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(54) Benævnelse: **Fremgangsmåder til fremstilling af græsk yoghurt med højt proteinindhold ved anvendelse af membransystemer før og efter fermentering**

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DESCRIPTION

FIELD OF THE INVENTION

[0001] The present invention is directed to improved processes for the manufacture of high-protein, Greek-style yogurt products, as defined in the appended claims.

BACKGROUND OF THE INVENTION

[0002] Yogurt is made by adding bacterial cultures to warm milk, followed by fermentation. During fermentation, lactose in the milk is converted into lactic acid, resulting in a specific texture and flavor. Greek yogurt is a concentrated form of yogurt, in which a part of a water-rich fraction in the form of whey is removed. Greek yogurt, therefore, has higher protein content than regular yogurt, and since some of the lactose also goes with the whey, Greek yogurt also has a lower lactose/carbohydrate content than regular yogurt.

[0003] Traditionally, Greek yogurt was manufactured by fermenting milk into a curd called yogurt, followed by straining the whey from the curd in cloth bags. Straining of whey from the curd helped to concentrate the solids and increase the consistency. The process was slow and manual with some food safety concerns due to its unhygienic nature.

[0004] EP3053444A1 relates to a method for producing strained yogurts including Greek yogurt, labneh and skyr, wherein the method reduces the amount of acid whey to be discharged by concentrating the protein content of milk before fermentation and adding acid whey recirculated from the straining step to the milk concentrate.

[0005] The present invention is directed to improved processes for the manufacture of high-protein, Greek-style yogurt products, as defined in the appended claims.

SUMMARY OF THE INVENTION

[0006] The present invention is defined by the appended claims.

[0007] Methods for making a yogurt product are disclosed herein. In accordance with an aspect of this invention, the method comprises

1. (a) concentrating a skim milk product to produce a protein-enriched milk fraction containing from 3.5 to 6 wt. % protein, wherein concentrating the skim milk product comprises ultrafiltering the skim milk product with a polymeric membrane system,
2. (b) combining the protein-enriched milk fraction with an additional milk fraction

comprising cream, skim milk, a lactose-rich fraction, a mineral-rich fraction, water, or combinations thereof, to produce a standardized yogurt base containing from about 3.5 to about 6 wt. % protein, (c) inoculating the standardized yogurt base with a yogurt culture and fermenting the inoculated yogurt base to produce a fermented product, and (d) removing (or separating) at least a portion of acid whey from the fermented product to form the yogurt product, wherein removing comprises ultrafiltering the fermented product with a ceramic membrane system. this invention, the step of removing (or separating) at least a portion of the acid whey from the fermented product comprises ultrafiltering the fermented product, by using a ceramic membrane system.

[0008] In another aspect of the invention, a method for making a yogurt product is disclosed, and in this aspect, the method comprises

1. (i) concentrating a skim milk product to produce a standardized yogurt base containing from 3.5 to 6 wt. % protein, wherein concentrating the skim milk product comprises ultrafiltering the skim milk product with a polymeric membrane system,
2. (ii) inoculating the standardized yogurt base with a yogurt culture and fermenting the inoculated yogurt base to produce a fermented product, and (iii) removing (or separating) at least a portion of acid whey from the fermented product to form the yogurt product, wherein removing comprises ultrafiltering the fermented product with a ceramic membrane system. As above, removing or separating the acid whey employs a ceramic ultrafiltration system.

[0009] Unexpectedly, and beneficially, these methods result in an excellent Greek yogurt product, and with the flexibility to increase the protein content of the yogurt product up to 20 wt. %, or more. Further, these methods can significantly reduce the amount of acid whey (and lactose contained therein) that must be disposed of.

BRIEF DESCRIPTION OF THE FIGURES

[0010]

FIG. 1 presents a schematic flow diagram of a process for producing a yogurt product consistent with an aspect of this invention.

FIG. 2 presents a schematic flow diagram of a process for producing a yogurt product which is not according to the invention.

DEFINITIONS

[0011] While compositions and processes are described herein in terms of "comprising" various components or steps, the compositions and methods can also "consist essentially of' or "consist of" the various components or steps, unless stated otherwise.

[0012] The terms "a," "an," and "the" are intended to include plural alternatives, e.g., at least one, unless otherwise specified. For instance, the disclosure of "a yogurt culture" and "an additional milk fraction" are meant to encompass one, or mixtures or combinations of more than one, yogurt culture and additional milk fraction, unless otherwise specified.

[0013] In the disclosed processes, the term "combining" encompasses the contacting of components in any order, in any manner, and for any length of time, unless otherwise specified. For example, the components can be combined by blending or mixing.

[0014] The term "about" can mean within 10% of the reported numerical value, preferably within 5% of the reported numerical value.

DETAILED DESCRIPTION OF THE INVENTION

[0015] The invention is defined by the appended claims.

[0016] Methods for making yogurt products are disclosed and described herein. These methods can be used to make, for example, high protein, Greek yogurt products with excellent taste and refrigerated shelf-stability, but with reduced levels of acid whey that must be removed to form the final yogurt product.

[0017] The methods disclosed herein use a specific concentration step to form the yogurt base prior to fermentation, and a specific acid whey removal step after fermentation. One potential benefit to these methods is a reduction in the fermentation time needed to form the fermented product. Another potential benefit is a more efficient removal of acid whey from the fermented product. Whey can be removed from the fermented product by mechanical centrifugal separators or by filtering through special membranes. Mechanical means can perform the separation based on differences in density. Centrifugal means can perform mechanical separation by applying centrifugal force. Use of mechanical separators to remove whey can result in the loss of some whey proteins, and puts a limitation on the protein content that can be achieved.

[0018] Filtration technologies (e.g., microfiltration, ultrafiltration, nanofiltration, and reverse osmosis) separate or concentrate components in mixtures - such as milk - by passing the mixture through a membrane system (or selective barrier) under a suitable pressure. The concentration/separation is, therefore, based on molecular size. The stream that is retained on by the membrane is called the retentate (or concentrate). The stream that passes through the pores of the membrane is called the permeate. As an example, the pore size of ultrafiltration membranes typically varies from 0.01 to 0.1 microns. In the dairy industry, the ultrafiltration membranes often are identified based on molecular weight cut-off (MWCO), rather than pore size. The molecular weight cut-off for ultrafiltration membranes can vary from 1000-100,000 Daltons.

[0019] As it pertains to the methods disclosed herein, and beneficially, ultrafiltration (and other membrane technologies) can be used to concentrate protein in the retentate to produce a higher-protein yogurt base, and if desired, a higher-protein yogurt product. Also beneficially, ultrafiltration (and other membrane technologies) can be used to remove the acid whey from the fermented product to result in the yogurt product. The amount of acid whey that must be removed can be reduced due to the higher-protein content of the yogurt base.

[0020] Reconstituted milk protein powders can be used to increase the protein content in Greek yogurt, but that results in poor taste of the final product, due to the longer fermentation time from yogurt bacteria inoculation until the yogurt curd is formed, and due to nature of dry protein powders. Moreover, the solubility of milk protein powders has its own challenges. Further, simply concentrating milk to the Greek yogurt solids level, followed by bacterial inoculation of the concentrated milk to get the desired acidity of Greek yogurt, results in long fermentation time and the poor product taste. It is believed that the methods disclosed herein overcome these deficiencies.

