料浓缩物，其中通过冻干(冷冻干燥)、喷雾干燥、流化床干燥、滚筒干燥或它们的组合，将所述蛋白质饮料浓缩物干燥以形成一种蛋白质汁液饮料浓缩粉末。

70. 一种制造一种蛋白质饮料浓缩组合物的方法，该蛋白质饮料浓缩组合物适合稀释以产生一种适于人消费的饮料，该方法包括：

将一种汁液浓缩物和一种蛋白质混合，该汁液浓缩物具有约 20° Brix 至约 75° Brix 的 Brix 值，并实现汁液浓缩物按重量计的百分比为按重量计约 0% 至按重量计约 60% 汁液，该蛋白质源自一种从蛋白质的膜过滤分离过程收集的并且没有进行大幅度干燥的水性蛋白质分离物，并实现在该混合物中蛋白质按重量计的百分比为按重量计约 0.02% 至按重量计约 75%，由此获得一种混合物；并且

将所述蛋白质饮料浓缩物包装在一种可以储存于室温的容器中。

71. 根据权利要求 70 所述的方法，其中所述水性蛋白质分离物已经从膜过滤分离过程新鲜收集或已经在从膜过滤分离过程收集后储存或运输。

72. 根据权利要求 71 所述的方法，其中将所述水性蛋白质分离物在用于一种蛋白质饮料浓缩物中之前在不采用冷藏时历经最多约 10 日或采用冷藏时历经最多约 30 日的时期进行储存或运输；并且由此在整个储存和运输期间维持该蛋白质在该蛋白质组合物中的巨大溶解度，并且由此在整个储存和运输期间所述蛋白质组合物基本上不含已知对人类健康有害的活性微生物。

73. 根据权利要求 71 所述的方法，其中所述水性蛋白质分离物的 pH 已经被调节至范围从约 2.0 至约 4.6 的 pH。

74. 根据权利要求 73 所述的方法，其中所述水性蛋白质分离物的所述 pH 是用选自下组的酸来调节，该组由以下各项组成：磷酸、氢氯酸、柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。

75. 根据权利要求 74 所述的方法，其中所述酸是一种矿物酸，该矿物酸选自磷酸、氢氯酸或其组合。

76. 根据权利要求 74 所述的方法，其中所述酸是一种选自下组的天然酸，该组由以下各项组成：柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合组成。

77. 根据权利要求 75 所述的方法，其中所述酸是一种选自下组的天然酸，该组由以下各项组成：柠檬酸、苹果酸、酒石酸或其两者或更多者的组合。

78. 根据权利要求 70 或权利要求 71 所述的方法，其中所述水性蛋白质分离物已经用二氧化碳处理以抑制微生物生长。

79. 根据权利要求 70 所述的方法，其中所述蛋白质饮料浓缩物范围是从约两倍浓缩物至约二十五倍浓缩物。

80. 根据权利要求 79 所述的方法，其中所述蛋白质饮料浓缩物是约五倍浓缩物。

81. 根据权利要求 70 所述的方法，其中将一份所述蛋白质饮料浓缩物用四份液体稀释以制备一种适于人消费的蛋白质饮料。

82. 根据权利要求 81 所述的方法，其中所述液体是水、果汁、蔬菜汁、茶、醇、咖啡、乳、豆浆、米浆、杏仁乳或它们的组合。

83. 根据权利要求 81 所述的方法，其中所述液体包含碳酸化。

84. 根据权利要求 81 所述的方法，其中所述蛋白质饮料包含碳酸化。

85. 根据权利要求 70 所述的方法，其中所述水性蛋白质分离物源自乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白及它们的组合。

86. 根据权利要求 70 所述的方法，进一步包括混合一种填料以实现在该混合物中填料按重量计的百分比为按重量计约 0% 至约 100%。

87. 根据权利要求 86 所述的方法，其中所述填料包括至少一种选自下组的额外成分，该组包括水、增甜剂、调味剂、着色剂、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、浓缩的植物提取物、防腐剂和醇。

88. 根据权利要求 87 所述的方法，其中所述能量生成添加物是咖啡因、瓜氨酸苹果酸盐、含镁化合物或其组合。

89. 根据权利要求 70 所述的方法，其中所述蛋白质饮料浓缩物可以由个人使用、在餐食服务饮料分配器中或在装瓶厂中使用。

90. 根据权利要求 70 所述的方法，其中所述蛋白质饮料浓缩物是一种蛋白质饮料浓缩糖浆。

91. 根据权利要求 70 所述的方法，其中通过冻干(冷冻干燥)、喷雾干燥、流化床干燥、滚筒干燥或它们的组合，将所述蛋白质饮料浓缩物干燥以形成一种蛋白质汁液饮料浓缩粉末。

92. 根据权利要求 70 所述的方法，其中将所述蛋白质饮料浓缩物用一种液体稀释以制备一种适于人消费的蛋白质饮料。

93. 根据权利要求 92 所述的方法，其中所述液体是水、果汁、蔬菜汁、茶、醇、咖啡、乳、豆浆、米浆、杏仁乳或它们的组合。

94. 根据权利要求 92 所述的方法，其中所述液体包含碳酸化。

95. 根据权利要求 92 所述的方法，其中所述蛋白质饮料包含碳酸化。

96. 一种蛋白质饮料，包含：

按重量计约 0.01% 至按重量计约 15% 的源自一种水性蛋白质分离物的蛋白质，该水性蛋白质分离物从蛋白质的膜过滤分离过程收集并且没有进行大幅度干燥，和余量的水；

由此在包装该蛋白质饮料时和在包装后不采用冷藏时持续至少 18 个月时期的任何后续储存期间，该蛋白质的巨大溶解度在所述蛋白质饮料中得以维持并且所述蛋白质饮料基本上不含致病微生物。

97. 根据权利要求 96 所述的蛋白质饮料组合物，其中所述水性蛋白质分离物已经从膜过滤分离过程新鲜收集或已经在从膜过滤分离过程收集后储存或运输。

98. 根据权利要求 97 所述的蛋白质饮料组合物，其中将所述水性蛋白质分离物在用于一种蛋白质饮料中之前在不采用冷藏时历经最多约 10 日或采用冷藏时历经最多约 30 日的时期进行储存或运输；并且由此在整个储存和运输期间维持该蛋白质在该蛋白质组合物中的巨大溶解度，并且由此在整个储存和运输期间所述蛋白质组合物基本上不含已知对人类健康有害的活性微生物。

99. 根据权利要求97所述的蛋白质饮料组合物，其中所述水性蛋白质分离物的pH已经被调节至范围从约2.0至约4.6的pH。

100. 根据权利要求99所述的蛋白质饮料组合物，其中所述水性蛋白质分离物的所述pH是用选自下组的酸来调节，该组由以下各项组成：磷酸、氢氯酸、柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。

101. 根据权利要求100所述的蛋白质饮料组合物，其中所述酸是一种矿物酸，该矿物酸选自磷酸、氢氯酸或其组合。

102. 根据权利要求100所述的蛋白质饮料组合物，其中所述酸是一种选自下组的天然酸，该组由以下各项组成：柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。

103. 根据权利要求100所述的蛋白质饮料组合物，其中所述酸是一种选自下组的天然酸，该组由以下各项组成：柠檬酸、苹果酸、酒石酸或其两者或更多者的组合。

104. 根据权利要求96或权利要求97所述的蛋白质饮料组合物，其中所述水性蛋白质分离物已经用二氧化碳处理以抑制微生物生长。

105. 根据权利要求96或权利要求97所述的蛋白质饮料组合物，其中所述水性蛋白质分离物选自下组，该组由以下各项组成：乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白及它们的组合。

106. 根据权利要求105所述的蛋白质饮料组合物，其中所述水性蛋白质分离物是乳清蛋白。

107. 一种用于人消费的蛋白质果味碳酸饮料，包含：按重量计约0.01%至按重量计约15%的基本上不含酪蛋白酸盐的蛋白质；并且由此所述蛋白质果味碳酸饮料展现出范围从约2.5至约4.5的pH，由此该蛋白质的巨大溶解度在该饮料组合物中得以维持，并且由此在包装该蛋白质饮料时及包装后至少一年的时期内所述蛋白质饮料基本上不含已知对人类健康有害的活性微生物。

108. 根据权利要求107所述的蛋白质果味碳酸饮料，其中所述蛋白质饮料是在颜色上澄清或透明的，基本上不展现浊度。

109. 根据权利要求107所述的蛋白质果味碳酸饮料，其中所述蛋白质饮料包含至少一种选自下组的额外成分，该组由以下各项组成：浓缩的植物提取物、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、调味剂、增甜剂、防腐剂、着色剂、汁液和醇。

110. 根据权利要求107所述的蛋白质果味碳酸饮料，其中该饮料的这种基本上不含活性微生物的条件是通过巴斯德消毒法、无菌包装、碳酸化、臭氧化、辐射、紫外光、高压处理、膜渗透、脉冲电场、超声波处理或它们的组合灭活微生物来创造的。

111. 根据权利要求107所述的蛋白质果味碳酸饮料，其中所述蛋白质是一种粉状的蛋白质浓缩物、一种粉状的蛋白质分离物。

112. 根据权利要求111所述的蛋白质果味碳酸饮料，其中将所述粉状的蛋白质复原以制备一种处于液体形式的蛋白质。

113. 根据权利要求107所述的蛋白质果味碳酸饮料，其中所述蛋白质是一种从蛋白质

的膜过滤分离过程收集的没有进行大幅度干燥的水性蛋白质分离物。

114. 根据权利要求 112 或权利要求 113 所述的蛋白质果味碳酸饮料，其中在将所述蛋白质添加至该蛋白质果味碳酸饮料之前，将所述蛋白质的 pH 用一种 pH 调节剂调节至范围从约 2.5 至约 4.5 的 pH。

115. 根据权利要求 114 所述的蛋白质果味碳酸饮料，其中该 pH 调节剂选自下组，该组由以下各项组成：磷酸、氢氯酸、柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。

116. 根据权利要求 107 所述的蛋白质果味碳酸饮料，其中所述蛋白质经水解。

117. 根据权利要求 107 所述的蛋白质果味碳酸饮料，其中所述蛋白质选自下组，该组由以下各项组成：乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或其任意组合。

118. 一种用于人类消费的蛋白质巧克力味碳酸饮料，

包含

按重量计约 0.01% 至按重量计约 15% 的基本上不含酪蛋白酸盐的蛋白质；并且由此所述蛋白质巧克力味碳酸饮料具有范围从约 4.5 至约 7.0 的 pH，由此该蛋白质的巨大溶解度在该饮料组合物中得以维持，并且由此在包装该蛋白质饮料时及包装后至少一年的时期内所述蛋白质饮料基本上不含已知对人类健康有害的活性微生物。

119. 根据权利要求 118 所述的蛋白质巧克力味碳酸饮料，其中所述蛋白质巧克力味碳酸饮料是浑浊的。

120. 根据权利要求 118 所述的蛋白质巧克力味碳酸饮料，其中所述蛋白质巧克力味碳酸饮料包含至少一种选自下组的额外成分，该组由以下各项组成：浓缩的植物提取物、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、调味剂、增甜剂、防腐剂、着色剂和醇。

121. 根据权利要求 118 所述的蛋白质巧克力味碳酸饮料，其中该饮料的所述基本上不含活性微生物的条件是通过巴斯德消毒法、无菌包装、碳酸化、臭氧化、辐射、紫外光、高压处理、膜渗透、脉冲电场、超声波处理或它们的组合灭活微生物来创造的。

122. 根据权利要求 118 所述的蛋白质巧克力味碳酸饮料，其中所述蛋白质是一种粉状的蛋白质浓缩物、一种粉状的蛋白质分离物。

123. 根据权利要求 122 所述的蛋白质巧克力味碳酸饮料，其中将所述粉状的蛋白质复原以制备一种处于液体形式的蛋白质。

124. 根据权利要求 118 所述的蛋白质巧克力味碳酸饮料，其中所述蛋白质是一种从蛋白质的膜过滤分离过程收集的没有进行大幅度干燥的水性蛋白质分离物。

125. 根据权利要求 123 或权利要求 124 所述的蛋白质巧克力味碳酸饮料，其中在将所述蛋白质添加至该蛋白质巧克力味碳酸饮料之前，将所述蛋白质的 pH 用一种 pH 调节剂调节至范围从约 2.5 至约 7.0 的 pH。

126. 根据权利要求 125 所述的蛋白质巧克力味碳酸饮料，其中 pH 调节剂选自下组，该组由以下各项组成：磷酸、氢氯酸、柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。

127. 根据权利要求 118 所述的蛋白质巧克力味碳酸饮料，其中所述蛋白质经水解。

128. 根据权利要求 118 所述的蛋白质巧克力味碳酸饮料，其中所述蛋白质选自下组，该组由以下各项组成：乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或其任意组合。

129. 一种用于人消费的蛋白质香草味碳酸饮料，包含：按重量计约 0.01% 至按重量计约 15% 的基本上不含酪蛋白酸盐的蛋白质；并且由此所述蛋白质香草味碳酸饮料具有范围从约 4.5 至约 7.0 的 pH，由此该蛋白质的巨大溶解度在该饮料组合物中得以维持，并且由此在包装该蛋白质饮料时及包装后至少一年的时期内所述蛋白质饮料基本上不含已知对人类健康有害的活性微生物。

130. 根据权利要求 129 所述的蛋白质香草味碳酸饮料，其中所述蛋白质香草味碳酸饮料是浑浊的。

131. 根据权利要求 129 所述的蛋白质香草味碳酸饮料，其中所述蛋白质香草味碳酸饮料包含至少一种选自下组的额外成分，该组由以下各项组成：浓缩的植物提取物、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、调味剂、增甜剂、防腐剂、着色剂和醇。

132. 根据权利要求 129 所述的蛋白质香草味碳酸饮料，其中该饮料的所述基本上不含活性微生物的条件是通过巴斯德消毒法、无菌包装、碳酸化、臭氧化、辐射、紫外光、高压处理、膜渗透、脉冲电场、超声波处理或它们的组合灭活微生物来创造的。

133. 根据权利要求 129 所述的蛋白质香草味碳酸饮料，其中所述蛋白质是一种粉状的蛋白质浓缩物、一种粉状的蛋白质分离物。

134. 根据权利要求 133 所述的蛋白质香草味碳酸饮料，其中将所述粉状的蛋白质复原以制备一种处于液体形式的蛋白质。

135. 根据权利要求 129 所述的蛋白质香草味碳酸饮料，其中所述蛋白质是一种从蛋白质的膜过滤分离过程收集的没有进行大幅度干燥的水性蛋白质分离物。

136. 根据权利要求 134 或权利要求 135 所述的蛋白质香草味碳酸饮料，其中在将所述蛋白质添加至该蛋白质香草味碳酸饮料之前，将所述蛋白质的 pH 用一种 pH 调节剂调节至范围从约 2.5 至约 7.0 的 pH。

137. 根据权利要求 136 所述的蛋白质香草味碳酸饮料，其中该 pH 调节剂选自下组，该组由以下各项组成：磷酸、氢氯酸、柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。

138. 根据权利要求 129 所述的蛋白质香草味碳酸饮料，其所述蛋白质经水解。

139. 根据权利要求 129 所述的蛋白质香草味碳酸饮料，其中所述蛋白质选自下组，该组由以下各项组成：乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或其任意组合。