METHODS FOR MAKING YOGURT PRODUCTS

[0021] In one aspect of the present disclosure, disclosed for illustration purpose and not forming part of the invention, a method for making a yogurt product is provided, and in this aspect, the method can comprise (or consist essentially of, or consist of) (a) concentrating a skim milk product to produce a protein-enriched milk fraction containing from about 3.5 to about 6 wt. % protein, (b) combining the protein-enriched milk fraction with an additional milk fraction to produce a standardized yogurt base containing from about 3.5 to about 6 wt. % protein, (c) inoculating the standardized yogurt base with a yogurt culture and fermenting the inoculated yogurt base to produce a fermented product, and (d) removing (or separating) at least a portion of acid whey from the fermented product to form the yogurt product. In another aspect, a method for making a yogurt product is provided, and in this aspect, the method can comprise (or consist essentially of, or consist of) (i) concentrating a skim milk product to produce a standardized yogurt base containing from about 3.5 to about 6 wt. % protein, (ii) inoculating the standardized yogurt base with a yogurt culture and fermenting the inoculated yogurt base to produce a fermented product, and (iii) removing (or separating) at least a portion of acid whey from the fermented product to form the yogurt product.

[0022] Generally, the features of the methods (e.g., the characteristics of the skim milk product or yogurt base, the amount and type of the yogurt culture, the techniques used for the concentrating and removing steps, the amount of acid whey removed, and the characteristics of the yogurt product, among others) are independently described herein. Also disclosed for illustration purpose but not forming part of the invention are the yogurt products (e.g., high protein Greek yogurts, ready for consumption) produced in accordance with any of the disclosed methods.

[0023] The skim milk product in step (a) and step (i) can have suitable amounts of lactose (or milk sugar), protein, fat, minerals, and solids. For example, the skim milk product can have less than or equal to about 0.5 wt. % fat, less than or equal to about 0.25 wt. % fat, or less than or equal to about 0.15 wt. % fat. The protein content of the skim milk product often ranges from about 3 to about 4 wt. %, the lactose content often ranges from about 4 to about 6 wt. %, the mineral content often ranges from about 0.5 to about 0.9 wt. %, and the solids content often ranges from about 8 to about 11 wt. %, although other appropriate ranges for these milk components are readily apparent from this disclosure.

[0024] Before step (a) and step (i), the skim milk product can be produced using any suitable technique, an example of which is separating (e.g., centrifugally separating) a fresh or raw milk product into the skim milk product and cream. The fresh or raw milk product can be cow's milk, which contains approximately 87 wt. % water, 3-4 wt. % protein, 4-5 wt. % carbohydrates/lactose, 3-4 wt. % fat, and 0.3-0.8 wt. % minerals. When the fresh or raw milk product is separated into the skim milk product and cream, the cream fraction typically contains high levels of fat (e.g., 20-50 wt. % fat, or 30-50 wt. % fat) and solids (e.g., 30-60 wt. %, or 40-55 wt. %), and often contains approximately 1.5-3.5 wt. % protein, 2-5 wt. % lactose, and 0.2-0.9 wt. % minerals, although not limited thereto.

[0025] In step (a), the skim milk product is concentrated to produce a protein-enriched milk fraction containing from 3.5 to 6 wt. % protein, while in step (i) the skim milk product is concentrated to produce a standardized yogurt base containing from 3.5 to 6 wt. % protein. While not being limited thereto, the concentration steps can be conducted at a temperature in a range from about 3 to about 15 °C, and more often from about 3 to about 10 °C, or from about 5 to about 8 °C. The steps of concentrating the skim milk product comprise ultrafiltering the skim milk product using a polymeric membrane system. The polymeric membrane system can be configured with pore sizes such that the materials having molecular weights greater than about 1,000 Daltons, greater than about 5,000 Daltons, or greater than about 10,000 Daltons, are retained, while lower molecular weight species pass through. In some aspects, ultrafiltration utilizes a membrane system having pore sizes in a range from about 0.01 to about 0.1 μm, and operating pressures typically in the 45-150 psig range.

[0026] Also disclosed for illustration purpose but not forming part of the invention, are steps of concentrating the skim milk product comprising nanofiltering the skim milk product. Generally, nanofiltration utilizes a membrane system having pore sizes in a range from about 0.001 to about 0.01 μm. Operating pressures typically are in the 150-450 psig range.

[0027] Also disclosed for illustration purpose but not forming part of the invention, are steps of concentrating the skim milk product comprising microfiltering the skim milk product. Generally, microfiltration utilizes a membrane system having pore sizes in a range from about 0.1 to about 0.2 µm. Operating pressures typically are below about 75 psig.

[0028] Also disclosed for illustration purpose but not forming part of the invention, are steps of concentrating the skim milk product comprising diafiltering the skim milk product. Generally, the diafiltration step is performed using ultrafiltration membranes, such as described herein: materials with molecular weights greater than about 1,000 Daltons, greater than about 5,000 Daltons, or greater than about 10,000 Daltons, typically are retained, while lower molecular weight species pass through. The membrane system can have pore sizes in a range from about 0.01 to about 0.1 µm, and operating pressures typically in the 45-150 psig range. Often, diafiltering the skim milk product can comprise diafiltering a mixture of the skim milk product and water, but is not limited thereto, and at any suitable weight ratio of the water to the skim milk product (e.g., from about 0.1:1 to about 1:1), and at any suitable concentration factor (e.g., from about 1.2 to about 5).

[0029] Also disclosed for illustration purpose but not forming part of the invention, are steps of concentrating the skim milk product comprising subjecting the skim milk product to reverse osmosis. Reverse osmosis is a tight filtration process in which substantially all the milk components are retained, and only water passes through. Generally, reverse osmosis utilizes a membrane system having pore sizes of less than or equal to about 0.001 µm. Operating pressures typically are in the 450-600 psig range.

[0030] Also disclosed for illustration purpose but not forming part of the invention, are steps of concentrating the skim milk product comprising subjecting the skim milk product to forward osmosis. Forward osmosis is typically performed at lower pressures than standard reverse osmosis, and utilizes a semi-permeable membrane system having pore sizes such that water passes through, while other materials (e.g., proteins, fats, lactose or other sugars, and minerals) do not. Operating pressures typically range from about 0 psig (atmospheric pressure) to about 50 psig, from about 0 psig to about 10 psig, from about 1 psig to about 50 psig, from about 1 psig to about 30 psig, from about 1 psig to about 10 psig, from about 10 psig to about 30 psig, from about 15 to about 25 psig, and the like. While not being limited thereto, forward osmosis membrane systems have a molecular weight cutoff of much less than 100 Da and, therefore, components other than water can be concentrated in the forward osmosis process. Generally, forward osmosis comprises a membrane system having pore sizes of less than or equal to about 0.001 µm. Any suitable draw solution that has a higher concentration of solutes or ions than the solution from which water is to be drawn through a semipermeable membrane can be used for the forward osmosis step.

[0031] Also disclosed for illustration purpose but not forming part of the invention, are steps of concentrating the skim milk product comprising condensing the skim milk product under reduced pressure. Reduced pressure encompasses any suitable sub-atmospheric pressure, and typically involves the use of a vacuum system or apparatus. Elevated temperatures can be employed during the condensing step, but this is not a requirement.

[0032] In the present invention, the protein content of the protein-enriched milk fraction (step (a)) and the standardized yogurt base (step (i)) increases, as compared to that of the skim milk product, and falls within the range from 3.5 to 6 wt. % protein. In some aspects, the amount of protein in the protein-enriched milk fraction (step (a)) and the standardized yogurt base (step (i)), independently, can be in a range from about 3.8 to about 5.5 wt. % protein; alternatively, from about 3.7 to about 5 wt. % protein; alternatively, from about 3.7 to about 4.5 wt. % protein; alternatively, from about 4 to about 5.2 wt. % protein; or alternatively, from about 4.1 to about 4.8 wt. % protein. Other appropriate ranges for the amount of protein in the protein-enriched milk fraction (step (a)) and/or in the standardized yogurt base (step (i)) are readily apparent from this disclosure.

[0033] Likewise, the percent solids of the protein-enriched milk fraction (step (a)) and the standardized yogurt base (step (i)) can increase, as compared to that of the skim milk product, due to the concentration process. The solids contents can fall within a range from about 9 to about 20 wt. %, from about 9.5 to about 15 wt. %, from about 10 to about 14 wt. %, or from about 10 to about 12 wt. %, although not being limited thereto. The protein-enriched milk fraction (step (a)) and the standardized yogurt base (step (i)) often can contain less than or equal to about 0.5 wt. % fat, less than or equal to about 0.25 wt. % fat, or less than or equal to about 0.15 wt. % fat, as well as a typical lactose content from about 4 to about 6 wt. %, and a typical mineral content from about 0.7 to about 1.3 wt. %, or from about 0.85 to about 1.2 wt. %.

[0034] In step (b) of the first method for making a yogurt product, the protein-enriched milk fraction is combined with an additional milk fraction to produce a standardized yogurt base containing from 3.5 to 6 wt. % protein. The standardized yogurt base of step (b) can have generally the same respective amounts of protein, fat, lactose, minerals, and solids as that of the standardized yogurt base in step (i). For example, the standardized yogurt base in step (b) contains from 3.5 to 6 wt. % protein, or can contain from about 3.8 to about 5.5 wt. % protein, from about 3.7 to about 5 wt. % protein, from about 3.7 to about 4.5 wt. % protein, from about 4 to about 5.2 wt. % protein, or from about 4.1 to about 4.8 wt. % protein, and have a solids content from about 9 to about 15 wt. %, from about 9.5 to about 14 wt. %, from about 10 to about 14 wt. %, or from about 10 to about 12 wt. %, although other appropriate ranges are readily apparent from this disclosure.

[0035] In the present invention, the additional milk fraction combined with the protein-enriched milk fraction to result in the standardized yogurt base comprises cream, skim milk, a lactose-rich fraction, a mineral-rich fraction, water, or combinations thereof. In some aspects, the additional milk fraction can comprise skim milk, a mineral-rich fraction, or both. As an example, cream can be added to increase the fat and solids content of the standardized yogurt base (e.g., up to approximately 1-5 wt. % or 2-4 wt. % fat, and up to approximately 12-17 wt. % or 12-16 wt. % solids, although not being limited thereto). As another example, a lactose-rich fraction can be added to increase the sugar content of the standardized yogurt base. As yet another example, a mineral-rich fraction can be added to increase the mineral content of the standardized yogurt base. As still another example, skim milk can be added to increase the mineral content and/or sugar content of the standardized yogurt base. One or more than one additional milk fraction can be combined with, in any relative proportion, the protein-enriched milk fraction to produce the standardized yogurt base in step (b). A "component-rich fraction" is meant to encompass any fraction containing at least 15% more of a component of milk (protein, lactose/sugar, fat, minerals) than that found in cow's milk. For instance, a lactose-rich fraction often can contain from about 6 to about 20 wt. % sugar (i.e., in any form, such as lactose, glucose, galactose, etc.), from about 6 to about 18 wt. % sugar, or from about 7 to about 16 wt. % sugar. A mineral-rich fraction can contain from about 1 to about 20 wt. % minerals, from about 1 to about 10 wt. % minerals, or from about 1.5 to about 8 wt. % minerals. A fat-rich fraction (e.g., cream) often can contain from about 8 to about 50 wt. % fat, from about 20 to about 50 wt. % fat, or from about 30 to about 45 wt. % fat.

[0036] These component-rich milk fractions can be produced by any technique known to those of skill in the art. While not limited thereto, the component-rich milk fraction (or milk fractions) can be produced by a membrane filtration process, such as disclosed in U.S. Patent Nos. 7,169,428, 9,510,606, and 9,538,770. For example, fresh or raw milk can be fractionated into skim milk and cream (fat-rich fraction) by centrifugal separators. The skim milk can be fractionated via combinations of microfiltration, ultrafiltration, nanofiltration, and reverse osmosis (or forward osmosis) into a protein-rich fraction, a lactose-rich fraction, a mineral/flavor-rich fraction, and a milk water fraction. Additionally or alternatively, the component-rich milk fraction (or milk fractions) can be produced by a process comprising mixing water and a powder ingredient (e.g., protein powder, lactose powder, mineral powder, etc.).

[0037] In this invention, the skim milk product in step (a) is concentrated using ultrafiltration, and the resulting UF retentate can be combined with skim milk, in any suitable proportion, to form the standardized yogurt base in step (b).

[0038] Also disclosed for illustration purpose but not forming part of the invention, is a method wherein the skim milk product in step (a) can be concentrated using diafiltration (with an ultrafiltration membrane), and the resulting DF retentate can be combined with skim milk, in any suitable proportion, to form the standardized yogurt base in step (b).

[0039] Also disclosed for illustration purpose but not forming part of the invention, is a method wherein the skim milk product in step (a) can be concentrated using microfiltration, and the resulting MF retentate can be combined with skim milk, in any suitable proportion, to form the standardized yogurt base in step (b).

[0040] In yet another aspect, the skim milk product in step (a) can be concentrated using ultrafiltration, and the resulting UF retentate can be combined with a mineral-rich fraction, in any suitable proportion, to form the standardized yogurt base in step (b). The mineral-rich fraction can be produced using reverse osmosis, forward osmosis, or other suitable technique.

[0041] Also disclosed for illustration purpose but not forming part of the invention, is a method wherein the skim milk product in step (a) can be concentrated using diafiltration (with an ultrafiltration membrane), and the resulting DF retentate can be combined with a mineral-rich fraction, in any suitable proportion, to form the standardized yogurt base in step (b). The mineral-rich fraction can be produced using reverse osmosis, forward osmosis, or other suitable technique.

[0042] While not limited thereto, the standardized yogurt base can contain from about 1100 to about 1800 ppm (by weight) of calcium in one aspect, from about 1200 to about 1800 ppm in another aspect, and from about 1200 to about 1600 ppm in yet another aspect (e.g., from about 1300 to about 1400 ppm). Likewise, the standardized yogurt base can contain from about 800 to about 1200 ppm phosphorus in one aspect, from about 850 to about 1150 ppm in another aspect, and from about 800 to about 1100 ppm in yet another aspect (e.g., from about 940 to about 980 ppm). The standardized yogurt base can be characterized by a weight ratio of calcium to protein that can fall within a range from about 0.02 to about 0.04, from about 0.025 to about 0.035 ppm, or from about 0.028 to about 0.033 (e.g., from about 0.029 to about 0.032). Additionally or alternatively, the standardized yogurt base can be characterized by a weight ratio of phosphorus to protein often falling in a range from about 0.013 to about 0.033, from about 0.015 to about 0.03 ppm, or from about 0.018 to about 0.025 (e.g., from about 0.02 to about 0.023).

[0043] The pH of the standardized yogurt base is generally neutral. For instance, the pH of the standardized yogurt based can be in a range from about 6.3 to about 7.3 in one aspect, from about 6.6 to about 6.9 in another aspect, and from about 6.7 to about 7 in yet another aspect. Beneficially, the standardized yogurt base can have a calcium to phosphorus ratio and a pH level that are similar to that of the starting material (e.g., the skim milk product).

[0044] Optionally, the disclosed methods can further comprise a step of pasteurizing the standardized yogurt base between step (b) and step (c), or between step (i) and step (ii). Any suitable pasteurization conditions can be used, such as conducting the pasteurization step at a temperature in a range from about 80 to about 95 °C for a time period in a range from about 2 to about 15 minutes; or alternatively, at a temperature of approximately 90 °C for a time period in a range from about 5 to about 7 minutes.

[0045] In step (c) and step (ii), the yogurt base is inoculated (or contacted or combined) with a yogurt culture and the inoculated yogurt base is fermented to produce a fermented product. The yogurt base generally is inoculated and/or fermented at an elevated temperature. In one aspect, the yogurt base can be inoculated and/or fermented at a temperature in a range from about 20 to about 45 °C, while in another aspect, the yogurt base can be inoculated and/or fermented at a temperature in a range from about 35 to about 45 °C, and in yet another aspect, the yogurt base can be inoculated and/or fermented at a temperature in a range from about 40 to about 45 °C. Other appropriate inoculation and/or fermentation temperatures are readily apparent from this disclosure.