蛋白质饮料及其制造方法

[0001] 相关申请

[0002] 本申请涉及2005年8月30日作为美国专利申请号11/215,524提交、2007年4月17日授权且名为“Carbonated Protein Drink and Method of Making(蛋白质碳酸饮料和制造方法)”的美国专利号7,205,018,它涉及2004年10月7日提交且名为:“Carbonated Whey Protein Beverage(乳清蛋白碳酸饮料)”的美国临时专利申请序列号60/617,146;2005年1月31日提交且名为:“Carbonated Aqueous Whey Protein Beverage and Method of Making Same(水性乳清蛋白碳酸饮料及其制造方法)”的美国临时专利申请序列号60/648,914;以及,2005年1月31日提交且名为:“Dry Carbonated Whey Protein Beverage and Method of Making Same(干乳清蛋白碳酸饮料及其制造方法)”的美国临时专利申请序列号60/648,974;2006年3月10日作为美国专利申请序列号11/373,412提交、2011年3月1日授权且名为“High Energy Carbonated Protein Drink and Method of Making(高能量蛋白质碳酸饮料及制造方法)”的美国专利号7,897,192,它是美国专利号7,205,018的部分连续案专利申请;2007年3月7日作为美国专利申请序列号11/683,338提交、2010年9月14日授权且名为“Protein Beverage and Method of Making the Same(蛋白质饮料及其制造方法)”的美国专利号7,794,770,它是美国专利号7,205,018的部分连续案专利申请;2007年3月7日提交作为美国专利申请序列号11/683,375的,2011年3月15日授权且名为“Protein Beverage and Method of Making the Same(蛋白质饮料及其制造方法)”的美国专利号7,906,160,它是美国专利号7,205,018的部分连续案专利申请;2007年3月7日作为美国专利申请序列号11/683,380提交、2010年9月21日授权且名为“Protein Beverage and Protein Beverage Concentrate and Methods of Making the Same(蛋白质饮料和蛋白质饮料浓缩物及其制造方法)”的美国专利号7,799,363,它是美国专利号7,205,018的部分连续案专利申请;2007年3月 13日作为美国专利申请序列号11/685,641提交、2010年11月30日授权且名为“Carbonated Protein Drink and Method of Making(蛋白质碳酸饮料及制造方法)”的美国专利号7,842,326,它是美国专利号7,205,018的连续申请(该专利号涉及2008年4月25日提交且名为“Protein Beverage and Method of Making The Same(蛋白质饮料及其制造方法)”的美国专利申请序列号12/110,263),所述文献的每一篇通过引用以其全文结合在此。

[0003] 本申请要求2011年4月1日提交且名为“Protein Beverage And Method Of Making The Same(蛋白质饮料及其制造方法)”的美国专利申请序列号13/078,918的优先权,该序列号涉及并且要求2008年4月25日提交且名为“Protein Beverage and Method of Making The Same(蛋白质饮料及其制造方法)”的美国专利申请序列号12/110,263的优先权,该序列号12/110,263涉及2007年8月17日提交且名为:“Protein Beverage and Method of Making the Same(蛋白质饮料及其制造方法)”的美国临时专利申请序列号60/956,663和2007年9月26日提交且名为“Protein Beverage and Method of Making the Same(蛋白质饮料及其制造方法)”的美国临时专利申请序列号60/975,500;这些专利申请的每一份通过引用以其全文特此结合。

[0004] 发明背景

1. 发明领域

[0005] 本发明涉及蛋白质饮料、蛋白质饮料浓缩物和在蛋白质饮料或蛋白质饮料浓缩物中使用的蛋白质组合物，并且涉及制造该蛋白质饮料、蛋白质饮料浓缩物和蛋白质组合物的方法。

[0006] 2. 背景技术简述

[0007] 这部分描述与披露的本发明实施例相关的背景主题。不存在明确的或隐含的以下意图：这部分中讨论的背景技术在法律上构成现有技术。另外，这份简述不意在充分描述此领域的主题，诚邀读者更彻底审查背景以便更好理解所披露内容。

[0008] 乳包含两个主要的蛋白质部分：可以占到按重量计约 80% 总蛋白 的酪蛋白和可以占到按重量计约 20% 总蛋白的乳清蛋白。乳清蛋白部分是当将酪蛋白部分凝结(例如，如因酶或酸) 并且作为干酪凝块分离时仍可以保持可溶的蛋白质部分。乳清蛋白可以包括几种蛋白质部分，包括例如 β－乳球蛋白、α－乳球蛋白、乳白蛋白、免疫球蛋白(例如像 IgG1、IgG2、IgA、和 IgM)、乳铁蛋白、糖巨肽和乳过氧化物酶。

[0009] 与酪蛋白和大豆相比，乳清蛋白可以是高度可溶的。乳清蛋白典型地可以在约 pH4.5 至约 pH5.5 时可溶性最小，该 pH 可以是乳清蛋白的等电点(净电荷是零时的 pH)。在 pH 小于约 4.5 的更酸体系中，如在许多碳酸饮料中，乳清蛋白的酸溶解度可以是尤其重要的；然而，蛋白质沉淀可以在混合期间出现，此时典型具有约 6 至约 7 的 pH 的乳清蛋白的 pH 通过等电点区过渡。蛋白质溶解度可能受热影响，并且因此巴斯德消毒期间遭遇的升高温度也可能不利地影响溶解度和流动性，导致蛋白质沉淀或凝胶化。

[0010] 乳清蛋白可以具有比酪蛋白更高的生物价值和 / 或蛋白质消化率校正氨基酸评分(PDCAAS)。乳清蛋白在消化道中的物理特性可以与酪蛋白的特性有明显区别。酪蛋白可以在胃内形成凝块，这些凝块可以从胃缓慢离开并且这些凝块可以在进入小肠之前增加它们的水解。可替代地，乳清蛋白可以几乎立即抵达空肠；然而它们在肠内的水解可能比酪蛋白更慢，因此，它们的消化和吸收可以在肠的更大长度内发生。

[0011] 蛋白质源的蛋白质功效比值(PER)测量在给定时期内幼龄动物增重 / 食入的每克蛋白质。将具有 PER2.5 的任何蛋白质视为品质良好。将乳清蛋白视为营养优异的蛋白质，因为它具有 PER3.2。酪蛋白具有 PER2.5，而许多常使用的蛋白质具有小于 2.5 的 PER，如大豆蛋白(PER2.2)、玉米蛋白(PER2.2)、花生蛋白质(PER1.8) 和小麦面筋(PER0.8)。乳清蛋白的较高 PER 可以部分归因于乳清蛋白中高水平的含硫氨基酸。这种较高水平可以有助于乳清蛋白增强免疫功能和抗氧化状态的能力。

[0012] 乳清蛋白是支链氨基酸(BCAA)的丰富来源，包括任何天然食品来源的最高已知水平。BCAA 对于运动员是重要的，因为不像其他必需氨基酸，它们是直接代谢进入肌肉组织并且是锻炼和耐力训练期间使用的首要氨基酸。亮氨酸可以对运动员是重要，因为它可以在肌肉蛋白质合成和瘦 肌肉(lean muscle)支撑和生长中发挥重要作用。研究表明锻炼的个体从高亮氨酸膳食中获益并且可以比其膳食含有较低水平亮氨酸的个体具有更多的瘦肌肉组织和更少的身体脂肪。乳清蛋白分离物可以比大豆蛋白分离物具有多约 45% (按重量计) 的亮氨酸。

[0013] 采用可以具有范围约 1% 至约 99% 乳清蛋白的制品，可以按几种形式获得乳清蛋白。乳清蛋白制品可以处于通过去除酪蛋白而产生的水性形式，但是经常采取几种其他形式，例如像，但不限于乳清蛋白提取物、乳清蛋白浓缩物、乳清蛋白分离物或乳清蛋白水解物。

[0014] 乳清蛋白浓缩物可以通过膜过滤从乳清中去除足够的非蛋白质组分来制备，从而可以选择干燥的成品以含有处于给定浓度的乳清蛋白，该给定浓度可以是按重量计约 25% 至按重量计约 89.9% 蛋白质。干酪乳清中的蛋白质是通过膜过滤、真空蒸发和喷雾干燥来浓缩以形成乳清蛋白浓缩粉末。蛋白质在乳清蛋白浓缩粉末中比在乳清中浓集得多，但 α－乳白蛋白、β－乳白蛋白、免疫球蛋白、牛血清白蛋白、糖巨肽、乳铁蛋白和乳过氧化物酶的相对量没有显著差异。

[0015] 乳清蛋白分离物可以通过经膜过滤或离子交换吸收从乳清中去除足够的非蛋白质组分来获得，从而干燥的成品可以含有按重量计约 90% 或更多的乳清蛋白、和少许（如果有的话）脂肪、胆固醇或糖（例如，乳糖）。在浓缩和喷雾干燥之前，水性乳清蛋白分离物（WPIaq）可以具有按重量计约 1% 至按重量计约 35% 的乳清蛋白浓度，并且还可以基本上不含脂肪、胆固醇和糖。

[0016] 乳清蛋白水解物是一种乳清蛋白制品，它可能已经经历蛋白酶的酶消化或有限的酸水解或肽键的合适机械破坏以形成更小肽和多肽。乳清蛋白水解物的蛋白质浓度可以取决于起始材料。例如，从按重量计 80% 乳清蛋白浓缩物制备的乳清蛋白水解物可以具有按重量计 80% 的蛋白质浓度，并且从按重量计 90% 乳清蛋白分离物制备的乳清蛋白水解物可以具有按重量计 90% 的蛋白质浓度。并非全部水解的乳清蛋白均可以在食品配制中相似地发挥作用，并且因此一种水解的乳清蛋白可能与另一种不可互换。乳清蛋白水解物的功能和生物学特性可以取决于多种因素而变化，如水解程度 和哪种蛋白酶酶用于水解。

[0017] 虽然乳清蛋白的水解可以导致增加的溶解度，但是它也可以不利地影响味道。乳清蛋白一般具有新鲜、中性味道，这种味道可以允许它含于其他食品中，而没有不利地影响味道。然而，乳清蛋白的水解可能导致极苦的味道，这可能对食品中可以使用的乳清蛋白水解物的量带来实际限制。因此，用乳清蛋白水解物制作的高蛋白饮料可能需要大量增甜剂，或苦味掩蔽剂以盖住苦味。然而，如此大量的增甜剂可能不是许多顾客希望的或对于一些应用，高蛋白饮料的苦回味可能难以或不可能掩蔽到令人满意的程度。

[0018] 乳清蛋白含有全部必需氨基酸，并且因此是一种高品质、完全蛋白质源，其中完全意指乳清蛋白含有用于身体组织生长的全部必需氨基酸。由于乳清蛋白以含有少许脂肪和糖的形式可获得，因此对运动员和存在特殊医疗需要的个体（例如，乳糖不耐受个体），它可以是特别有价值的营养源，并且可以是膳食计划的有价值组分。另外，由于乳清蛋白可以含有生物活性蛋白如免疫球蛋白、乳过氧化物酶和乳铁蛋白，所以乳清蛋白可以提供胜过其他蛋白质源（如大豆蛋白）的优点。

[0019] 乳血清蛋白（milk serum protein）基本上与干酪乳清中存在的蛋白质相同，除了它们是从乳中直接取出，没有暴露于干酪制作过程、酶反应或化学反应之外。乳血清蛋白是乳清中存在的蛋白质，主要是 α－乳球蛋白、α－乳白蛋白、牛血清白蛋白、乳铁蛋白和免疫球蛋白。

[0020] 乳和乳制产品可以为广泛的微生物提供优异的生长和增殖环境。通过施加热持续

特定时间，巴斯德消毒法已经成为使用超过百年的阻止或减少微生物生长并且增加乳及乳制产品货架期的传统方法。巴斯德消毒法可能未杀死乳和乳产品中的全部微生物。然而，它的确减少它们的数目，从而它们不可能在消费那些产物的人群中造成疾病。非无菌性乳产品，包括巴氏消毒乳产品，典型地具有限于短时期如几周的货架期，原因在于因幸存于巴斯德消毒或由加工后微生物污染引入的微生物的生长所致的腐败变质。

[0021] 传统的巴斯德消毒方法是槽式巴斯德消毒法，它涉及在大槽或罐中加热液体成分至少 30 分钟。已经开发了传统巴斯德消毒方法的变型，如，高温短时（HTST）巴斯德消毒、超级巴斯德消毒（UP）处理和超高温（UHT）巴斯德消毒。这些基于传统巴斯德消毒方法的变型使用更高温度持续更短时间，并且可以导致在不冷藏下可超过 3 个月的增加的货架期。然而，尽管使用巴斯德消毒方法，仍可能经常需要稳定剂和防腐剂以改进巴氏消毒产品的稳定性。

[0022] 通过任何巴斯德消毒方法的热处理可能对乳和乳制产品的感官特性及营养特性产生有害影响。因此，可能需要延长货架期的更多非加热方法，这些方法将不显著地降低或改变乳和乳制产品的感官特性及营养特性。

[0023] 巴斯德消毒的一种替代方案可以是可能尤其适合高酸含量食品的高压处理（HPP）。HPP 是一种食品加工方法，其中食品可以在热存在或不存在下暴露于升高的压力以灭活微生物。HPP 还可以称作高静水压处理（HPP）和超高压处理（UHP）。

[0024] 不加热的 HPP 可以用来延长乳和乳制产品的货架期，而并未有害地改变这些产品的感官特性及营养特性。不加热的 HPP 可以消除热降解，并且可以允许保护食品的‘新鲜’特征。可以从 HPP 实现与巴氏消毒产品相似的货架期。

[0025] 乳或乳制产品的 HPP 可以通过以下方式实现：将产品放置在充水（或其他传压流体）的压力容器内部的容器内，闭合压力容器，并且通过泵送更多水至压力容器中、借助外部增压器来提高施加在该容器上的压力。可以将升高的压力保持一段特定时间，然后可以将它降低。典型地，在 25℃约 600MPa 的压力水平可足以灭活营养体形式的微生物，如不形成孢子的病原体、营养期细菌、酵母和真菌。

[0026] 在 2003 年 10 月 21 日授予 Maerz（梅尔茨）的名为“Method for inactivating microorganisms using high pressure processing（使用高压处理灭活微生物的方法）”的美国专利 6,635,223 B2 中对 HPP 作了更详细地解释，其中披露了一种使用高压处理灭活产品中的微生物的方法。该方法涉及以下步骤：将 产品装填在柔性容器中，将产品加热至预加压的温度，使产品在加压的温度经受压力一段时间；并且在该段时间后降低压力。该方法还可以进一步包括一个额外步骤：使产品经受预定量的氧持续一个时间间隔。这些方法可以适用于食品、化妆品或药物产品。

[0027] 已知二氧化碳（CO_2）（生乳中随生乳暴露于空气或经巴氏消毒而减少的一种天然存在成分）具有抗微生物特性。CO_2 在食品中产生最小损害。因此，它是抑制食品腐败微生物的适合物质。目前，存在 CO_2 借以抑制微生物的至少三种已知的一般机制。在 J. H. Hotchkiss（霍奇基斯）等人，引自 Comprehensive Reviews in Food Science and Food Safety（《食品科学与食品安全综述》）2006;5:158-168, 题名为：“Addition of carbon dioxide to dairy products to improve quality:a comprehensive review（向乳产品添加二氧化碳以改进品质：综述）”的论文中更详细地讨论了以下简要概述的这些机制。

[0028] CO_2 可以借以抑制微生物生长的一种机制可以单纯是 O_2 被 CO_2 替换。CO_2 可以借以抑制微生物生长的另一种机制可以是通过在食品的水相中借助以下平衡反应溶解 CO_2 并且形成碳酸而降低食品的 pH：$H_2O + CO_2 \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^- \leftrightarrow 2H^+ + CO_3^{2-}$。$CO_2$ 可以借以抑制微生物生长的第三种机制是 CO_2 直接影响微生物的代谢。

[0029] 最后提到的机制，CO_2 对微生物代谢的直接抗微生物作用，可以是膜流动性变化(这归因于 CO_2 溶解)、胞内 pH 降低和直接抑制代谢途径(包括脱羧反应和 DNA 复制)的结果。CO_2 是相当亲脂的，这可以允许它浓缩在细菌的脂质膜内部，或穿过脂质膜并浓缩在细菌细胞内部，从而降低胞内 pH。CO_2 也可以直接干扰微生物内部需要的酶促过程，如基因表达。

[0030] 公开的欧洲专利申请。1997 年 12 月 17 日公开的名为“Method for preparing dairy products having increased shelf-life (用于制备货架期增加的乳产品的方法)”的 Henzler (亨茨勒)等人的 EP 0812544 A2 描述了一种通过向乳产品中掺入 CO_2 制备货架期增加的此类产品的方法，该方法包括使乳食品原料的液态乳部分与 CO_2 接触，将该液态乳部分和 CO_2 混合成溶液并且使该溶液经受足以在该液态乳部分与溶解的 CO_2 之间达到稳态的条件。这种获专利的方法据描述适用于广泛种类的消费乳产品，增加货架期至约 45 日至约 60 日。

[0031] HPP 与 CO_2 之间的相互作用和它们对食品腐败酶和微生物的影响由 Corwin (科温) 和 Shellhammer (谢尔哈默) 在 Journal of Food Science (《食品科学杂志》) 2002;67:697-701 的名为“Combined carbon dioxide and high pressure inactivation of pectin methylesterase, polyphenol oxidase, Lactobacillus plantarum and Escherichia col (联合二氧化碳和高压灭活果胶甲酯酶、多酚氧化酶、植物乳杆菌和大肠杆菌)”中描述。所研究的酶是果胶甲酯酶(PME)和多酚氧化酶(PPO)，并且所研究的微生物是植物乳杆菌 ATCC8014 (L. plantarum) (一种耐酸的、产生乳酸的、不形成孢子的革兰氏阳性细菌)和大肠杆菌 K12 (大肠杆菌) (一种酸敏感的、不形成孢子的革兰氏阴性细菌)。该研究的目标是确定 CO_2 对增加压力处理功效以灭活酶和微生物的影响。将 CO_2 以大约 0.2 摩尔 % 添加至以 500 至 800MPa 处理的溶液，以便进一步灭活 PME、PPO、植物乳杆菌和大肠杆菌。对于 PME 和 PPO，分别在 25℃和 50℃发现 CO_2 与压力之间的显著相互作用。据描述在全部压力处理时通过 CO_2 降低 PPO 的活性。据描述在全部压力时通过添加 CO_2 减少植物乳杆菌的存活，并且 CO_2 和高压的组合具有显著的相互作用。据描述 CO_2 对压力下大肠杆菌的存活没有显著影响。

[0032] 2006 年 5 月 9 日授予 Hotchkiss (霍奇基斯)等人的名为“Carbon dioxide as an aid in pasteurization (二氧化碳作为巴斯德消毒法中的助剂)”的美国专利 7,041,327B2 描述了抑制或减少液体中细菌和其他病原体生长的方法，该方法是通过向液体添加 CO_2 并且热灭活细菌和其他病原体从而使得 CO_2 增强热灭活过程进行的。该方法据描述适用于多种流体、液体、半固体和固体。在热灭活之前或与其同时，通过喷射或鼓泡，将 CO_2 添加至产品，以优选地获得约 400-2000ppm 水平。与热灭活步骤之前不添加 CO_2 情况下所进行的热灭活法相比，在这个 CO_2 水平，正常巴斯德消毒(HTST)方法中加热期间出现的微生物死亡的量据描述增加了 10% 至 90%。在完成热灭活过程后，据描述去除游离 CO_2。

[0033] 在饮料含有额外组分(如汁液)时，在制造、运输和储存期间蛋白质饮料中的蛋白质沉淀和蛋白质分离可能会复杂化。本领域已知用于尝试克服蛋白质从汁液饮料中沉淀

的方法。然而，这些方法大部分涉及稳定剂的使用。

[0034] 可以添加纤维或其他糖作为蛋白质稳定剂，如果胶、纤维素胶、黄原胶、阿拉伯树胶、卡拉胶、瓜耳胶、糊精、右旋糖一水合物和聚葡萄糖。尽管稳定剂可以帮助防止蛋白质沉淀，但是它们可能由于与天然存在的钙阳离子交联而具有增加饮料粘度的缺点。这种增加的粘度可以是不希望的，因为对于至少一些应用，它可以导致饮料具有低劣的感官特性。可以使用的稳定剂的量范围可能是相当窄的。例如，在低于按重量计 0.06% 的果胶浓度下，沉降可能是个显著问题，然而在高于该浓度情况下，饮料的粘度可能不利地高。必须针对每个饮料配方实验地确定稳定剂的理想量，并且可能需要逐批次调整该量。因此，不包含蛋白质稳定剂、但是产生具有良好蛋白质溶解度的饮料的饮料配方是许多应用所希望的。

[0035] 2006 年 9 月 5 日授予 Shen 等人的名为“Ultra High Pressure Homogenization Process for Making a Stable Protein Based Acid Beverage（用于制造基于蛋白质的稳定酸性饮料的超高压均化方法）”的美国专利 7,101,585 B2 描述了一种用制备稳定酸性饮料悬浮液的方法，其中将水合蛋白质稳定剂（A）和调味材料（B）合并作为预掺合物（I）并且与均化蛋白质材料（C）或水合蛋白质稳定剂（A）的均化预掺合物（II）的浆液与蛋白质材料（C）的浆液组合以形成掺混物，并且该掺混物进行巴斯德消毒和均化。掺混物的均化以两个阶段进行，这两个阶段包括从 8000-30,000 磅 / 平方英寸的高压阶段和从 300-1,000 磅 / 平方英寸的低压阶段。该酸性饮料组合物具有从 3.0 至 4.5 的 pH。这种饮料含有汁液，但是未碳酸化。添加果胶作为稳定剂。

[0036] 2003 年 5 月 29 日公布的 Yang 的公开专利申请 US 2003/0099753 A1 描述了基于果汁的饮料组合物，该饮料组合物含有：选自下组的蛋白质，该组由乳清蛋白分离物以及乳清蛋白分离物与乳清蛋白水解物的组合组成；选自下组的糖，该组由蔗糖、果糖、高果糖玉米糖浆 42（HFCS42）、HFCS55，蔗糖、果糖、HFCS42 及 HFCS55 的组合以及麦芽糊精与另一种糖的组合组成，该另一种糖选自由蔗糖、果糖、HFCS42 和 HFCS55 组成的组；选自下组的可食用酸，该组由柠檬酸、磷酸、柠檬酸和磷酸的组合以及苹果酸与另一种可食用酸（该另一种可食用酸选自由柠檬酸和磷酸组成的组）的组合组成；果汁或果汁组合；各种维生素和矿物质；以及可任选的纤维及香料（flavor），并描述了用于制造这种组合物的方法。含有以上成分的组合物据称是澄清的，具有约 4.0 或更小的 pH，并具有小于约 40 厘泊的粘度。使用蛋白质稳定剂，包括果胶。

[0037] 1984 年 10 月 23 日授予 Dahlen（达伦）等人的名为“Protein containing fruit drink and process for the manufacture thereof（含有蛋白质的水果饮料及其制造方法）”的美国专利 4,478,858 披露了含有蛋白质的果汁饮料，该果汁饮料包含 10%-85% 的含柑桔汁（citrus juice）部分的果汁部分；按重量计 90%-15% 的乳原料部分，其中该乳原料部分包含处于按重量计 0.5%-10% 成品的量的乳清蛋白；和作为增甜剂的、由基本上纯的乳糖（该基本上纯的乳糖是从乳清或来自超滤乳或乳清的渗透物中制备）制成的、含有纯葡萄糖和半乳糖衍生物的水解乳糖，据称它甚至在含有柑桔汁部分的水果饮料中充当蛋白质的结合物。该水果饮料可以按浓缩形式从蛋白质浓缩物、浓缩果汁和 / 或水果芳香物质和浓缩的水解乳糖制造。可以将含有多糖的稳定剂添加至该浓缩物。

[0038] 某些实施方案的详细说明

[0039] 作为详述说明的前言，应当注意除非上下文另外清楚地说明，否则如在本说明书

和所附权利要求书中所用的，单数形式“一个(a)”、“一种(an)”和“该(the)“包括复数指示物。

[0040] 如在此使用的，术语“约”和“大约“表示所呈现的标称值的精度是 ±10%。

[0041] 使用下文描述的方法产生的披露的本发明实施例的蛋白质饮料组合物提供了高蛋白含量(相对于前述饮料)。此外，当将蛋白质饮料经热处理以灭活微生物时，成品展现出对这种产品而言出乎意料长的货架储存稳定性。

[0042] 我们已经开发出一种改进的蛋白质饮料，与本产业中先前已知的饮料的蛋白质浓度相比较，它含有高蛋白浓度。典型的蛋白质浓度范围是从按重量计约 0.01% 至按重量计约 15%，更典型地，蛋白质浓度范围是从按重量计约 2% 至按重量计约 15%，并且最典型的浓度范围是从按重量计约 2% 至按重量计约 5%。

[0043] 该蛋白质可以是乳清蛋白(whey protein)、乳血清蛋白(milk serum protein)、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或其任意组合。该蛋白质可以是蛋白质分离物、蛋白质浓缩物、蛋白质水解物或其任意组合。蛋白质可以处于液体或粉末形式。当处于粉末形式时，该蛋白质可以在水或另一种适合液体中复原以制备处于液体形式的蛋白质。可以在将液体蛋白质添加至饮料之前将该液体蛋白质的 pH 用 pH 调节剂调节。

[0044] 在某些实施例中，一种蛋白质饮料组合物适于人消费，该蛋白质饮料组合物包含：基本上不含酪蛋白酸盐并且源自水性蛋白质分离物的蛋白质，该水性蛋白质分离物已经从蛋白质的膜过滤分离过程收集并且从未干燥过；并且，其中所述蛋白质饮料组合物展现出范围从约 2.0 至约 4.6 的 pH，由此维持了该蛋白质在饮料组合物中的巨大溶解度，并且其中在包装该蛋白质饮料时及包装后 18 个月的时期内所述蛋白质饮料基本上不含已知对人类健康有害的活性微生物。典型地，该蛋白质饮料组合物可以含有按重量计约 0.01% 至按重量计约 15% 蛋白质和余量的水。更典型地，该蛋白质饮料组合物可以含有按重量计约 0.01% 至按重量计约 8% 蛋白质和余量的水。最典型地，该蛋白质饮料组合物可以含有按重量计约 2% 至按重量计约 8% 蛋白质和余量的水。在一些实施例中，该蛋白质还可以不含乳糖和脂肪。

[0045] 在其他实施例中，提供一种制备蛋白质饮料的方法，所述方法包括：将已经从蛋白质的膜过滤分离过程收集并且从未干燥过的水性蛋白质分离物与 pH 调节剂混合，以提供在约 2 与约 4.6 之间的 pH，由此获得混合物。典型地，该蛋白质饮料可以含有按重量计约 0.01% 至按重量计约 15% 蛋白质和余量的水。更典型地，该蛋白质饮料可以含有按重量计约 0.01% 至按重量计约 8% 蛋白质和余量的水。最典型地，该蛋白质饮料组合物可以含有按重量计约 2% 至按重量计约 8% 蛋白质和余量的水。

[0046] 在一个实施例中，水性蛋白质分离物具有按重量计约 0.01% 至按重量计约 49% 的蛋白质浓度。水性蛋白质分离物可以是乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或其任意组合。该蛋白质可以是蛋白质分离物、蛋白质浓缩物、蛋白质水解物或其任意组合。

[0047] 在一个实施例中，该蛋白质基本上不含酪蛋白酸盐。典型地，这种基本上不含酪蛋

白酸盐的蛋白质是本文前述种类的乳清蛋白。在一些实施例中，这种基本上不含酪蛋白酸盐的蛋白质可以具有一些酪蛋白酸盐或可以是可源自乳清蛋白分离物或乳清蛋白浓缩物的乳清蛋白，虽然可以使用其他乳清蛋白制品，例如，如但不限于乳清蛋白提取物或乳清蛋白水解物。乳清蛋白分离物可以典型地是其中乳清蛋白浓度为按重量计约 1% 至按重量计约 40% 的水性乳清蛋白分离物。乳清蛋白浓缩物可以典型地是其中乳清蛋白浓度为按重量计约 1% 至按重量计约 40% 的水性乳清蛋白浓缩物。此外，可以通过添加蛋白质如乳清蛋白和其他蛋白质如大豆蛋白的混合物增加总蛋白含量。

[0048] 在某些实施例中，适于人消费的蛋白质饮料包含：按重量计约 2% 至按重量计约 8% 源自水性蛋白质分离物的蛋白质和余量的水，该水性蛋白质分离物已经从蛋白质的膜过滤分离过程收集并且从未干燥过；并且，由此所述蛋白质饮料组合物展现出范围从约 3.0 至约 6.0 的 pH，由此维持了该蛋白质在饮料组合物中的巨大溶解度，并且其中在包装该蛋白质饮料时及包装后 18 个月的时期内所述蛋白质饮料基本上不含已知对人类健康有害的活性微生物。该蛋白质饮料可以可任选地进一步包含按重量计约 0% 至按重量计约 1.5% 的香料、按重量计约 0% 至按重量计约 0.5% 的增甜剂、按重量计约 0% 至按重量计约 0.5% 的酸化剂、按重量计约 0% 至按重量计约 0.1% 色料和按重量计约 0% 至按重量计约 1.5% 的膳食纤维。在一个实施例中，水性蛋白质分离物可以是水性乳清蛋白分离物。在另一个实施例中，水性蛋白质分离物可以是水性大豆蛋白分离物。在其他实施例中，水性蛋白质分离物可以源自一种或多种可食用的水性蛋白质，例如，如但不限于乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或其任意组合。该蛋白质可以是蛋白质分离物、蛋白质浓缩物、蛋白质水解物或其任意组合。