[0046] The amount and type of the yogurt culture used can vary depending upon the desired attributes of the final yogurt product as well as the characteristics of the yogurt base. While not being limited thereto, the amount of the yogurt culture can range from about 0.0001 to about 3 wt. %, from about 0.0005 to about 0.05 wt. %, from about 0.0001 to about 0.01 wt. %, or from about 0.0005 to about 0.01 wt. %, based on the weight of the standardized yogurt base. Other appropriate ranges for the amount of the yogurt culture added to the yogurt base are readily apparent from this disclosure.

[0047] The form of the yogurt culture is not particularly limited; the yogurt culture can be bulk, freeze dried, or frozen, and mixtures or combinations can be used as well. Typical yogurt cultures that can be used include, but are not limited to, *Lactobacillus bulgaricus, Streptococcus thermophilus, Lactobacillus acidophillus, Lactobacillus casei, Lactococcus lactis, Lactococcus cremoris, Latobacillus plantarum, Bifidobacterium, Leuconostoc,* and the like, as well as any combination thereof. In some aspects, the yogurt culture can comprise *Lactobacillus bulgaricus, Streptococcus thermophilus,* or a combination thereof.

[0048] As would be readily recognized by those of skill in the art, any suitable vessel can be used for forming the fermented product, and such can be accomplished batchwise or continuously. As an example, the fermentation step can be conducted in a tank, a silo, or a vat. Any suitable period of time can be used, and this can depend upon the temperature and the amount of the yogurt culture, amongst other variables. Generally, the inoculated yogurt base can be fermented for a time period in a range from about 1 to about 18 hours, from about 2 to about 8 hours, or from about 3 to about 7 hours.

[0049] Typically, the inoculated yogurt base is fermented until the pH of the fermented product has reached a certain pH range. In some aspects, for example, the targeted pH can be in a range from about 4.3 to about 4.8, from about 4.4 to about 4.8, from about 4.4 to about 4.7, from about 4.5 to about 4.8, from about 4.5 to about 4.7, from about 4.6 to about 4.8, or from about 4.6 to about 4.7. Other appropriate ranges for the pH of the fermented product are readily apparent from this disclosure.

[0050] Optionally, the disclosed methods can further comprise a step of agitating the fermented product between step (c) and step (d), and between step (ii) and step (iii). Often, this step can be referred to as breaking of the curd. Additionally or alternatively, the disclosed methods can further comprise a step of heat treating the fermented product between step (c) and step (d), and between step (ii) and step (iii). The optional heat treating step can be performed after the agitation step and at any suitable combination of temperature and time, such as at a temperature in a range from about 55 to about 65 °C for a time period in a range from about 1 to about 3 minutes.

[0051] In step (d) and step (iii), at least a portion of acid whey from the fermented product is removed to form the yogurt product. In the invention, removing at least a portion of the acid whey from the fermented product comprises ultrafiltering the fermented product. While not being limited thereto, ultrafiltration of the fermented product can be conducted at a temperature in a range from about 35 to about 55 °C; alternatively, from about 40 to about 60 °C; or alternatively, from about 45 to about 55 °C. In these acid whey removal steps, the fermented product is ultrafiltered using a ceramic membrane system. The ceramic membrane system can be configured with pore sizes of less than or equal to about 0.1 μm, such that the acid whey passes through the pores, and the yogurt product is retained. While not wishing to be bound by the following theory, it is believed that a ceramic membrane system is superior to a polymeric membrane system at this stage of the process, in which a higher viscosity product (the fermented product) is ultrafiltered to retain the yogurt product. Further, a ceramic membrane system can withstand higher operating temperatures, has more cleaning options (pH range from acid to alkaline, as well as hot water sterilization at 80-90 °C for 30 to 90 min), and fouling/scale can be more easily removed by exposure to elevated temperatures.

[0052] Also disclosed for illustration purpose but not forming part of the invention, is a method wherein the steps of removing at least a portion of the acid whey can be achieved by nanofiltering the fermented product. Generally, nanofiltration utilizes a membrane system having pore sizes in a range from about 0.001 to about 0.01 μm, and temperatures ranging from about 15 to about 45 °C often can used.

[0053] Also disclosed for illustration purpose but not forming part of the invention, is a method wherein the steps of removing at least a portion of the acid whey can be achieved by microfiltering the fermented product. Generally, microfiltration utilizes a membrane system having pore sizes in a range from about 0.1 to about 0.2 μm, and temperatures ranging from about 35 to about 55 °C often can used.

[0054] Also disclosed for illustration purpose but not forming part of the invention, is a method wherein the steps of removing at least a portion of the acid whey can be achieved by subjecting the fermented product to reverse osmosis. Generally, reverse osmosis utilizes a membrane system having pore sizes of less than or equal to about 0.001 μm, and temperatures ranging from about 15 to about 45 °C often can used.

[0055] Also disclosed for illustration purpose but not forming part of the invention, is a method wherein the steps of removing at least a portion of the acid whey can be achieved by subjecting the fermented product to a mechanical separation process. Often, the mechanical separation process can comprise centrifugal separation, but other suitable separations processes can be used.

[0056] Regardless of the acid whey removal technique that is utilized, a large majority of the acid whey is removed from the fermented product. In accordance with aspects of this invention, at least about 90 wt. %, at least about 92 wt. %, at least about 95 wt. %, at least about 98 wt. %, or at least about 99 wt. %, of the acid whey present in the fermented product is removed in step (d) or step (iii). The acid whey material that is removed has a very low solids content, typically characterized by a solids content of less than about 8 wt. %, less than about 7 wt. %, or less than about 6.5 wt. %.

[0057] Depending upon the characteristics of the yogurt base, the relative amounts of the yogurt product and the acid whey can vary. In one aspect, the weight ratio of the yogurt product to the acid whey in the fermented product can be in a range from about 35:65 to about 70:30. In another aspect, the weight ratio of the yogurt product to the acid whey in the fermented product can be in a range from about 40:60 to about 70:30. In yet another aspect, the weight ratio of the yogurt product to the acid whey in the fermented product can be in a range from about 45:55 to about 65:35. Other ranges for the weight ratio of the yogurt product to the acid whey in the fermented product are readily apparent from this disclosure.

[0058] The disclosed methods can further comprise a step of packaging the yogurt product in a container. Optionally, this packaging step can be performed aseptically, using any suitable aseptic filling/packaging system.

[0059] In further aspects of this invention, the disclosed methods can further comprise a step of combining the yogurt product and any suitable ingredient, and packaging in a container. Non-limiting examples of such ingredients can include a sugar/sweetener, a flavorant, a preservative (e.g., to prevent yeast or mold growth), a stabilizer, an emulsifier, a prebiotic substance, a special probiotic bacteria, a vitamin, a mineral, an omega 3 fatty acid, a phyto-sterol, an antioxidant, or a colorant, and the like, as well as any mixture or combination thereof.

[0060] Prior to packaging, the disclosed methods can further comprise a step of cooling to a suitable temperature, such as in a range from about 15 to about 25 °C, from about 15 to about 21 °C, or from about 15 to about 20 °C. Also prior to packaging, or after packaging in a suitable container, the yogurt product can be heat treated for shelf-stability. Any suitable container can be used to package the yogurt product, such as might be used for the distribution and/or sale of yogurt products in a retail outlet. Illustrative and non-limiting examples of typical containers include a cup, a bottle, a bag, or a pouch, and the like. The container can be made from any suitable material, such as glass, metal, plastics, and the like, as well as combinations thereof.

[0061] The packaged yogurt product generally is stored at refrigerated conditions, such as in a range from about 2 °C to about 10 °C, or from about 1 to about 5 °C. Under refrigerated conditions (2-10 °C, or 1-5 °C), the yogurt product can be shelf-stable for a time period in a range from about 30 to about 90 days; alternatively, shelf-stable for a time period of from about 30 to about 60 days; or alternatively, shelf-stable for a time period of from about 30 to about 45 days.