[0049] 在某些实施例中，适于人消费的蛋白质饮料可以是含有蛋白质的加味水饮料，该加味水饮料包含：按重量计约 2% 至按重量计约 8% 的源自水性蛋白质分离物的蛋白质以及余量的水，该水性蛋白质分离物已经从蛋白质的膜过滤分离过程收集并且从未干燥过；并且，其中所述蛋白质饮料组合物展现出范围从约 3.0 至约 6.0 的 pH，由此维持了该蛋白质在饮料组合物中的巨大溶解度，并且由此在包装该蛋白质饮料时及包装后 18 个月的时期内所述蛋白质饮料基本上不含已知对人类健康有害的活性微生物。该蛋白质饮料可以可任选地进一步包含按重量计约 0% 至按重量计约 1.5% 的香料、按重量计约 0% 至按重量计约 0.5% 的增甜剂、按重量计约 0% 至按重量计约 0.5% 的酸化剂、按重量计约 0% 至按重量计约 0.1% 色料和按重量计约 0% 至按重量计约 1.5% 的膳食纤维。在一个实施例中，水性蛋白质分离物可以是水性乳清蛋白分离物。在另一个实施例中，水性蛋白质分离物可以是水性大豆蛋白分离物。在其他实施例中，水性蛋白质分离物可以源自一种或多种可食用的水性蛋白质，例如，如但不限于乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或其任意组合。该蛋白质可以是蛋白质分离物、蛋白质浓缩物、蛋白质水解物或其任意组合。

[0050] 乳清蛋白是从哺乳动物乳获得的蛋白质部分。典型地，可商购的乳清蛋白源自牛乳；然而，乳清蛋白可以源自任何哺乳动物的乳，例如，如但不限于山羊、绵羊、水牛、骆驼、

黑熊、美洲驼、鹿、袋鼠、猪、犬、兔、 大象、海豚、驴、马、海豹或人的乳。可替代地，乳清蛋白可以通过重组 DNA 技术、使用本领域公知的分子生物学技术来制备。

[0051] 在其他实施例中，蛋白质可以是除乳清蛋白或乳血清蛋白之外的任何可食用蛋白质，例如，如但不限于乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或其任意组合。该蛋白质可以是蛋白质分离物、蛋白质浓缩物、蛋白质水解物或其任意组合。

[0052] 在另一个实施例中，蛋白质可以是本文前述种类的乳清蛋白和 / 或乳血清蛋白以及除乳清蛋白或乳血清蛋白之外的可食用蛋白质的组合，该可食用蛋白质例如是如但不限于酪蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白或马铃薯蛋白。

[0053] 在一个实施例中，该蛋白质可以是水性大豆蛋白分离物，其中大豆蛋白浓度为按重量计约 0.01% 至按重量计约 49%，或更典型地按重量计约 1% 至按重量计约 20%。然而，可以使用其他水性蛋白质分离物。

[0054] 乳清蛋白分离物可以通过膜过滤或离子交换吸收从乳清中去除足够的非蛋白质组分来获得，从而使得干燥的成品可以包含按重量计约 90% 或更多的乳清蛋白、和少许（如果有的话）脂肪、胆固醇或糖（例如，乳糖）。在浓缩和喷雾干燥之前，乳清蛋白分离物是水性乳清蛋白分离物（WPIaq），它可以具有按重量计约 0.01% 至按重量计约 49% 的乳清蛋白浓度，并且还可以基本上不含脂肪、胆固醇和糖。这种水性乳清蛋白分离物也可以基本上不含酪蛋白酸盐和乳糖。

[0055] 可以将水性乳清蛋白分离物（WPIaq）以按重量计约 20% 至约 35% 实际乳清蛋白的浓度收集。

[0056] 可以将 WPIaq 用水稀释至约 1% 至约 24% 的蛋白质浓度，该浓度代表从单一浓度饮料蛋白质水平至适于酸化、添加营养素、运输至饮料生产设施 及后续稀释、热处理和集装箱运输的浓缩物的范围。

[0057] 利用来自膜过滤的水性蛋白质流的明显优点可以包括不存在因强烈剪切力、热和脱水所致的损害，该损害是传统的经喷雾干燥的蛋白质粉末成分固有的。另外，可以存在大幅度较少的可能在干燥期间被引入成分中的微生物群体，尤其是酵母、霉菌和相关孢子。通过避免在蛋白质制造厂将喷雾干燥蛋白质和再水化蛋白质粉末作为饮料生产工艺部分的需要，还提供了制造经济性；节约时间和劳动力以及蛋白质泡沫干扰减少可以属于益处。

[0058] 如果不通过添加的成分浑浊化，成品饮料的风味、气味和澄清性或透明性总体上可以比使用粉状乳清蛋白分离物产生的在营养素组成上相同的饮料优越。

[0059] 尽管不希望受任何现存作用理论约束，目前认为通过阻止或至少大幅度减少蛋白质在穿过等电点区时沉淀和胶凝，在将水性乳清蛋白添加至饮料组合物之前降低水性乳清蛋白的 pH 导致具有优越感官特性的蛋白质饮料。认为现有领域的饮料未试图快速地移向最终 pH 而允许组合物在低温在等电点或等电点附近停留太长时间，由此允许大量或全部材料沉淀。借助发明人的可以在沉淀开始之前越过这种低溶解度瞬态的发现，实施者可以易于用最少的测试制造这些澄清饮料。

[0060] 乳清蛋白具有高缓冲容量，并且因此这个 pH 调节步骤倾向于防止乳清蛋白对饮料的酸进行缓冲。

[0061] 水性蛋白质分离物和成品饮料的 pH 调节步骤可以用本领域技术人员已知和清楚的任何适合的酸进行。这些酸可以包括矿物酸，如饮料工业中常用的磷酸，或氢氯酸。虽然磷酸是由 FDA（美国美国食品药品管理局）划分为 GRAS 物质（总体上认可为安全物质）的食品级酸，但是在食品和饮料中使用时，有时在一些溶液中不认为它完全是一种“天然”化合物。因此，在制备“全天然“或更天然的饮料时，应当使用有机酸替代磷酸，该有机酸例如柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组 合。更典型地，有机酸将包括柠檬酸、苹果酸、酒石酸或其两者或更多者的组合。

[0062] 所用的特定酸或酸组合，以及所用每种酸的量，将取决于各种因素，如，水性蛋白质分离物的所希望的 pH、成品饮料的目标 pH、水性蛋白质分离物的蛋白质浓度、成品饮料的蛋白质浓度、成品饮料中所用的其他成分、水性蛋白质分离物的目标货架期、成品饮料的所希望的货架期、成品饮料的所希望的风味、和成品饮料是否作为“全天然”饮料或更天然的饮料销售。

[0063] 可以将酸以干（颗粒状）酸的形式或以溶液形式添加至水性蛋白质分离物或成品饮料中。溶液可以处于浓缩形式或稀释形式。当希望在不显著降低蛋白质浓度情况下调节水性蛋白质分离物或成品饮料的 pH 时，应当使用干（颗粒状）酸或其高浓度溶液。当希望同时调节水性蛋白质分离物或成品饮料的 pH 并显著地降低蛋白质浓度时，可以使用更稀的酸溶液。

[0064] 所用的酸的量将取决于使用哪种酸而变化。如下表 1 中显示，为降低水性蛋白质分离物的 pH，需要比使用柠檬酸或苹果酸时更少的量的酒石酸。

[0065] 表 1 为降低 100.0g 的 25.0% 水性蛋白质分离物的 pH 所添加的干酸（颗粒状）克数，其中蛋白质的初始 pH 是 6.65

[0066]

按重量计25.0%水性乳清蛋白分离物的pH	为实现pH所添加的柠檬酸(g)	(g)柠檬酸/(kg)乳清蛋白(基于干重)	为实现pH所添加的苹果酸(g)	(g)苹果酸/(kg)乳清蛋白(基于干重)	为实现pH所添加的酒石酸(g)	(g)酒石酸/(kg)乳清蛋白(基于干重)
6.65	0.00	0	0.00	0	0.00	0
5.00	1.08	43.2	1.04	41.6	1.02	40.8
4.60	2.0	80	1.55	62	1.43	57.2
4.20	3.90	156	2.95	118	2.35	94
3.80	5.00	200	4.33	173.2	3.15	126
3.50	6.75	270	6.05	242	4.12	164.8

[0067]

3.20	8.05	322	7.50	300	4.76	190.4

[0068] 尽管使用从来自膜过滤蛋白质的蛋白质流衍生的水性蛋白质分离物存在几个优点，但是如果水性蛋白质分离物需要从膜过滤位置被运输至饮料生产位置，一些缺点可能出现。一个缺点是增加的运输时间可以导致水性蛋白质分离物的微生物污染增加，这归因于来自从膜过滤的蛋白质流的水性蛋白质分离物中存在微生物。我们已经发现通过酸化水性蛋白质分离物、向水性蛋白质分离物添加二氧化碳或通过这两者来抑制水性蛋白质分离物中的微生物生长，可以显著地减弱这个缺点。

[0069] 酸还可以通过摧毁细菌和抑制细菌增殖充当防腐剂。因此，降低水性蛋白质分离物的pH还可以延长水性蛋白质分离物的货架期、允许水性蛋白质分离物在其用于蛋白质饮料中之前的更长的储存和/或运输时间。在将酸化的水性蛋白质分离物添加至蛋白质饮料之前，向水性蛋白质分离物添加pH调节剂允许使水性蛋白质分离物在室温(约21℃)下储存约10日而在冷藏(约4℃)下储存约30日。

[0070] 还可以通过将二氧化碳添加至水性蛋白质分离物来抑制微生物。CO_2可以通过以下方式抑制微生物生长：CO_2替换O_2，通过溶解CO_2并形成碳酸降低水性蛋白质分离物的pH，以及CO_2直接影响微生物代谢。因此，添加二氧化碳将允许增加水性蛋白质分离物的运输距离和时间。

[0071] 可能因使用从来自膜过滤蛋白质的蛋白质流衍生的水性蛋白质分离物而产生的另一个缺点是，水性蛋白质分离物的逐步胶凝作用可以在运输期间产生，该胶凝作用将导致水性蛋白质分离物难以从运输提袋取出以及水性蛋白质分离物难以或不可能从中生产出澄清蛋白质饮料。我们已经发现可以通过水性蛋白质分离物的酸化克服这个缺点，该酸化将导致水性乳清蛋白分离物因水性蛋白质分离物的pH被调节至低于该蛋白质等电点而仍处于溶液形式。可以通过使蛋白质浓度低于约25%而避免胶凝作用。

[0072] 在本发明的一个实施例中，一种制备蛋白质饮料的方法包括：将从蛋白质的膜过滤分离过程收集的没有进行大幅度干燥的水性蛋白质分离物与 pH 调节剂混合，以提供在约 2 与约 4.6 之间的 pH，由此获得一种酸化的蛋白质混合物；将酸化的蛋白质混合物在室温储存最多约 10 日或采用冷藏时储存最多约 1 个月直至需要酸化的蛋白质混合物用于制备蛋白质饮料；将酸化的蛋白质混合物与至少一种选自下组的额外成分混合，该组由以下各项组成：水、汁液、醇、碳酸化、浓缩的植物提取物、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、调味剂、增甜剂、防腐剂和着色剂。

[0073] 在本发明的另一个实施例中，一种制备蛋白质饮料的方法包括：将从蛋白质的膜过滤分离过程收集的没有进行大幅度干燥的水性蛋白质分离物与 pH 调节剂混合，以提供在约 2 与约 4.6 之间的 pH，由此获得一种酸化的蛋白质混合物；将酸化的蛋白质混合物在室温持续最多约 10 日或采用冷藏时持续最多约 1 个月运输至另一个地理位置，在该另一个地理位置处需要酸化的蛋白质混合物用于制备蛋白质饮料；将酸化的蛋白质混合物与至少一种选自下组的额外成分混合，该组由以下各项组成：水、汁液、醇、碳酸化、浓缩的植物提取物、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、调味剂、增甜剂、防腐剂和着色剂。

[0074] 在一些实施例中，该蛋白质饮料可以含有汁液。成品饮料中典型的汁液浓度范围是从按重量计约 0% 至按重量计约 100%，更典型地，汁液浓度范围是从按重量计约 0% 至按重量计约 98%，并且最典型的浓度范围是从约 0% 至按重量计约 25%。典型地，汁液来源可以是果汁、蔬菜汁或其组合，并且可以完整地、作为液体、液体浓缩物、原浆或以含有一种或多种汁液组分的另一种修饰形式来添加。更典型地，可以将汁液脱果胶，使得大部分果胶通过酶消化、色谱、沉淀或通过另一种汁液脱果胶方法去除。可以将汁液脱果胶的一种方法是用果胶酶处理汁液，如美国专利号 6,620,452B1 中所详述的。脱果胶的果汁典型地可以是具有按重量计约 0.05% 至按重量计约 0.25% 果胶含量的汁液。

[0075] 可以使用单一果汁、单一蔬菜汁、果汁掺混物、蔬菜汁掺混物或果汁和蔬菜汁掺混物。可以使用的许多具体汁液的一些实例可以包括来自以下项的汁液：苜蓿芽、苹果、杏、鳄梨、竹笋、香蕉、豆类、豆芽、甜菜、全部类型的浆果、卷心菜、胡萝卜、芹菜、樱桃、黄瓜、黑醋栗、枣(date)、无花果、葡萄柚、葡萄、番石榴、猕猴桃、金橘、柠檬、酸橙、荔枝果实、橘、芒果、全部类型的瓜类、油桃、诺丽(noni)、橙、番木瓜、百香果、桃、梨、菠萝、李、石榴、西梅、萝卜、大黄、芜菁甘蓝(rutabaga)、海草、南瓜、橘柚、柑橘、番茄和 / 或芜菁；然而，可以使用任何类型的汁液。

[0076] 在一些实施例中，可以将蛋白质饮料碳酸化。就存在的蛋白质的量而言，在维持碳酸饮料的稳定性同时已经实现的碳酸化的量出乎意料地高，其中碳酸化的量是从约 0.1 体积碳酸化(饮料中存在的每体积液体)至约 6 体积碳酸化。更典型地，存在的碳酸化的量是从约 1.6 体积至约 3.5 体积，并且最典型的浓度是从约 1.7 体积至约 3.0 体积。

[0077] 添加物可以与基础高蛋白饮料制剂组合以提供“高能量”高蛋白饮料。例如，可以添加咖啡因以增加饮料消费者的身体中循环型脂肪酸的水平。在循环中的这种增加已经显示增加了这些燃料的氧化，总体上增强了脂肪氧化。咖啡因作为增强脂肪酸代谢的手段而被熟知。

[0078] 可以包含的另一种添加物是镁。镁可以影响能量水平并且是身体中超过约 300 种

生物化学反应所需要的。镁可以帮助调节血糖水平、可以促进正常血压并且可以支持能量代谢和蛋白质合成。

[0079] 可以添加第三添加物以影响能量水平。该第三添加物可以是瓜氨酸苹果酸盐。瓜氨酸是可以在氮平衡和代谢过程中发挥作用的氨基酸。补充性瓜氨酸苹果酸盐是该氨基酸的盐形式。瓜氨酸苹果酸盐可以通过影响乳酸代谢和减少疲劳来改进有氧性能和能力。

[0080] 对代谢的这些影响中的一种或多种已经得到以下证据支持：实质上是胞内能量转移的“分子货币”的氧化三磷酸腺苷(ATP)的比率增加，并且肌肉锻炼期间的能量产生增加。已经将辅助能量生成的这三种添加物及它们的组合配制入在此所述的高蛋白饮料中，并对产品的可制造性或货架存储寿命具有很小或没有不利影响。

[0081] 瓜氨酸苹果酸盐能量生成添加物在游离形式下可以具有非常苦的味道。我们惊奇地发现，在本文所述种类的蛋白质饮料中使用的瓜氨酸苹果酸盐提供了味道令人愉快的饮料，并无需对不含有瓜氨酸苹果酸盐的配方 作出重大调整。

[0082] 除高蛋白浓度之外，蛋白质饮料是基本上不含生物上致病的微生物，如通常受食品工业监测的细菌和其他腐败病原体种类。由于用来灭活生物上致病的微生物的方法，在将蛋白质饮料包装至单独容器或份额中并且在非冷藏饮料业中标准的货架条件下储存之后该蛋白质饮料基本上不含这些致病微生物持续超过 18 月。除不存在生物上致病的微生物之外，还存在少量或不存在蛋白质沉淀、存在少量或不存在变稠，香料和颜色维持，和味道及口感维持。在设计成透明的无浊度的制剂中，蛋白质饮料在这个储存期后颜色澄清。推荐的储存温度是高于冰冻(32 ℉)至约 75 ℉。蛋白质饮料在超过 100 ℉的温度储存几个月(如约 5 个月)的时期甚至是可能的，同时不损失味道和澄清度。

[0083] 在一个实施例中，可以处理蛋白质饮料以便在可以用来向饮料提供味道和口感的碳酸化存在时灭活微生物，同时维持所需最小量的碳酸化以提供这种味道和口感。

[0084] 灭活或除去微生物的处理可以包括暴露于升高温度的热处理法、无菌包装、碳酸化、臭氧化、辐射、紫外光、高压处理、过滤、膜渗透、脉冲电场、超声波处理和它们的组合。典型地，用于微生物灭活的处理可以在用于储存和处置蛋白质碳酸饮料的单独份额包装物中进行。测试已经显示，对于在单独份额包装物中进行的微生物灭活，在范围 35 ℉与约 75 ℉之间的温度储存超过 18 个月时期后，微生物的平板计数是可忽略的并且典型地是零。

[0085] 在一个实施例中，热处理不用来灭活微生物。在这个实施例中，微生物灭活归因于添加二氧化碳至蛋白质饮料。如先前所描述，CO_2 可以通过以下方式抑制微生物生长：CO_2 替换 O_2，通过溶解 CO_2 并形成碳酸而降低蛋白质碳酸饮料的 pH，和 CO_2 直接影响微生物代谢。

[0086] 在另一个实施例中，热处理不用来灭活微生物。在这个实施例中，微生物灭活归因于蛋白质饮料的高压处理(HPP)。HPP 可以适用于碳酸化及包装之前、碳酸化之后且包装之前、或碳酸化及包装之后的蛋白质饮料。 HPP 还可以用于未碳酸化的蛋白质饮料。可以使用各种类型的 HPP 设备系统，如由 Avure Technologies of22408 66th Avenue South, Kent, WA98032 (华盛顿州 98032，肯特，第 66 大道南 22408 的 Avure 技术公司)、Elmhurst Research, Inc. of60Loudonville Rd., Albany, NY12204 (纽约州 12204，奥尔巴尼，劳顿维尔路 60 号的艾姆赫斯特研究公司)，和 NC Hyperbaric of28760Tres Cantos, Madrid, Spain (西班牙，马德里，特雷斯坎托斯 28760 的 NC Hyperbaric)生产的那些。

[0087] HPP 可以通过以下方式实现：将蛋白质饮料放置在充水(或其他传压流体)的压力容器内部的容器内，闭合压力容器，并且通过泵送更多水至压力容器中、借助外压强化器提高施加在该容器上的压力。可以将升高的压力保持一段特定时间，然后可以将它降低。在 25℃约 600MPa 的压力水平典型地可以足以灭活营养体形式的微生物，如不形成孢子的病原体、营养期细菌、酵母和霉菌。HPP 可以通过 2003 年 10 月 21 日授予 Maerz (梅尔茨)的名为“Method for inactivating microorganisms using high pressure processing(使用高压处理灭活微生物的方法)”的美国专利 6,635,223 B2 中描述的方法进行。

[0088] 在另一个实施例中，热处理不用来灭活微生物。在这个实施例中，微生物灭活归因于添加二氧化碳至蛋白质饮料和对蛋白质碳酸饮料的 HPP 的联合作用。HPP 可以适用于包装之前或包装之后的蛋白质碳酸饮料。

[0089] 在其他实施例中，热处理不用来灭活微生物。在这些实施例中，微生物灭活可以归因于碳酸化、无菌包装、臭氧化、辐射、紫外光、HPP、膜渗透、脉冲电场、超声波处理、它们的组合及其他。

[0090] 在本发明的又一个实施例中，热处理用来灭活微生物。将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒，其中将产品在连续流动下热处理，最高温度为约 160 ℉至约 200 ℉，在最高温度的停留时间范围是从约 15 秒至约 3 秒。将产品紧邻灌装入被设计用于热灌装的玻璃或塑料容器中之前略微冷却至约 160 ℉至约 185 ℉。

[0091] 连续处理法具有胜过槽法的几个优点，最重要的是节约时间和能量。对于大多数连续处理，使用高温短时(HTST)巴斯德氏消毒器。使用平板热交换器完成热处理。这种设备由框中夹在一起的一叠波纹面不锈钢板组成。存在可以使用的几种流动样式。垫圈用来限定通道的边界及防止泄漏。加热介质可以是真空蒸汽或热水。

[0092] 本发明的一个实施例的蛋白质饮料可以进一步包含额外的添加物，以便：增强营养价值(除了为增强能量生成而特别添加的那些之外)；有助于身体活动期间保护肌肉系统和关节；增加饮料的风味价值；或，提供所希望的饮料外观，前提是该额外物质在饮料中是稳定的。在本发明的一个实施例中，蛋白质饮料可以作为膳食替代品消费。增强营养价值的额外物质的实例包括多种营养素，如维生素、矿物质(包括钙或钙衍生物)、草药补充物、浓缩的植物提取物、氨基葡萄糖、氨基酸、脂肪酸、和纤维。实例包括以下：维生素，以举例的方式而不是以限制的方式例如为维生素 A、维生素 C、维生素 D 和维生素 E；矿物质，以举例的方式而不是以限制的方式例如为锌、铬、铁、钙、镁(先前提到)和钾；草药补充物，以举例的方式而不是以限制的方式例如为人参、银杏、锯棕榈、绿茶和蝴蝶亚；氨基酸，以举例的方式而不是以限制的方式例如为 L- 谷氨酰胺、L- 精氨酸、牛磺酸、肌酸、N- 乙酰 - 胱氨酸、N- 乙酰 - 肉碱、L- 亮氨酸、L- 异亮氨酸和 L- 缬氨酸；脂肪酸，以举例的方式而不是以限制的方式例如为二十二碳六烯酸(DHA)、二十碳五烯酸(EPA)、ω3′ 和 ω6′ 的；以及纤维，以举例的方式而不是以限制的方式例如为低聚果糖多糖、玉米纤维、燕麦纤维和亚麻纤维。

[0093] 可以添加可富含维生素和营养素同时热量低的浓缩植物提取物。这些提取物可以源自可具有高含量营养组分的水果、药草、蔬菜和其他植物。这些提取物的生产可以通过常规方法进行，如美国专利 6,620,452 B1 中详述的那些；然而，这些提取物可以是可商购的。这些提取物的一个实例可以是源自绿茶的提取物，称作 Sunphenon90M，其来自美国明尼苏达州 55416 明尼阿波利斯的 Taiyo International。

[0094] 有助于身体活动期间保护肌肉系统和关节的添加物的实例可以是与蛋白质饮料中已经存在的可食性营养蛋白组合发挥作用的超免疫乳蛋白浓 缩物。超免疫乳蛋白浓缩物可以按照美国专利5,650,175中详述的方式制造。超免疫乳蛋白的一个实例例如并且不限于从Stolle Milk Biologies of Chicago,I11以商标MicroLactin™下可获得并且由Humanetics Corporation of Eden Prairie,MN(明尼苏达州伊登普雷里的Humanetics公司)分销。超免疫乳蛋白浓缩物可以源自乳清,如来自乳清的部分。然而,超免疫乳蛋白浓缩物可以展现与酪蛋白相似的功能特性。超免疫乳蛋白浓缩物在饮料制剂中的使用典型地导致了展现浊度的饮料。

[0095] 调味剂或多种调味剂可以提供例如并且不限于果味、可乐味、香草味或巧克力味。其他调味剂,以举例的方式而不是以限制的方式例如为甜菊叶提取物和罗汉果。可以使用天然或合成的增甜剂,以举例的方式而不是以限制的方式例如为蔗糖、蔗糖素、阿斯巴甜和/或乙酰磺胺酸钾、纽甜、聚葡萄糖、丙三醇、山梨醇、高果糖玉米糖浆、玉米糖浆、糖精、蜜、糖蜜、枫糖浆和木糖醇。可以添加着色剂。可以添加多种物质,如柠檬酸、延胡索酸、己二酸、酒石酸和在一些情况下乳酸,以调节酸味(tartness)。

[0096] 可以在专门化产品应用中添加镇痛药形式的额外成分,例如像阿司匹林。可以添加除前文提到的咖啡因之外的温和刺激物,例如像绿茶。还可以添加松弛剂,例如,褪黑激素。

[0097] 为了提供稳定性,蛋白质饮料可以包含消泡剂如二甲基聚硅氧烷,和pH调节剂如磷酸、氢氯酸、柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者。典型地,将是使用磷酸作为pH调节剂。然而,如果希望的是“全天然”饮料或更天然饮料,则使用天然酸。一般地,所用的天然酸可以包括柠檬酸、苹果酸、酒石酸或其组合。蛋白质饮料的调节的pH典型地是从约2.0至约5.5,更典型地是从约2.0至约3.4。为了进一步提供稳定性,可以将蛋白质饮料配制成基本上排除某种组分,这种组分包括酪蛋白酸盐。酪蛋白酸盐可能在蛋白质饮料的pH下是不稳定的。

[0098] 可以将一种或多种防腐剂添加至蛋白质饮料,例如像一种或多种化学防腐剂、一种或多种天然防腐剂、其组合、或其他。可以使用的化学防腐剂的实例包括例如山梨酸盐或苯甲酸盐。可以使用的天然防腐剂的实例包 括例如乳酸链球菌素或纳他霉素,它们可以从食品成分供应商(如Danisco AJS Langebrogade 1 DK-1001 Copenhagen(DK-1001哥本哈根,Langebrogade1,丹尼斯克AJS))商购获得。

[0099] 蛋白质饮料可以通过在水中混合消泡剂、某个量的pH调节剂和某个量的蛋白质来制备,其中该pH调节剂的量提供约2至约5.5的pH,该蛋白质的量足以在饮料中提供范围从按重量计约0.01%至按重量计约8%蛋白质的最终蛋白质含量。

[0100] 蛋白质饮料可以通过按足以获得以下这样一种蛋白质碳酸饮料的量将二氧化碳添加至混合物进行碳酸化:在该蛋白质碳酸饮料中,饮料中存在的碳酸化的量范围是每体积液体混合物约0.1体积至约6体积。在该方法的一些实施例中,可以将二氧化碳以无菌碳酸水的形式添加。在其他实施例中,使无菌二氧化碳鼓入通过液体混合物直至所希望量的二氧化碳存在。在上述两者中的任一实施例中,饮料的最终蛋白质含量范围是从按重量计约0.01%至按重量计约8%,并且碳酸化范围是从约0.1体积至约6体积。在其他实施例

中，饮料的最终蛋白质含量范围是从按重量计约 2% 至按重量计约 8%，并且碳酸化范围是从约 0.1 体积至约 6 体积。

[0101] 蛋白质饮料可以通过以下方式制备：在水中混合消泡剂、某个量的 pH 调节剂、某个量的汁液和某个量的蛋白质，其中该 pH 调节剂的量提供约 2 至约 4.6 的 pH，该汁液的量提供在饮料中范围从按重量计约 0% 至按重量计约 100% 汁液的最终汁液含量，该蛋白质的量足以在饮料中提供范围从按重量计约 0.01% 至按重量计约 8% 蛋白质的最终蛋白质含量；将该混合物加热至范围从约 140 ℉至约 188 ℉的温度持续一段足以灭活可能存在于混合物中的微生物的时间；将该混合物冷却至约 40 ℉或更低的温度。

[0102] 蛋白质饮料可以通过按足以获得以下这样一种蛋白质碳酸饮料的量将二氧化碳添加至混合物进行碳酸化：在该蛋白质碳酸饮料中，饮料中存在的碳酸化的量是每体积液体混合物约 0.1 体积至约 6 体积。在该方法的一些实施例中，将二氧化碳以无菌碳酸水的形式添加。在其他实施例中，使无菌二氧化碳鼓入通过液体混合物直至所希望量的二氧化碳存在。在上述二者中的任一实施例中，饮料的最终汁液含量范围是从按重量计约 0% 至按重量计约 100%，饮料的最终蛋白质含量范围是从按重量计约 0.01% 至按重量计约 8%，并且碳酸化范围是从约 0.1 体积至约 6 体积。在其他实施例中，饮料的最终汁液含量范围是从按重量计约 0% 至按重量计约 98%，饮料的最终蛋白质含量范围是从按重量计约 2% 至按重量计约 8%，并且碳酸化范围是从约 0.1 体积至约 6 体积。

[0103] 蛋白质饮料还可以按照与上文描述相似的方式、同时进行灭活蛋白质饮料中的微生物的额外 HPP 步骤来制备。HPP 步骤可以在添加二氧化碳之前或添加二氧化碳之后进行。可以在包装之前或包装于容器中之后用 HPP 处理蛋白质碳酸饮料。

[0104] 蛋白质饮料还可以按照与上文描述相似的方式来制备，不同在于，混合物的加热可以在添加碳酸化之后而非在添加碳酸化之前进行。这要求应当准备好在加热和冷却过程期间维持碳酸化。我们已经发现如果可以将蛋白质碳酸饮料包装在特定尺寸容器中并且然后可以针对微生物灭活对饮料的容器进行处理，则维持碳酸化是可能的。

[0105] 在另一个实施例中，蛋白质饮料可以包含按体积计约 0% 的醇至按体积计约 15% 的醇。典型地，按体积计的醇百分比范围是从按体积计约 4% 至按体积计约 8%。使用的醇可以源自麦芽基、从谷物发酵而来。

[0106] 在一个实施例中，本发明是一种用于蛋白质饮料或蛋白质饮料浓缩物中的蛋白质组合物。这种蛋白质组合物包含蛋白质和 pH 调节剂，其中该蛋白质基本上不含酪蛋白酸盐并且源自从蛋白质的膜过滤分离过程收集的并且没有进行大幅度干燥的水性蛋白质分离物，该 pH 调节剂处于调节水性蛋白质分离物的 pH 至约 2.0 与约 4.6 之间 pH 的量。该蛋白质组合物可以用二氧化碳来处理以抑制微生物生长。可以将该蛋白质组合物在用于蛋白质饮料或蛋白质饮料浓缩物中之前进行储存或运输。可以将该蛋白质组合物在用于蛋白质饮料或蛋白质饮料浓缩物中之前在不采用冷藏时历经最多约 10 日或采用冷藏时历经最多约 30 日的时期进行储存或运输。在整个储存和运输期间该蛋白质在蛋白质组合物中的巨大溶解度得以维持，并且在整个储存和运输期间该蛋白质组合物基本上不含已知对人类健康有害的活性微生物。