[0062] If desired, the methods disclosed herein can further comprise a treatment step to increase the shelf-stability of the yogurt product. Such treatment steps can include, but are not limited to, pasteurization, ultra-high temperature (UHT) sterilization, high pressure processing (HPP), and the like, as well as combinations thereof. After such treatment, the yogurt product can be shelf-stable without refrigeration (at a temperature from about 20 °C to about 25 °C) for a time period in a range from about 7 to about 180 days, from about 7 to about 120 days, from about 14 to about 120 days, or from about 30 to about 150 days.

[0063] The yogurt products of the methods disclosed herein typically can contain a relatively high amount of protein. In one aspect, the yogurt product can contain from about 7 to about 25 wt. % protein (e.g., from about 7 to about 12 wt. % protein). In another aspect, the yogurt product can contain from about 9 to about 20 wt. % protein (e.g., from about 9 to about 12 wt. % protein). In yet another aspect, the yogurt product can contain from about 8 to about 13 wt. % protein (e.g., from about 8 to about 10 wt. % protein). In still another aspect, the yogurt product can contain from about 12 to about 20 wt. % protein.

[0064] The lactose content of the yogurt product is not limited to any particular range, but often, the yogurt product can contain from about 0.5 to about 3 wt. % lactose, or from about 1 to about 2 wt. % lactose. Additionally or alternatively, the yogurt product beneficially can have a relatively high weight ratio of protein to lactose (protein:lactose), such as greater than or equal to about 4:1, greater than or equal to about 5:1, greater than or equal to about 6:1, greater than or equal to about 8:1, or greater than or equal to about 10:1. At high levels of protein content (e.g., 15-20 wt. %), the amount of lactose can be less than 1 wt. % (and approach zero); therefore, the protein:lactose ratio can be greater than 50:1, or greater than 100:1, in some aspects of this invention. In the examples that follow, the protein:lactose ratio is in the 5:1 to 6:1 range.

[0065] Further, the yogurt product can be characterized by a solids content in a range from about 10 to about 30 wt. %, from about 12 to about 20 wt. %, from about 11 to about 19 wt. %, or from about 13 to about 16 wt. %. Additionally or alternatively, the yogurt product can be characterized by a titratable acidity (% lactic acid) in a range from about 0.75 to about 2 %, or from about 1 to about 1.5 %. Additionally or alternatively, the yogurt product can be characterized by a fat content of less than or equal to about 0.7 wt. % fat, less than or equal to about 0.5 wt. % fat, or less than or equal to about 0.3 wt. % fat, or a fat content in a range from about 1 to about 8 wt. % fat, or from about 2 to about 7 wt. % fat. Additionally or alternatively, the yogurt product can be characterized by a mineral content from about 0.8 to about 2 wt. %, or from about 0.9 to about 1.5 wt. %.

[0066] An illustrative and non-limiting example of a suitable method for making a yogurt product consistent with aspects of this invention is shown in FIG. 1. First, fresh whole milk is separated into cream and a skim milk product. The skim milk product is then subjected to ultrafiltration, via a polymeric membrane system, as described herein, resulting in a retentate often referred to as the protein-enriched milk fraction. Additional milk fractions, such as cream, then can be combined with the protein-enriched milk fraction, to form a standardized yogurt base with the desired amounts of the respective milk components (e.g., protein, fat, lactose, and minerals).

[0067] In **FIG. 1**, the yogurt base is pasteurized and then cooled to a temperature of 40-45 °C, followed by inoculating the yogurt base with a yogurt culture, and incubating (or fermenting) the inoculated yogurt base until a target pH has been reached, for example, a pH of 4.6. The resulting fermented product is subjected to agitation to break the curd, followed by a heat treatment step, typically in the 55-65 °C range. The fermented product is then subjected to ultrafiltration, via a ceramic membrane system, as described herein, resulting in a retentate often referred to as the yogurt product, and a permeate that contains the acid whey from the fermented product.

[0068] Flavor, sugar/sweetener, and stabilizer ingredients are combined with the yogurt product in **FIG. 1**, followed by cooling to 20-25 °C, and packaging (e.g., aseptically) in a suitable container, such as a bottle, cup, or bag. The packaged yogurt product is generally stored at refrigerated conditions, often in the 1-5 °C range.

[0069] Another illustrative example of a suitable method for making a yogurt product which is disclosed for illustration purpose and does not form part of the invention is shown in **FIG. 2.** The steps in **FIG. 2** are the same as those in **FIG. 1**, except that the fermented product is subjected to a mechanical separation step (such as centrifugal separation, instead of ultrafiltration with a ceramic membrane system), resulting in a retentate often referred to as the yogurt product, and a permeate that contains the acid whey from the fermented product.

EXAMPLES

[0070] The invention is further illustrated by the following examples.

[0071] Total solids (wt. %) was determined in accordance with procedure SMEDP 15.10 C by CEM Turbo Solids and Moisture Analyzer (CEM Corporation, Matthews, North Carolina). Ash is the residue remaining after ignition in a suitable apparatus at 550 °C to a constant weight; such treatment at 550 °C typically eliminates all organic matter, with the remaining material being primarily minerals (Standard Methods for the examination of dairy products, 17th edition (2004), American Public Health Association, Washington DC). The ash test was performed by using a Phoenix (CEM Microwave Furnace), which heated the samples at 550 °C for 30 min. The ash content was determined in wt. %. The mineral content (in wt. %) is generally similar to the ash content (wt. %), and thus the result of an ash test is used for quantification of the total mineral content in this disclosure.

[0072] Specific Ca, Mg, Na, and K contents were determined using a Perkin Elmer Atomic Absorption Spectrophotometer. Samples were treated with trichloroacetic acid to precipitate proteins and the filtrate was analyzed by the Atomic Absorption Spectrophotometer. Phosphorus content was determined via Inductively Coupled Plasma Spectrometry (official method of Analysis of AOAC, International 8th edition, methods 965.17 and 985.01). Chlorine content was determined by the official method of analysis of AOAC International 8th edition, methods 963.05, 972.27, and 986.26; AOAC International, Gaithersburg, MD (2005). Titratable acidity (%) was determined in accordance with American Public Health Association method 15.021, 17th edition, Standard Method for the examination of dairy product.

[0073] Tables I-VIII summarize composition information relating to the preparation of yogurt products as described herein and illustrated in **FIGS. 1-2**. First, a raw or fresh milk product was separated into a skim milk product and cream. The respective compositions of the raw milk product, skim milk product, and cream are summarized in **Table I**. The skim milk product was subjected to ultrafiltration at a temperature of approximately 5 °C using a polymeric membrane system with a molecular weight cut-off of 10,000 Daltons, resulting in a yogurt base with higher protein and solids; the composition of this yogurt base (UF skim milk) at a 6.6-6.8 pH is summarized in **Table I** and detailed in **Table II.**

[0074] The UF skim milk yogurt base was pasteurized at 88-92 °C for 6-8 minutes, cooled to ~40 °C, and then inoculated with 0.004-0.009 wt. % of a yogurt culture containing *Lactobacillus bulgaricus* and *Streptococcus thermophilus,* and fermented at a temperature of ~40 °C for 4-8 hours, at which time a pH of 4.4-4.6 was reached. After agitation and a thermization treatment at 55-60 °C for ~3 minutes, the fermented product was subjected to ultrafiltration at 45-55 °C using a ceramic membrane system with pore sizes of approximately 0.1 μm, resulting in a high protein, yogurt product (Skim Greek yogurt) with the composition summarized in **Table I** and detailed in **Table VI.** Substantially all (greater than 90 wt. %) of the acid whey was removed in the ceramic membrane ultrafiltration step, and the weight ratio of the yogurt product to acid whey in the fermented product was approximately 40:60. The composition of the acid whey (permeate) is detailed in **Table IV.**