[0107] 在另一个实施例中，本发明是一种蛋白质饮料和制造该蛋白质饮料的方法，该蛋白质饮料包含按重量计约 0.01% 至按重量计约 15% 蛋白质，该蛋白质基本上不含酪蛋白酸

盐并且源自从蛋白质的膜过滤分离过程收集的并且没有进行大幅度干燥的水性蛋白质分离物。该蛋白质饮料组合物展现范围从约 2.0 至约 4.6 的 pH。该蛋白质的巨大溶解度在饮料组合物中得以维持，并且在包装该蛋白质饮料时及包装后至少一年的时期内该蛋白质饮料基本上不含已知对人类健康有害的活性微生物。该饮料可以被碳酸化。该饮料可以包含至少一种选自下组的额外成分，该组由以下各项组成：浓缩的植物提取物、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、调味剂、增甜剂、防腐剂、着色剂、汁液和醇。蛋白质饮料是在颜色上澄清或透明的，基本上不展现浊度。

[0108] 该饮料基本上不含活性微生物的条件可以通过巴斯德消毒法、无菌包装、碳酸化、臭氧化、辐射、紫外光、高压处理、膜渗透、脉冲电场、超声波处理或它们的组合灭活微生物来创造。

[0109] 可以将该饮料中所用的水性蛋白质分离物从膜过滤分离过程新鲜收集或可以将它在从膜过滤分离过程收集之后在用于饮料中之前已经进行储存或运输。可以将水性蛋白质分离物在用于蛋白质饮料中之前在不采用冷藏时历经最多约 10 日或采用冷藏时历经最多约 30 日的时期进行储存或运输。在整个储存和运输期间该蛋白质在蛋白质组合物中的巨大溶解度得以维持，并且在整个储存和运输期间该蛋白质组合物基本上不含已知对人类健康有害的活性微生物。可以将水性蛋白质分离物的 pH 用选自下组的酸调节至范围从约 2.0 至约 4.6 的 pH，该由以下各项组成：磷酸、氢氯酸、柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。优选地，水性蛋白质的 pH 是用矿物酸（如磷酸）或用天然酸（如柠檬酸，苹果酸、酒石酸或其两者或更多者的组合）来调节。可以将水性蛋白质分离物在储存或运输之前用二氧化碳处理，以便抑制这段时间期间的微生物生长。

[0110] 水性蛋白质分离物可以选自下组，该组由以下各项组成：乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、 明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或其任意组合。

[0111] 在本发明的另一个实施例中，该蛋白质饮料包含：按重量计约 0.01% 至按重量计约 15% 的源自水性蛋白质分离物的蛋白质以及余量的水，该水性蛋白质分离物是从蛋白质的膜过滤分离过程收集并且没有进行大幅度干燥。在包装蛋白质饮料时和在包装后不采用冷藏时持续至少 18 个月时期的任何后续储存期间，该蛋白质的巨大溶解度在该蛋白质饮料中得以维持并且该蛋白质饮料基本上不含致病微生物。

[0112] 该饮料基本上不含活性微生物的条件是可以通过巴斯德消毒法、无菌包装、碳酸化、臭氧化、辐射、紫外光、高压处理、膜渗透、脉冲电场、超声波处理或它们的组合灭活微生物来创造。

[0113] 可以将该饮料中所用的水性蛋白质分离物从膜过滤分离过程新鲜收集或可以将它在从膜过滤分离过程收集之后在用于饮料中之前已经进行储存或运输。可以将水性蛋白质分离物在用于蛋白质饮料中之前在不采用冷藏时历经最多约 10 日或采用冷藏时历经最多约 30 日的时期进行储存或运输。在整个储存和运输期间该蛋白质在蛋白质组合物中的巨大溶解度得以维持，并且在整个储存和运输期间该蛋白质组合物基本上不含已知对人类健康有害的活性微生物。可以将水性蛋白质分离物的 pH 用选自下组的酸调节至范围从

约 2.0 至约 4.6 的 pH，该组由以下各项组成：磷酸、氢氯酸、柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。优选地，水性蛋白质的 pH 是用矿物酸（如磷酸）或用天然酸（如柠檬酸，苹果酸、酒石酸或其两者或更多者的组合）来调节。可以将水性蛋白质分离物在储存或运输之前用二氧化碳处理，以便抑制这段时间期间的微生物生长。

[0114] 水性蛋白质分离物可以选自下组，该组由以下各项组成：乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或 其任意组合。

[0115] 在本发明的另一个实施例中，蛋白质饮料是由按重量计约 0.01% 至按重量计约 15% 的基本上不含酪蛋白酸盐的蛋白质组成的蛋白质果味碳酸饮料，具有范围从约 2.5 至约 4.5 的 pH。在包装蛋白质饮料时和在包装后不采用冷藏时持续至少 18 个月时期的任何后续储存期间，该蛋白质的巨大溶解度在该蛋白质饮料中得以维持，并且该蛋白质饮料基本上不含致病微生物。该蛋白质饮料是在颜色上澄清或透明的，基本上不展现浊度。

[0116] 该饮料可以包含至少一种选自下组的额外成分，该组由以下各项组成：浓缩的植物提取物、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、调味剂、增甜剂、防腐剂、着色剂、汁液和醇。该饮料的果味可以源自调味剂或来自果汁。

[0117] 该饮料基本上不含活性微生物的条件可以通过巴斯德消毒法、无菌包装、碳酸化、臭氧化、辐射、紫外光、高压处理、膜渗透、脉冲电场、超声波处理或它们的组合灭活微生物来创造。

[0118] 蛋白质可以选自下组，该组由以下各项组成：乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或其任意组合。

[0119] 该蛋白质可以是粉状的蛋白质浓缩物或粉状的蛋白质分离物，或它可以源自从蛋白质的膜过滤分离过程收集的并且没有进行大幅度干燥的水性蛋白质分离物和余量的水。该蛋白质可以是完整或水解的。

[0120] 该蛋白质可以是蛋白质浓缩物或蛋白质分离物。当处于粉末形式时，可以将该蛋白质在水或另一种适合液体中复原以制备处于液体形式的蛋白质。在将液体蛋白质添加至饮料之前可以将该液体蛋白质的 pH 用 pH 调节剂调节。

[0121] 如果该蛋白质是水性蛋白质分离物，则可以将它从膜过滤分离过程新鲜收集或可以将它在从膜过滤分离过程收集之后在用于饮料中之前已经进行储存或运输。可以将水性蛋白质分离物在用于蛋白质饮料中之前在不 采用冷藏时历经最多约 10 日或采用冷藏时历经最多约 30 日的时期进行储存或运输。在整个储存和运输期间该蛋白质在蛋白质组合物中的巨大溶解度得以维持，并且在整个储存和运输期间该蛋白质组合物基本上不含已知对人类健康有害的活性微生物。可以将水性蛋白质分离物的 pH 用选自下组的酸调节至范围从约 2.0 至约 4.6 的 pH，该组由以下各项组成：磷酸、氢氯酸、柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。优选地，水性蛋白质的 pH 是用矿物酸（如磷酸）或用天然酸（如柠檬酸，苹果酸、

酒石酸或其两者或更多者的组合）来调节。可以将水性蛋白质分离物在储存或运输之前用二氧化碳处理，以便抑制这段时间期间的微生物生长。

[0122] 在本发明的另一个实施例中，该蛋白质饮料是与经典的美国鸡蛋奶油饮料相似的蛋白质巧克力味或香草味碳酸饮料。鸡蛋奶油饮料是19世纪晚期在纽约汽水饮料柜（soda fountain）出售的巧克力和香草味碳酸乳饮料，它含有巧克力或香草糖浆、苏打和全乳。然而，通过制造不含乳的货架稳定的高蛋白巧克力或香草味碳酸饮料，我们已经对这种美国经典作出改进。

[0123] 蛋白质巧克力味或香草味碳酸饮料包含按重量计约0.01%至按重量计约15%的基本上不含酪蛋白酸盐的蛋白质，具有范围从约4.5至约7.0的pH。在包装蛋白质饮料时和在包装后不采用冷藏时持续至少18个月时期的任何后续储存期间，该蛋白质的巨大溶解度在该蛋白质饮料中得以维持，并且该蛋白质饮料基本上不含致病微生物。该蛋白质饮料可以是浑浊的，与乳基饮料的外观相似。

[0124] 蛋白质巧克力味或香草味碳酸饮料可以包含至少一种选自下组的额外成分，该组由以下各项组成：浓缩的植物提取物、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、调味剂、增甜剂、防腐剂、着色剂和醇。

[0125] 蛋白质巧克力味或香草味碳酸饮料的基本上不含活性微生物的条件可以通过巴斯德消毒法、无菌包装、碳酸化、臭氧化、辐射、紫外光、高压处理、膜渗透、脉冲电场、超声波处理或它们的组合灭活微生物来创造。

[0126] 在蛋白质巧克力味或香草味碳酸饮料中使用的蛋白质可以选自下组，该组由以下各项组成：乳清蛋白、乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或其任意组合。

[0127] 在蛋白质巧克力味或香草味碳酸饮料中所用的蛋白质可以是粉状的蛋白质浓缩物或粉状的蛋白质分离物，或它可以源自从蛋白质的膜过滤分离过程收集的并且没有进行大幅度干燥的水性蛋白质分离物和余量的水。该蛋白质可以是完整或水解的。

[0128] 该蛋白质可以是蛋白质浓缩物或蛋白质分离物。当处于粉末形式时，可以将该蛋白质在水或另一种适合液体中复原以制备处于液体形式的蛋白质。可以在将液体蛋白质添加至饮料之前将该液体蛋白质的pH用pH调节剂调节。

[0129] 如果该蛋白质是水性蛋白质分离物，则可以将它从膜过滤分离过程新鲜收集或可以将它在从膜过滤分离过程收集之后在用于饮料中之前已经进行储存或运输。可以将水性蛋白质分离物在用于蛋白质饮料中之前在不采用冷藏时历经最多约10日或采用冷藏时历经最多约30日的时期进行储存或运输。在整个储存和运输期间该蛋白质在蛋白质组合物中的巨大溶解度得以维持，并且在整个储存和运输期间该蛋白质组合物基本上不含已知对人类健康有害的活性微生物。可以将水性蛋白质分离物的pH用选自下组的酸调节至范围从约2.5至约7.0的pH，该组由以下各项组成：磷酸、氢氯酸、柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。优选地，将水性蛋白质的pH用矿物酸（如磷酸）或用天然酸（如柠檬酸，苹果酸、酒石酸或其两者或更多者的组合）来调节。可以将水性蛋白质分离物在储存或运输之前用二氧化碳处理，以便抑制这段时间期间的微生物生长。

[0130] 在其他实施例中、蛋白质饮料可以按浓缩形式制备，该浓缩形式可以在消费之前用一种液体稀释，该液体例如但不限于水、果汁、蔬菜汁、茶、醇、咖啡、乳、豆浆、米浆、杏仁乳、其组合、或其他。某些实施例包括用于稀释的液体，该液体可以是碳酸化的液体或未碳酸化的液体。如果使用未碳酸化的液体，可以在稀释后将该饮料用二氧化碳气体进行碳酸化。

[0131] 蛋白质饮料浓缩物的实施例可以是浓缩糖浆，该浓缩糖浆可以包含按重量计约 0% 至按重量计约 60% 的汁液浓缩物(其中所述汁液浓缩物具有约 20° Brix 至约 75° Brix 的 Brix 值)、和按重量计约 0.02% 至按重量计约 75% 的蛋白质。蛋白质饮料浓缩糖浆的另一个实施例可以包含按重量计约 0% 至按重量计约 60% 的汁液浓缩物(其中所述汁液浓缩物具有约 20° Brix 至约 75° Brix 的 Brix 值)、和按重量计约 4% 至按重量计约 75% 的蛋白质。这类蛋白质饮料浓缩糖浆可以在包装时和在不冷藏时后续储存期间维持蛋白质的巨大溶解度。蛋白质饮料浓缩糖浆的这种实施例还可以在包装时和在不冷藏时后续储存期间基本上不含已知对人类健康有害的致病微生物。

[0132] 蛋白质饮料浓缩糖浆可以包含按重量计约 0% 的汁液浓缩物和按重量计约 0.01% 至按重量计约 49% 的蛋白质。

[0133] 用于蛋白质饮料浓缩糖浆的汁液浓缩物可以源自单一果汁、单一蔬菜汁、果汁掺混物、蔬菜汁掺混物，或可以使用果汁和蔬菜汁掺混物。可以使用的许多具体汁液的一些实例可以包括但不限于来自以下项的汁液：苜蓿芽、苹果、杏、鳄梨、竹笋、香蕉、豆类、豆芽、甜菜、全部类型的浆果、卷心菜、胡萝卜、芹菜、樱桃、黄瓜、黑醋栗、枣(date)、无花果、葡萄柚、葡萄、番石榴、猕猴桃、金橘、柠檬、酸橙、荔枝果实、橘、芒果、全部类型的瓜类、油桃、诺丽(noni)、橙、番木瓜、百香果、桃、梨、菠萝、李、石榴、西梅、萝卜、大黄、芜菁甘蓝(rutabaga)、海草、南瓜、橘柚、柑橘、番茄和 / 或芜菁、以及它们的组合；然而，可以使用任何类型的汁液。

[0134] 用于蛋白质饮料浓缩糖浆实施例的蛋白质可以基本上不含酪蛋白酸盐。在一些实施例中，基本上不含酪蛋白酸盐的蛋白质可以具有一些酪蛋白酸盐或可以是本文前述种类的乳清蛋白。基本上不含酪蛋白酸盐的蛋白 质可以是可源自乳清蛋白分离物或乳清蛋白浓缩物的乳清蛋白，虽然也可以使用其他乳清蛋白制品，例如但不限于乳清蛋白提取物或乳清蛋白水解物。乳清蛋白分离物可以是其中乳清蛋白浓度为按重量计约 0.01% 至按重量计约 49% 的水性乳清蛋白分离物。乳清蛋白浓缩物可以是水性乳清蛋白浓缩物。除基本上不含酪蛋白酸盐之外，该蛋白质还可以基本上不含脂肪和乳糖。

[0135] 乳清蛋白分离物可以通过膜过滤或离子交换吸附从乳清中去除足够的非蛋白质组分来获得，从而干燥的成品可以包含按重量计约 90% 或更多的乳清蛋白、和少许(如果有的话)脂肪、胆固醇或糖(例如，乳糖)。在浓缩和喷雾干燥之前，水性乳清蛋白分离物(WPIaq)可以具有按重量计约 0.01% 至按重量计约 49% 的乳清蛋白浓度，并且还可以基本上不含脂肪、胆固醇和糖。

[0136] 水性乳清蛋白分离物(WPIaq)是以按重量计约 20% 至约 35% 实际乳清蛋白的浓度来收集。

[0137] 将 WPIaq 用水稀释至约 1% 至约 24% 的蛋白质浓度，该浓度代表从单一浓度饮料蛋白质水平至适于酸化、添加营养素、运输至饮料生产设施及后续稀释、热处理和集装箱运输

的浓缩物的范围。

[0138] 用于蛋白质饮料浓缩糖浆的蛋白质还可以包括除乳清蛋白之外的任何可食用蛋白质，例如但不限于乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或其任意组合。

[0139] 用于蛋白质饮料浓缩糖浆的蛋白质还可以包括本文前述种类的乳清蛋白和除乳清蛋白之外的可食用蛋白质的组合，该可食用蛋白质例如像但不限于乳血清蛋白、乳白蛋白、血清白蛋白、糖巨肽、蛋清蛋白质、卵清蛋白、明胶、水解明胶、水解胶原蛋白、大豆蛋白、卡诺拉蛋白、菜籽蛋白、豌豆蛋白、稻米蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、马铃薯蛋白或其任意组合。

[0140] 典型地，可以将水性蛋白质(分离物或浓缩物)的pH在蛋白质与饮料组合物混合之前用适当的pH调节剂调节以匹配蛋白质饮料浓缩糖浆的pH。

[0141] 水性蛋白质分离物和蛋白质饮料浓缩糖浆的pH调节步骤可以用本领域技术人员已知和清楚的任何适合酸进行。这些酸可以包括矿物酸，如饮料工业中常用的磷酸，或氢氯酸。虽然磷酸是由FDA(美国美国食品药品管理局)划分为GRAS物质(总体上认可为安全物质)的食品级酸，但是在食品和饮料中使用时，经常认为它是一种人工化合物。因此，在制备“全天然”或更天然的蛋白质饮料或蛋白质饮料浓缩糖浆时，应当使用天然酸替代磷酸，该天然酸例如柠檬酸、苹果酸、酒石酸、延胡索酸、乳酸、抗坏血酸、肉桂酸、戊二酸、葡糖酸、琥珀酸、马来酸、己二酸或其两者或更多者的组合。更典型地，天然酸将包括柠檬酸、苹果酸、酒石酸或其两者或更多者的组合。

[0142] 所用的特定酸或酸组合、以及所用每种酸的量将取决于各种因素，例如水性蛋白质分离物的所希望的pH、蛋白质饮料浓缩糖浆的所希望的pH、水性蛋白质分离物的蛋白质浓度、蛋白质饮料浓缩糖浆的蛋白质浓度、蛋白质饮料浓缩糖浆中所用的其他成分、水性蛋白质分离物的所希望的货架期、蛋白质饮料浓缩糖浆的所需货架期、由蛋白质饮料浓缩糖浆制成的成品饮料的所希望风味以及蛋白质饮料浓缩糖浆或由蛋白质饮料浓缩糖浆制成的成品饮料是否作为“全天然”饮料或更天然的糖浆或饮料销售。

[0143] 可以将酸以干(颗粒状)酸的形式或以溶液形式添加至水性蛋白质分离物或蛋白质饮料浓缩糖浆中。溶液可以处于浓缩形式或稀释形式。当希望在不显著降低蛋白质浓度的情况下调节水性蛋白质分离物或蛋白质饮料浓缩糖浆的pH时，应当使用干(颗粒状)酸或浓酸溶液。当希望同时调节水性蛋白质分离物或蛋白质饮料浓缩糖浆的pH并显著地降低蛋白质浓度时，可以使用更稀的酸溶液。

[0144] 蛋白质饮料浓缩糖浆可以进一步包含按重量计约0%至按重量计约100%的填料，其中该填料可以是水、增甜剂、调味剂、着色剂、消泡剂、营养素、钙或钙衍生物、能量生成添加物、草药补充物、浓缩的植物提取物、防腐剂、它们的组合或其他。

[0145] 蛋白质饮料浓缩糖浆可以通过巴斯德消毒、无菌包装、碳酸化、臭氧化、辐射、紫外光、高压处理、膜渗透、脉冲电场、超声波处理、它们的组合或其他微生物灭活处理法处理以灭活微生物。

[0146] 蛋白质饮料浓缩糖浆范围可以是约两倍糖浆至约二十五倍糖浆。可以将蛋白质饮料浓缩糖浆的另外一个实施例制备为约五倍糖浆，其中一份蛋白质饮料浓缩糖浆可以用四

份液体稀释以制备蛋白质饮料。该液体可以是用于人消费的任何适合液体，例如但不限于水、果汁、蔬菜汁、茶、醇、咖啡、乳、豆浆、米浆、杏仁乳、它们的组合、或其他。

[0147] 在一些实施例中，由蛋白质饮料浓缩糖浆制成的蛋白质饮料可以是碳酸饮料。蛋白质饮料的碳酸化范围可以是每体积饮料约 1.0 体积至约 3.5 体积，优选地每体积饮料约 1.6 至约 3.5 体积；更优选地，每体积饮料约 1.6 至约 3.0 体积。

[0148] 碳酸化可以按碳酸化液体(例如但不限于碳酸水)的形式添加。碳酸化可以通过以下方式添加：使无菌二氧化碳鼓入通过蛋白质饮料直至所希望量的二氧化碳存在。碳酸化还可以通过添加任何可食用性碳酸化源来添加，该可食用性碳酸化源例如但不限于是一旦与水接触就能够与酸或酸混合物发生反应以实现二氧化碳释放的碳酸盐物质。参见美国专利申请公开号 20020136816，其披露内容通过引用方式结合在此。

[0149] 在一些实施例中，蛋白质饮料浓缩糖浆可以由个人使用，并且可以将其包装于一次性使用份额(serving)中或小瓶(例如像但不限于适用于家庭的 50ml-1500ml 瓶)中。在其他实施例中，可以将蛋白质饮料浓缩糖浆包装在适于在餐食服务饮料分配器中或餐厅或酒吧饮料分配器中使用的较大容器内。在另外的其他实施例中，可以大批量生产蛋白质饮料浓缩糖浆以供装瓶厂或其他商业饮料制品设施在制备蛋白质饮料中使用。

[0150] 可以通过以下方式制备蛋白质饮料浓缩糖浆：将汁液浓缩物和蛋白质混合，该汁液浓缩物具有约 20° Brix 至约 75° Brix 的 Brix 值并实现该汁液浓缩物的重量百分比为按重量计约 0% 至按重量计约 60%，该蛋白质实现该蛋白质在混合物中的重量百分比为按重量计约 0.05% 至按重量计约 60%，由此获 得混合物。可以将蛋白质饮料浓缩糖浆包装在一种可储存于室温的容器中。

[0151] 在一个实施例中，蛋白质饮料浓缩物可以是浓缩粉末，该浓缩粉末可以被制备为干燥制品，例如像但不限于粉末，颗粒状，晶体，或其他类型的干燥颗粒制品。干燥制品可以通过以下方式制备：将如上文所述的各种成分进行混合以形成浓缩糖浆，然后通过常规干燥方法，例如像但不限于冻干(冷冻干燥)、喷雾干燥、流化床干燥、转鼓式干燥、它们的组合或其他，将该糖浆干燥成干燥粉末形式。

[0152] 在下文描述的许多实例中，所用的蛋白质是乳清蛋白，因为这种蛋白质提供了味道并且提供先前所讨论种类的其他营养优点。然而，本领域技术人员将理解，通过调节 pH 以延伸至更高的或更低 pH 范围和 / 或通过产生具有约 0.01% 至约 15% 范围内其他位置处的蛋白质含量的蛋白质碳酸饮料，同样可以单独地或组合地使用其他蛋白质例如(以举例的方式而不是以限制的方式)乳蛋白、大豆蛋白、乳白蛋白、血清白蛋白、糖巨肽、稻米蛋白、豌豆蛋白、卡诺拉蛋白、小麦蛋白、大麻蛋白、玉米醇溶蛋白、亚麻蛋白、蛋清蛋白质，卵清蛋白、明胶、它们的组合、或其他，以产生本发明的蛋白质饮料。这些常见蛋白质源的水解物和衍生物也可以在本披露预期的实施例中使用。

[0153] 在下文描述的大部分实例中，用来灭活微生物的方法是巴斯德消毒，然而，可以使用其他方法，如无菌包装、碳酸化、臭氧化、辐射、紫外光、高压处理、膜渗透、脉冲电场、超声波处理、它们的组合或其他。

[0154] 实例

[0155] 实例 1

[0156] 以下实例描述了水性蛋白质成分用于生产大约 10,000 升果味蛋白质饮料的用

途，该果味蛋白质饮料具有 3.33% 的乳清蛋白浓度，该浓度大约等于牛乳中的总蛋白浓度。该批次的重量是大约 10,350kg。

[0157] 在酸化过程期间应当将温度维持在 40-50 华氏度范围内。

[0158] 将具有 33.3%（w/w）总蛋白的 1035kg 水性乳清蛋白通过添加和缓慢混合相等重量的纯化水进行稀释，以产生 2070kg 的水性 16.65% 乳清蛋白。

[0159] 以约 5kg/ 分钟的速率在恒定混合下添加大约 50kg 的 85% 磷酸，终点是目标 pH3.2±0.2。

[0160] 将酸化的水性蛋白质转移至被设计用于托盘化食品级液体运输的两个散装提袋中。这些提袋典型地具有 250-300 加仑的容量，并且在这种情况下，提袋容纳总计约 450 加仑。

[0161] 散装运输应当以可使温度维持在 40-60 度的方式实施。

[0162] 在抵达饮料生产设施后，将蛋白质转移至体积适当的分批混合罐（在此实例中，3,000-5,000 加仑容量）。

[0163] 添加额外的水以达到大约 99% 的最终体积，此后添加香料、色料、增甜剂和其他所希望的成分。通过添加单一有机酸如柠檬酸、苹果酸、酒石酸、其组合或其他有机酸，实现最终 pH3.2±0.2。

[0164] 将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒，其中将产品在连续流动下热处理，最高温度为 160 ℉ -200 ℉，在最高温度的停留时间是从 15 秒至约 3 秒。将产品紧邻灌装入被设计用于热灌装的玻璃或塑料容器之前略微冷却至 160 ℉ -185 ℉。

[0165] 实例 2

[0166] 可以通过以下方式进行生产这种饮料的替代方法：在蛋白质生产地点实施完全稀释和成分添加，随后将成品饮料散装运输至饮料加工厂 / 装瓶厂。认为这种方法更昂贵，这归因于额外水的运输，并且通常将避免，除非饮料加工厂不能完成批量制备。

[0167] 实例 3

[0168] 生产这种饮料的另一种替代方法由以下组成：运输处于其未稀释和未酸化状态的高度浓缩的水性蛋白质，此后这些步骤在饮料加工和容器灌装地点进行。

[0169] 实例 4

[0170] 第四实例涉及使用来自大豆蛋白的膜过滤分离过程的水性蛋白质流。在这个实例中，推荐在该工艺开始时添加抗微生物剂，因为水性大豆蛋白将不会作为浓缩物或作为成品饮料而被酸化，原因是其在酸性溶液中的不溶性。温度应当维持在 30 ℉ -42 ℉直至使用用于灭菌的灭菌技术和容器灌装来加工成品饮料。

[0171] 实例 5

[0172] 以下实例描述了水性蛋白质成分用于生产大约 385 升水基果味蛋白质饮料的用途，该水基果味蛋白质饮料具有约 3.35% 的乳清蛋白浓度，大约等于牛乳中的总蛋白浓度。该批次的重量是大约 387kg。

[0173] 在酸化过程期间温度应当维持在 40-50 华氏度范围内。

[0174] 将大约 3.6kg 的膳食纤维（如 VitaSugar™ 牌糠纤维，来自位于加拿大埃德蒙顿市的 Bio Neutra）通过添加和缓慢混入大约 316.3kg 纯化水中进行稀释。可替代地，可以保

留少量如大约 1kg 或更少的膳食纤维从而与具有小于 1kg 的少量添加的其他干成分一起制造一种“预混物”。

[0175] 将具有约 20.0% (w/w)总蛋白的大约 64.8kg 水性乳清蛋白分离物(如水性乳清蛋白分离物，从位于威斯康星州的 Trega 可获得)通过添加和缓慢混合至水和纤维混合物中来稀释。将混合物充分混合，但要小心防止空气掺入混合物中，这会造成不希望的起泡效果。注意乳清蛋白在水性乳清蛋白制品中的浓度可以在批次和 / 或制造商之间变动，并且因此应当据此调节添加的水性乳清蛋白分离物和水的量，以便在成品饮料中实现所希望的最终蛋白质浓度。

[0176] 检查混合物的 pH，并且如果高于 3.22，则以约 5kg/ 分钟的速率在恒定混合下添加磷酸，终点是目标 pH 约 3.2。

[0177] 将大约 0.39kg 苹果酸和大约 0.39kg 柠檬酸添加至该混合物并且在充分混合后记录 pH。

[0178] 将大约 81.24 克蔗糖素和大约 154.75 克色料(如红色 2479)添加至混合物。可替代地，可以将蔗糖素和色料与大约 1kg 或更少的膳食纤维预混(上文提到)以有助于分散和润湿蔗糖素和色料。

[0179] 将大约 386.87 克天然石榴香料(如从纽约布鲁克林的 Virginia Dare 可获得的天然石榴香料)和大约 773.74 克天然水果宾治(fruit punch)香料(如从纽约布鲁克林的 Virginia Dare 可获得的天然水果宾治香料)添加至该混合物。在充分混合后再次记录 pH。

[0180] 将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒，其中将产品在连续流动下热处理，最高温度为 160 ℉ -200 ℉，在最高温度的停留时间范围是从 15 秒至约 3 秒。将产品紧邻灌装入被设计用于热灌装的玻璃或塑料容器之前略微冷却至 160 ℉ -185 ℉。

[0181] 实例 6

[0182] 以下实例描述了水性蛋白质成分用于生产大约 385 升水基果味蛋白质饮料的用途，该水基果味蛋白质饮料具有约 3.35% 的乳清蛋白浓度，大约等于牛乳中的总蛋白浓度。该批次的重量是大约 387kg。

[0183] 在酸化过程期间温度应当维持在 40-50 华氏度范围内。

[0184] 将大约 3.6kg 膳食纤维(如 VitaSugar™ 牌纤维，来自位于加拿大埃德蒙顿市的 Bio Neutra)通过添加和缓慢混入大约 315.6kg 纯化水中进行稀释。可替代地，可以保留少量如大约 1kg 或更少的膳食纤维从而与小于 1kg 的少量添加的其他干成分制造一种“预混物”。

[0185] 将具有约 20.0% (w/w)总蛋白的大约 64.8kg 水性乳清蛋白分离物(如水性乳清蛋白分离物，从位于威斯康星州的 Trega 可获得)通过添加和缓慢混合至水和纤维混合物中来稀释。将混合物充分混合，但要小心防止空气掺入混合物中，这会造成不希望的起泡效果。注意乳清蛋白在水性乳清蛋白制品中的浓度可以在批次和 / 或制造商之间变动，并且因此应当据此调节添加的水性乳清蛋白分离物和水的量，以便在成品饮料中实现所希望的最终蛋白质浓度。

[0186] 检查混合物的 pH，并且如果高于 3.22，则以约 5kg/ 分钟的速率在恒定混合下添加磷酸，终点是目标 pH 约 3.2。

[0187] 将大约 0.39kg 苹果酸和大约 0.39kg 柠檬酸添加至该混合物并且在充分混合后记

录 pH。

[0188] 将大约 81.24 克蔗糖素和大约 96.72 克色料(如紫色 2748)添加至混合物。可替代地,可以将蔗糖素和色料与大约 1kg 或更少的膳食纤维预混(上文提到)以有助于分散和润湿蔗糖素和色料。

[0189] 将大约 1160.6 克天然蓝莓香料(如从纽约布鲁克林的 Virginia Dare 可获得的天然蓝莓香料)和大约 773.74 克天然覆盆子香料(如从纽约布鲁克林的 Virginia Dare 可获得的天然覆盆子香料)添加至该混合物。在充分混合后再次记录 pH。