[0075] In a separate experiment, the UF skim milk product (protein-enriched) was combined with cream, resulting in a yogurt base with higher protein, fat, and solids; the composition of this yogurt base (UF skim milk + cream) is summarized in **Table I** and detailed in **Table III.** The UF skim milk + cream yogurt base was then processed in a manner similar to the UF skim milk yogurt base, described above. The resultant fermented product was subjected to ultrafiltration using a ceramic membrane system, resulting in a high protein, yogurt product (Whole Greek yogurt) with the composition summarized in **Table I** and detailed in **Table VII.** Substantially all (greater than 90 wt. %) of the acid whey was removed in the ultrafiltration step, and the weight ratio of the yogurt product to acid whey in the fermented product was approximately 50:50. The composition of the acid whey (permeate) is detailed in **Table V.**

[0076] Constructive examples that demonstrate an unexpected benefit of the disclosed methods are summarized in **Table VIII,** in which yogurt bases having different protein contents are listed (A = 3.2 wt. %, B = 4.46 wt. %, C = 5 wt. %, D = 6 wt. %, wherein the method using yogurt base A is not according to the invention). To produce a Greek-style yogurt product having a target or nominal 10 wt. % protein content, the estimated amount of acid whey (in kg) that would be produced per 100 kg of the yogurt product is listed in **Table VIII** for each yogurt base (and yogurt base protein content). Advantageously, increasing the protein content of the yogurt base can dramatically decrease the amount of acid whey that is produced, and that must be disposed of. Note that an increase in yogurt base protein content from 3.2 to 5 wt. % (or from 4.46 to 6 wt. %) can reduce the amount of the acid whey by-product by 50%.

Table I. Compositional Summary.

Product	**Fat Wt. %**	**Protein Wt. %**	**Lactose Wt. %**	**Minerals Wt. %**	**Solids Wt. %**	**Titratable acidity (%)**
Raw milk	3.5	3.2	4.8	0.70	12.2	0.12
Skim milk	0.07	3.3	4.9	0.75	8.9	0.13
Cream	44.0	1.9	2.5	0.40	48.8	0.05
UF skim milk	0.17	4.2	4.6	0.96	10.1	0.11
UF skim milk + cream	2.14	4.8	4.3	1.04	12.2	0.12
Whole Greek yogurt	4.46	8.3	1.5	1.07	16.0	1.09
Skim Greek yogurt	0.28	9.6	1.7	1.28	13.8	1.12

Table II. UF skim milk base - detailed composition.

Component	Result	Method reference
Fat (wt. %)	0.17	AOAC 989.05
Protein (wt. %)	4.15	AOAC 992.23
Lactose (wt. %)	4.57	AOAC 980.13
Total solids (wt. %)	10.05	SMEDP 15.10 C
Chloride (wt. %)	0.10	AOAC 980.25
Titratable acidity (%)	0.11	
Calcium (per 100 g)	133 mg	AOAC 984.27
Magnesium (per 100 g)	12.3 mg	AOAC 984.27
Phosphorus (per 100 g)	94.0 mg	AOAC 984.27
Potassium (per 100 g)	151 mg	AOAC 984.27
Sodium (per 100 g)	41.5 mg	AOAC 984.27
Zinc (per 100 g)	0.44 mg	AOAC 984.27
Calcium/protein	0.032	
Phosphorus/protein	0.023	

Table III. UF skim milk + cream base - detailed composition.

Component	Result	Method reference
Fat (wt. %)	2.14	AOAC 989.05
Protein (wt. %)	4.78	AOAC 992.23
Lactose (wt. %)	4.31	AOAC 980.13
Total solids (wt. %)	12.24	SMEDP 15.10 C
Chloride (wt. %)	0.09	AOAC 980.25
Titratable acidity (%)	0.12	
Calcium (per 100 g)	140 mg	AOAC 984.27

Component	Result	Method reference
Magnesium (per 100 g)	12.5 mg	AOAC 984.27
Phosphorus (per 100 g)	97.7 mg	AOAC 984.27
Potassium (per 100 g)	144 mg	AOAC 984.27
Sodium (per 100 g)	38.9 mg	AOAC 984.27
Zinc (per 100 g)	0.50 mg	AOAC 984.27
Calcium/protein	0.029	
Phosphorus/protein	0.020	

Table IV. Acid whey (permeate) of Skim Greek yogurt - detailed composition.

Component	Result	Method reference
Fat (wt. %)	0.05	AOAC 989.05
Protein (wt. %)	0.38	AOAC 992.23
Lactose (wt. %)	3.76	AOAC 980.13
Total solids (wt. %)	6.16	USDA918 RL
Chloride (wt. %)	0.11	AOAC 980.25
Titratable acidity (%)	0.12	
Calcium (per 100 g)	140 mg	AOAC 984.27
Magnesium (per 100 g)	13.1 mg	AOAC 984.27
Phosphorus (per 100 g)	82.7 mg	AOAC 984.27
Potassium (per 100 g)	171 mg	AOAC 984.27
Sodium (per 100 g)	46.3 mg	AOAC 984.27
Zinc (per 100 g)	0.41 mg	AOAC 984.27
As (wt. %)	0.83	AOAC 945.46

Table V. Acid whey (permeate) of Whole Greek yogurt - detailed composition.

Component	Result	Method reference
Fat (wt. %)	0.01	AOAC 989.05
Protein (wt. %)	0.38	AOAC 992.23
Lactose (wt. %)	3.62	AOAC 980.13
Total solids (wt. %)	5.95	USDA918 RL
Chloride (wt. %)	0.09	AOAC 980.25
Titratable acidity (%)	0.12	
Calcium (per 100 g)	153 mg	AOAC 984.27
Magnesium (per 100 g)	12.5 mg	AOAC 984.27
Phosphorus (per 100 g)	79.6 mg	AOAC 984.27
Potassium (per 100 g)	174 mg	AOAC 984.27
Sodium (per 100 g)	44.3 mg	AOAC 984.27

Component	Result	Method reference
Zinc (per 100 g)	0.37 mg	AOAC 984.27

Table VI. Skim Greek yogurt - detailed composition.

Component	Result	Method reference
Fat (wt. %)	0.28	AOAC 989.05
Protein (wt. %)	9.57	AOAC 992.23
Lactose (wt. %)	1.68	AOAC 980.13
Total solids (wt. %)	13.81	USDA918 RL
Titratable acidity (%)	1.12	
Calcium (per 100 g)	95.9 mg	AOAC 984.27
Magnesium (per 100 g)	9.69mg	AOAC 984.27
Potassium (per 100 g)	116 mg	AOAC 984.27
Sodium (per 100 g)	32.5 mg	AOAC 984.27
Lactic acid bacteria	2.4 billion per gram	
Calcium/protein	0.010	

Table VII. Whole Greek yogurt - detailed composition.

Component	Result	Method reference
Fat (wt. %)	4.46	AOAC 989.05
Protein (wt. %)	8.25	AOAC 992.23
Lactose (wt. %)	1.52	AOAC 980.13
Total solids (wt. %)	16.02	USDA918 RL
Titratable acidity (%)	1.09	
Calcium (per 100 g)	90.6 mg	AOAC 984.27
Magnesium (per 100 g)	8.64mg	AOAC 984.27
Potassium (per 100 g)	100 mg	AOAC 984.27
Sodium (per 100 g)	30.7 mg	AOAC 984.27
Lactic acid bacteria	1.7 billion per gram	
Calcium/protein	0.011	

Table VIII. Acid Whey Production. (A method using Yogurt Base A is not according to the present invention).

Attribute	Yogurt Base A	Yogurt Base B	Yogurt Base C	Yogurt Base D
Yogurt Base Protein (wt. %)	3.2	4.46	5	6
Target Yogurt Product Protein (wt. %)	10	10	10	10

Attribute	Yogurt Base A	Yogurt Base B	Yogurt Base C	Yogurt Base D
Acid whey (in kg) per 100 kg of Yogurt Product	220	140	100	67

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- EP3053444A1 [0004]
- US7169428B [0036]
- US9510606B [0036]
- US9538770B [0036]

Non-patent literature cited in the description

- Standard Methods for the examination of dairy productsAmerican Public Health Association20040000 [0071]
- Analysis of AOAC [0072]
- AOAC International [0072]
- AOAC International20050000 [0072]
- Standard Method for the examination of dairy productAmerican Public Health Association method [0072]

PATENTKRAV

1. Fremgangsmåde til fremstilling af et yoghurtprodukt, hvilken fremgangsmåde omfatter enten:
   (a) opkoncentrering af et skummetmælkeprodukt til frembringelse af en proteinberiget mælkefraktion, der indeholder fra 3,5 til 6 vægt-% protein, hvor opkoncentrering af skummetmælkeproduktet omfatter ultrafiltrering af skummetmælkeproduktet med et polymert membransystem;
   (b) kombinering af den proteinberigede mælkefraktion med en yderligere mælkefraktion, der omfatter fløde, skummetmælk, en laktoserig fraktion, en mineralrig fraktion, vand eller kombinationer deraf, til frembringelse af en standardiseret yoghurtbase, der indeholder fra 3,5 til 6 vægt-% protein;
   (c) podning af den standardiserede yoghurtbase med en yoghurtkultur og fermentering af den podede yoghurtbase til frembringelse af et fermenteret produkt; og
   (d) fjernelse af mindst en del af sur valle fra det fermenterede produkt til frembringelse af yoghurtproduktet, hvor fjernelse omfatter ultrafiltrering af det fermenterede produkt med et keramisk membransystem;

   eller
   (i) opkoncentrering af et skummetmælkeprodukt til frembringelse af en standardiseret yoghurtbase, der indeholder fra 3,5 til 6 vægt-% protein, hvor opkoncentrering af skummetmælkeproduktet omfatter ultrafiltrering af skummetmælkeproduktet med et polymert membransystem;
   (ii) podning af den standardiserede yoghurtbase med en yoghurtkultur og fermentering af den podede yoghurtbase til frembringelse af et fermenteret produkt; og
   (iii) fjernelse af mindst en del af sur valle fra det fermenterede produkt til frembringelse af yoghurtproduktet, hvor fjernelse omfatter ultrafiltrering af det fermenterede produkt med et keramisk membransystem.

2. Fremgangsmåde ifølge krav 1, hvor den proteinberigede mælkefraktion i trin (a) eller den standardiserede yoghurtbase i trin (i) indeholder fra 3,8 til 5,5 vægt-% protein, fra 3,7 til 5 vægt-% protein eller fra 3,7 til 4,5 vægt-% protein.

3. Fremgangsmåde ifølge krav 1 eller 2, som yderligere omfatter et trin med separering af et råmælkeprodukt i skummetmælkeproduktet og fløde før trin (a) eller trin (i).

4. Fremgangsmåde ifølge et hvilket som helst af kravene 1-3, hvor den standardiserede

yoghurtbase er kendetegnet ved

- et calciumindhold i et interval fra 1100 til 1800 ppm, fra 1200 til 1800 ppm eller fra 1200 til 1600 ppm på vægtbasis; og
- et phosphorindhold i et interval fra 800 til 1200 ppm, fra 850 til 1150 ppm eller fra 800 til 1100 ppm på vægtbasis.

5. Fremgangsmåde ifølge et hvilket som helst af kravene 1-4, hvor den standardiserede yoghurtbase i trin (b) og i trin (i) er kendetegnet ved:
et faststofindhold i et interval fra 9 til 15 vægt-%, fra 9,5 til 14 vægt-% eller fra 10 til 14 vægt-%;
et vægtforhold mellem calcium og protein i et interval fra 0,02 til 0,04, fra 0,025 til 0,035 ppm eller fra 0,028 til 0,033; og
et vægtforhold mellem phosphor og protein i et interval fra 0,013 til 0,033, fra 0,015 til 0,03 ppm eller fra 0,018 til 0,025.

6. Fremgangsmåde ifølge et hvilket som helst af kravene 1-5, som yderligere omfatter et trin med pasteurisering af den standardiserede yoghurtbase mellem trin (b) og trin (c) eller mellem trin (i) og trin (ii).

7. Fremgangsmåde ifølge et hvilket som helst af kravene 1-6, hvor yoghurtbasen podes og/eller fermenteres ved en temperatur i et interval fra 20 til 45 °C, fra 35 til 45 °C eller fra 40 til 45 °C.

8. Fremgangsmåde ifølge et hvilket som helst af kravene 1-7, hvor yoghurtkulturen omfatter *Lactobacillus bulgaricus, Streptococcus thermophilus* eller en kombination deraf.

9. Fremgangsmåde ifølge et hvilket som helst af kravene 1-8, hvor den podede yoghurtbase fermenteres, indtil pH i det fermenterede produkt er i et interval fra 4,4 til 4,8, fra 4,4 til 4,7 eller fra 4,5 til 4,7.

10. Fremgangsmåde ifølge et hvilket som helst af kravene 1-9, hvor skummetmælkeproduktet i trin (a) eller trin (i) opkoncentreres ved en temperatur i et interval fra 3 til 15 °C, fra 3 til 10 °C eller fra 5 til 8 °C.

11. Fremgangsmåde ifølge et hvilket som helst af kravene 1-10, hvor det fermenterede produkt ultrafiltreres ved en temperatur i et interval fra 35 til 55 °C, fra 40 til 60 °C eller fra 45 til 55 °C.

12. Fremgangsmåde ifølge et hvilket som helst af kravene 1-11, hvor mindst 90 vægt-%, mindst 95 vægt-% eller mindst 99 vægt-% af den sure valle fjernes i trin (d) eller trin (iii).

13. Fremgangsmåde ifølge et hvilket som helst af kravene 1-12, hvor:
den sure valle er kendetegnet ved et faststofindhold på mindre end eller lig med 8 vægt-%, mindre end eller lig med 7 vægt-% eller mindre end eller lig med 6,5 vægt-%; og
et vægtforhold mellem yoghurtproduktet og sur valle i det fermenterede produkt er i et interval fra 35:65 til 70:30, fra 40:60 til 70:30 eller fra 45:55 til 65:35.

14. Fremgangsmåde ifølge et hvilket som helst af kravene 1-13, som yderligere omfatter et trin med kombinering af yoghurtproduktet med en bestanddel og pakning i en beholder, hvor bestanddelen omfatter et sukker/sødemiddel, et smagsstof, et konserveringsmiddel, et stabiliseringsmiddel, et emulgeringsmiddel, et præbiotisk stof, en speciel probiotisk bakterie, et vitamin, et mineral, en omega-3-fedtsyre, en fytosterol, et antioxidant, et farvestof eller en hvilken som helst kombination deraf.

15. Fremgangsmåde ifølge et hvilket som helst af kravene 1-14, hvor yoghurtproduktet indeholder:
fra 7 til 25 vægt-% protein, fra 9 til 20 vægt-% protein eller fra 8 til 13 vægt-% protein;
fra 0,5 til 3 vægt-% lactose eller fra 1 til 2 vægt-% lactose;
faststoffer i et interval fra 10 til 30 vægt-%, fra 12 til 20 vægt-% eller fra 11 til 19 vægt-%; og
yoghurtproduktet er kendetegnet ved et vægtforhold mellem protein og lactose større end eller lig med 4:1, større end eller lig med 5:1 eller større end eller lig med 8:1 og mindre end eller lig med 100:1 eller mindre end eller lig med 50:1.