[0190] 将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒,其中将产品在连续流动下热处理,最高温度为 160 ℉ -200 ℉,在最高温度的停留时间范围是从 15 秒至约 3 秒。将产品紧邻灌装入被设计用于热灌装的玻璃或塑料容器之前略微冷却至 160 ℉ -185 ℉。

[0191] 实例 7

[0192] 以下实例描述了水性蛋白质成分用于生产大约 385 升水基绿茶味蛋白质饮料的用途,该水基绿茶味蛋白质饮料具有约 3.35% 的大豆蛋白浓度。该批次的重量是大约 387kg。

[0193] 在酸化过程期间温度应当维持在 40-50 华氏度范围内。

[0194] 将大约 3.6kg 膳食纤维(如 VitaSugar™ 牌纤维,来自位于加拿大埃德蒙顿市的 Bio Neutra)通过添加和缓慢混入大约 301.7 纯化水中进行稀释。可替代地,可以保留少量如大约 1kg 或更少的膳食纤维从而与小于 1kg 的少量添加的其他干成分制造一种“预混物”。

[0195] 将具有约 16.7% (w/w) 总蛋白的大约 77.6kg 水性大豆蛋白分离物通过添加和缓慢混合至水和纤维混合物中来稀释。将混合物充分混合,但要小心防止空气掺入混合物中,这会造成不想要的起泡效果。注意大豆蛋白在水性大豆蛋白制品中的浓度可以在批次和 / 或制造商之间变动,并且因此应当据此调节添加的水性大豆蛋白分离物和水的量,以便在成品饮料中实现所希望的最终蛋白质浓度。

[0196] 检查混合物的 pH,并且如果高于 6.0,则以约 5kg/ 分钟的速率在恒定混合下添加磷酸,终点是目标 pH 约 5.75。

[0197] 将大约 0.39kg 柠檬酸添加至该混合物并且在充分混合后记录 pH。

[0198] 将大约 127.7 克罗汉果增甜剂添加至该混合物。可替代地,可以将罗汉果增甜剂与大约 1kg 或更少的膳食纤维预混(上文提到)以有助于分散和润湿罗汉果。

[0199] 将大约 2.32kg 天然绿茶香料(如从纽约布鲁克林的 Virginia Dare 可获得的天然绿茶香料)、大约 773.74 克天然红茶香料(如从纽约布鲁克林的 Virginia Dare 可获得的天然红茶香料)和大约 386.87 克天然柠檬草香料(如从纽约布鲁克林的 Virginia Dare 可获得的天然柠檬草香料)添加至该混合物。在充分混合后再次记录 pH。

[0200] 将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒,其中将产品在连续流动下热处理,最高温度为 160 ℉ -200 ℉,在最高温度的停留时间范围是从 15 秒至约 3 秒。将产品紧邻灌装入被设计用于热灌装的玻璃或塑料容器之前略微冷却至 160 ℉ -185 ℉。

[0201] 实例 8

[0202] 以下实例描述了水性蛋白质成分用于生产大约 19400 千克橙及芒果味水基蛋白

质饮料的用途，该橙及芒果味水基蛋白质饮料具有大约 5% 的乳清蛋白浓度。

[0203] 在酸化过程期间温度应当维持在 20-25 摄氏度范围内。

[0204] 将具有 20% (w/w)总蛋白的 4811.24kg Trega 预酸化的水性乳清蛋白分离物通过添加和缓慢混合 14492.42kg 的水来稀释。

[0205] 在恒定搅拌下添加大约 4.85kg 苹果酸。

[0206] 添加如下香料、色料、防腐剂和增甜剂：4074.04g 蔗糖素增甜剂、291g Sensient#8006 干黄 #6 (橙色)、11.64kg 苯甲酸钾、15520.14g VDare 橙 PB26 天然香料和 31040.28g VDare 芒果 SW45 天然香料。

[0207] 通过添加大约 29.10kg 柠檬酸实现 2.95 至 3.10 的最终 pH。

[0208] 将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒，其中将产品在连续流动下热处理，最高温度为 160-200 华氏度，在最高 温度的停留时间是从约 15 秒至约 3 秒。将产品紧邻灌装入被设计用于热灌装的玻璃或塑料容器之前略微冷却至 160-185 华氏度。

[0209] 实例 9

[0210] 以下实例描述了水性蛋白质成分用于生产大约大约 19400 千克葡萄味水基蛋白质饮料的用途，该葡萄味水基蛋白质饮料具有大约 5% 的乳清蛋白浓度。

[0211] 在酸化过程期间温度应当维持在 20-25 摄氏度范围内。

[0212] 将具有 20% (w/w)总蛋白的 4811.24kg Trega 预酸化的水性乳清蛋白分离物通过添加和缓慢混合 14522.49kg 的水来稀释。

[0213] 在恒定搅拌下添加大约 19.4kg 酒石酸。

[0214] 添加如下香料、色料、防腐剂和增甜剂：4074.04g 蔗糖素增甜剂，232.80g Sensient#7700 干红色 #40 (红色)、11.64kg 苯甲酸钾，21340.19gVDare 葡萄 CS10 香料和 58.20g Sensient#5601 干蓝 #1 (蓝色)。

[0215] 通过添加大约 9.70kg 柠檬酸实现 3.0 至 3.10 的最终 pH。

[0216] 将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒，其中将产品在连续流动下热处理，最高温度为 160-200 华氏度，在最高温度的停留时间范围是从约 15 秒至约 3 秒。将产品紧邻灌装入被设计用于热灌装的玻璃或塑料容器之前略微冷却至 160-185 华氏度。

[0217] 实例 10

[0218] 以下实例描述了水性蛋白质成分用于生产大约 19400 千克热带果味水基蛋白质饮料的用途，该热带果味水基蛋白质饮料具有大约 5% 的乳清蛋白浓度。

[0219] 将具有 20% (w/w)总蛋白的 4811.24kg Trega 预酸化的水性乳清蛋白分离物通过添加和缓慢混合 14519.67kg 的水来稀释。

[0220] 添加如下香料、色料、防腐剂和增甜剂：4074.04g 蔗糖素增甜剂、194g Sensient#7700 干红 #40 (红色)、11.64kg 苯甲酸钾、14550.13g VDare 宾治 AN28 液体天然香料和 9700.09g VDare 宾治 AN27 干香料。

[0221] 通过添加大约 29.10kg 柠檬酸实现 2.95 至 3.10 的最终 pH。

[0222] 将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒，其中将产品在连续流动下热处理，最高温度为 160-200 华氏度，在最高温度的停留时间范围是从约

15 秒至约 3 秒。将产品紧邻灌装入被设计用于热灌装的玻璃或塑料容器之前略微冷却至 160-185 华氏度。

[0223] 实例 11

[0224] 以下实例描述了水性蛋白质成分用于生产大约大约 3880 千克橙及芒果味水基蛋白质饮料的用途，该橙及芒果味水基蛋白质饮料具有大约 3.3% 的乳清蛋白浓度。

[0225] 在酸化过程期间温度应当维持在 20-25 摄氏度范围内。

[0226] 将具有 21.50% (w/w)总蛋白的 604.56kg Trega 水性乳清蛋白分离物通过添加和缓慢混合 3218.57kg 的水来稀释。

[0227] 在恒定搅拌下添加大约 1.164kg 苹果酸。

[0228] 添加如下香料、色料、防腐剂和增甜剂：795.41g 蔗糖素增甜剂，232.80g Colormaker 橙 2733 胭脂树粉，2716.02g 苯甲酸钾，36.86kg VitaSugar 纤维，3104.03g VDare 橙 PB26 天然香料和 6208.06g VDare 芒果 SW45 天然香料。

[0229] 通过添加大约 5.82kg 柠檬酸实现 2.95 至 3.05 的最终 pH。

[0230] 将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒，其中将产品在连续流动下热处理，最高温度为 160-200 华氏度，在最高温度的停留时间范围是从约 15 秒至约 3 秒。将产品紧邻灌装入被设计用于热灌装的玻璃或塑料容器之前略微冷却至 160-185 华氏度。

[0231] 实例 12

[0232] 以下实例描述了水性蛋白质成分用于生产大约大约 3880 千克石榴味水基蛋白质饮料的用途，该石榴味水基蛋白质饮料具有大约 3.3% 的乳清蛋白浓度。

[0233] 在酸化过程期间温度应当维持在 20-25 摄氏度范围内。

[0234] 将具有 21.50% (w/w)总蛋白的 604.56kg Trega 水性乳清蛋白分离物通过添加和缓慢混合 3216.11kg 的水来稀释。

[0235] 在恒定搅拌下添加大约 2.716kg 苹果酸。

[0236] 添加如下香料、色料、防腐剂和增甜剂：776.01g 蔗糖素增甜剂、388.0g Colormaker 紫色胡萝卜 2748 粉、1552g Colormaker 红色卷心菜 2714 粉、2716.02g 苯甲酸钾、36.86kg VitaSugar 纤维、3880.04g VDare 石榴天然香料和 7760.07g VDare 水果宾治天然香料。

[0237] 通过添加大约 2.716kg 柠檬酸实现 2.95 至 3.05 的最终 pH。

[0238] 将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒，其中将产品在连续流动下热处理，最高温度为 160-200 华氏度，在最高温度的停留时间范围是从约 15 秒至约 3 秒。将产品紧邻灌装入被设计用于热灌装的玻璃或塑料容器之前略微冷却至 160-185 华氏度。

[0239] 实例 13

[0240] 以下实例描述了水性蛋白质成分用于生产大约 3880 千克蓝莓和覆盆子味水基蛋白质饮料的用途，该蓝莓和覆盆子味水基蛋白质饮料具有大约 3.3% 的乳清蛋白浓度。

[0241] 在酸化过程期间温度应当维持在 20-25 摄氏度范围内。

[0242] 将具有 21.50% (w/w)总蛋白的 604.56kg Trega 水性乳清蛋白分离物通过添加和缓慢混合 3210.67kg 的水来稀释。

[0243] 在恒定搅拌下添加大约 1.552kg 苹果酸。

[0244] 添加如下香料、色料、防腐剂和增甜剂：776.01g 蔗糖素增甜剂、1940.02g Colormaker 红色卷心菜 2714 粉、2716.02g 苯甲酸钾、36.86kg VitaSugar 纤维、11640.11g VDare 蓝莓天然香料和 7760.07g VDare 覆盆子天然香料。

[0245] 通过添加大约 1.552kg 柠檬酸实现 3.05 至 3.15 的最终 pH。

[0246] 将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒，其中将产品在连续流动下热处理，最高温度为 160-200 华氏度，在最高温度的停留时间范围是从约 15 秒至约 3 秒。将产品紧邻灌装入被设计用于 热灌装的玻璃或塑料容器之前略微冷却至 160-185 华氏度。

[0247] 实例 14

[0248] 以下实例描述了水性蛋白质成分用于生产大约 3860 千克蔓越橘和苹果味水基蛋白质饮料的用途，该蔓越橘和苹果味水基蛋白质饮料具有大约 1.04% 的乳清蛋白浓度。

[0249] 在酸化过程期间温度应当维持在 20-25 摄氏度范围内。

[0250] 将具有 20.0% (w/w)总蛋白的 200.778kg Trega 水性乳清蛋白分离物通过添加和缓慢混合 3589.67kg 的水来稀释。

[0251] 在恒定搅拌下添加大约 2.317kg 苹果酸。

[0252] 添加如下香料、色料和增甜剂：772.22g 蔗糖素增甜剂，3861.11g Mastertast 冻干蔓越橘果粉、772.22g Colormaker 紫色胡萝卜 2748 粉、772.22g Colormaker 红色卷心菜 2714 粉、44.40kg VitaSugar 纤维、11583.32g VDare 蔓越橘 BX09 天然香料和 5019.44g VDare 苹果 AU02 天然香料。

[0253] 通过添加大约 1158.33g 抗坏血酸实现 3.05 至 3.15 的最终 pH。

[0254] 将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒，其中将产品在连续流动下热处理，最高温度为 160-200 华氏度，在最高温度的停留时间范围是从约 15 秒至约 3 秒。将产品紧邻灌装入被设计用于热灌装的玻璃或塑料容器之前略微冷却至 160-185 华氏度。

[0255] 实例 14

[0256] 以下实例描述了水性蛋白质成分用于生产大约大约 3880 千克橙及芒果味水基蛋白质饮料的用途，该橙及芒果味水基蛋白质饮料具有大约 3.3% 的乳清蛋白浓度。

[0257] 在酸化过程期间温度应当维持在 20-25 摄氏度范围内。

[0258] 将具有 21.50% (w/w)总蛋白的 604.56kg Trega 水性乳清蛋白分离物通过添加和缓慢混合 3218.57kg 的水来稀释。

[0259] 在恒定搅拌下添加大约 1.164kg 苹果酸。

[0260] 添加如下香料、色料、防腐剂和增甜剂：795.41g 蔗糖素增甜剂，232.80g Colormaker 橙 2733 胭脂树粉，2716.02g 苯甲酸钾，36.86kg VitaSugar 纤维，3104.03g VDare 橙 PB26 天然香料和 6208.06g VDare 芒果 SW45 天然香料。

[0261] 通过添加大约 5.82kg 柠檬酸实现 2.95 至 3.05 的最终 pH。

[0262] 将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒，其中将产品在连续流动下热处理，最高温度为 160-200 华氏度，在最高温度的停留时间范围是从约 15 秒至约 3 秒。将产品紧邻灌装入被设计用于热灌装的玻璃或塑料容器之前略微冷却至

160-185 华氏度。

[0263] 实例 15

[0264] 以下实例描述了水性蛋白质成分用于生产大约大约 3860 千克蓝莓和覆盆子味水基蛋白质饮料的用途，该蓝莓和覆盆子味水基蛋白质饮料具有大约 1.04% 的乳清蛋白浓度。

[0265] 在酸化过程期间温度应当维持在 20-25 摄氏度范围内。

[0266] 将具有 21.50% (w/w)总蛋白的 186.77kg Trega 水性乳清蛋白分离物通过添加和缓慢混合 3600.98kg 的水来稀释。

[0267] 在恒定搅拌下添加大约 1.544kg 苹果酸。

[0268] 添加如下香料、色料和增甜剂：772.22g 蔗糖素增甜剂，3861.11g Mastertast 冻干覆盆子果实 705353 粉、1930.55g Colormaker 红色卷心菜 2714 粉末、44.403kg VitaSugar 纤维、11583.32g VDare 蓝莓天然香料和 7722.22gVDare 覆盆子天然香料。

[0269] 通过添加大约 1.544kg 柠檬酸实现 3.05 至 3.15 的最终 pH。

[0270] 将散装饮料以饮料及果汁业常见的称作“热灌装”的方式进行巴氏消毒，其中将产品在连续流动下热处理，最高温度为 160-200 华氏度，在最高温度的停留时间范围是从约 15 秒至约 3 秒。将产品紧邻灌装入被设计用于热灌装的玻璃或塑料容器之前略微冷却至 160-185 华氏度。

[0271] 尽管已经披露本发明的具体实施例，应当理解的是各种不同的修改是可能的并且这些修改预期是在所附权利要求书的真实精神和范围之 内。因此并非旨在限制于在此呈现的确切的摘要、实例或披露。