DRAWINGS

FIG. 1

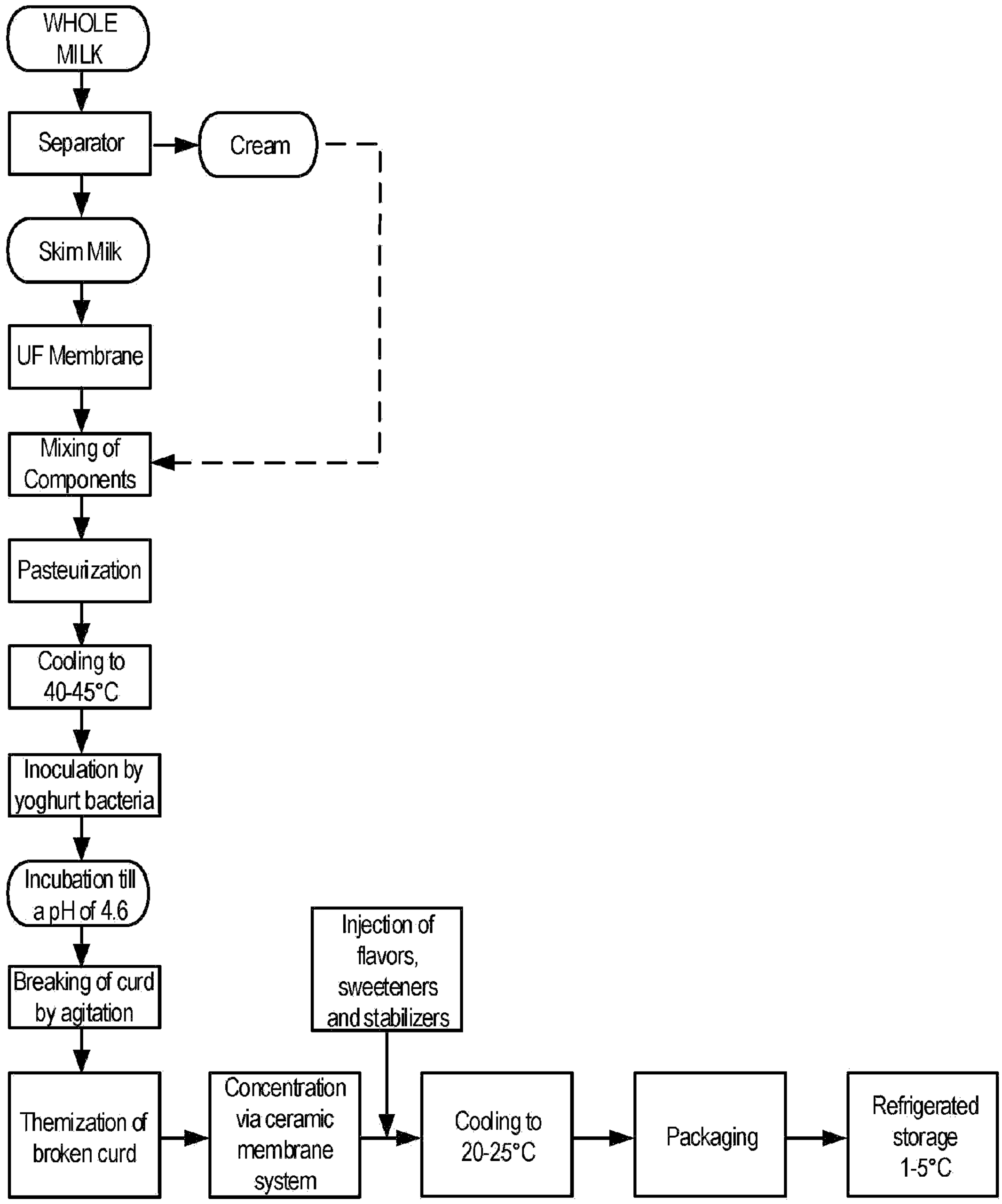
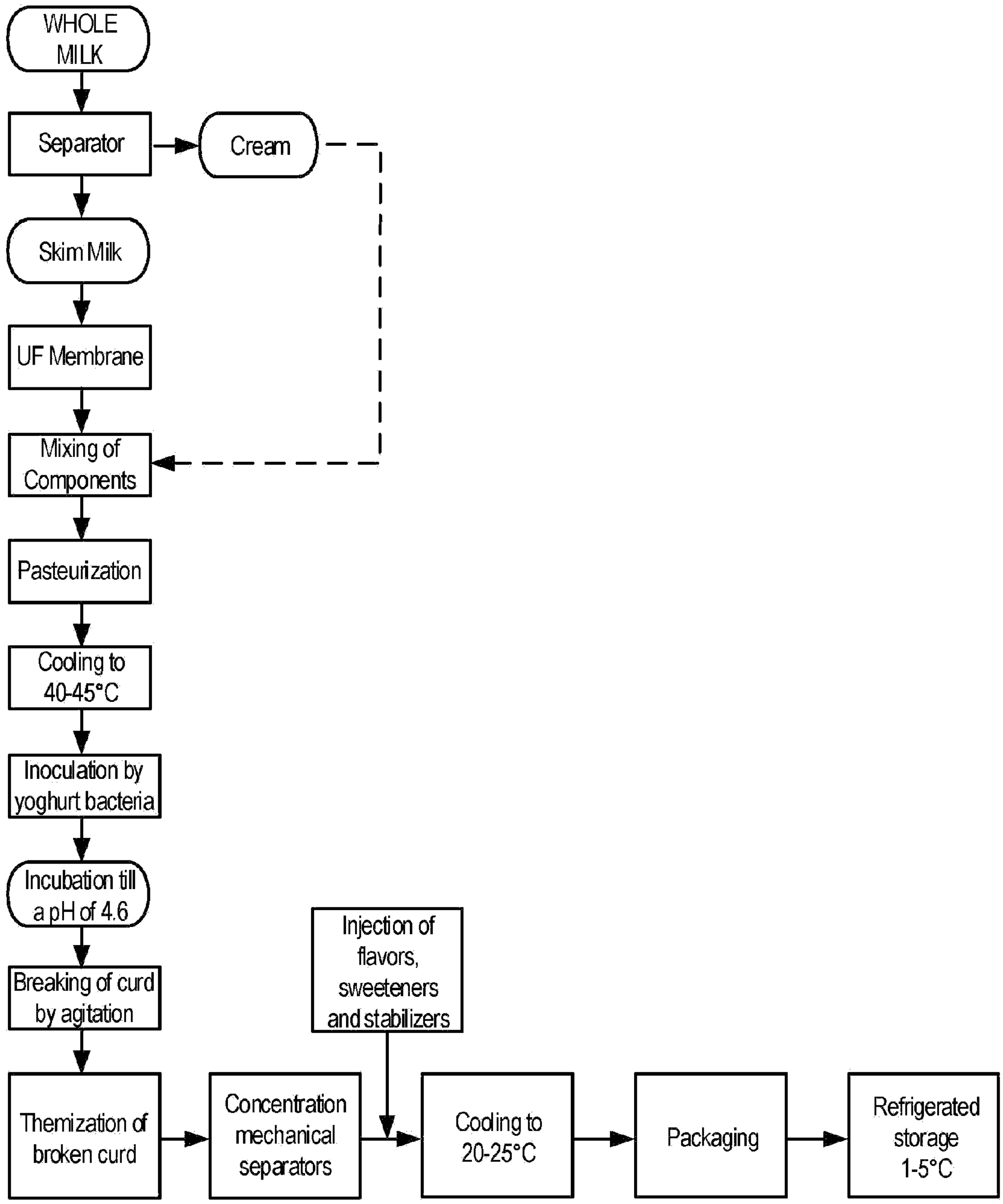


FIG. 2


WHOLE MILK
Separator
Cream
Skim Milk
UF Membrane
Mixing of Components
Pasteurization
Cooling to 40-45°C
Inoculation by yoghurt bacteria
Incubation till a pH of 4.6
Breaking of curd by agitation
Themization of broken curd
Concentration mechanical separators
Injection of flavors, sweeteners and stabilizers
Cooling to 20-25°C
Packaging
Refrigerated storage 1-5°C