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(30) Priority Data		(72) Inventors:	Heinz WYSS
(33) Country:	CH		Chiesemattweg 12
(31) Number:	EU 96202669.6		3515 Oberdiessbach Switzerland
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(54) Title: Milk Substitute And Process For Its Manufacture

(57) Abstract:

Milk substitute which is produced from milk powder and whey powder, optionally and partially substituted with lactose, having the advantage of preventing or reducing the presence of free Ca<sup>++</sup> calcium ions in the solution which are liable to destabilize the casein micelle.

The process for manufacturing the milk substitute from whey comprises dissolving the ingredients sequentially in two stages in batches or in a batch stage followed by an in-line stage, guaranteeing the thermal stability of the product in spite of the presence of a large quantity of whey proteins.

**Inventors Continued**

2. Martinas KUSLYS  
Moosackerweg 2 B  
CH-3506  
GROSSHOECHSTETTEN  
Switzerland

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3. Hans Engel  
Dorfstrasse 17  
CH-3646 EINIGEN  
Switzerland

**Milk substitute and process for its manufacture**

The present invention concerns a milk substitute wherein  
5 milk is partly substituted by whey and/or lactose. The  
invention also concerns a process for manufacturing such a  
milk substitute.

The use of whey is known in the manufacture of milk  
10 products. The advantage of using whey as a milk substitute  
is essentially connected with its low cost. However, the  
use of whey as a replacement for milk is a difficult  
operation. It is in point of fact difficult to ensure that  
the product has thermal stability and good storage life  
15 with whey proteins.

Patent application EP-A-0 627 169 concerns a process for  
processing milk which enables these fixed objectives to be  
partially achieved. Within the context of this patent  
20 application, the product to be processed may be in the form  
of whole milk, partially skimmed milk, skimmed milk or  
whey. Processing is carried out by the technique of  
evaporation. However, there are some advantages that this  
method does not have :

25 - Firstly, it is not suitable for obtaining milk  
reconstituted from milk powder. Consequently, the milk  
must be processed as near as possible to the milk producer  
and the consumer in order to reduce transport costs.

30 - Secondly, this processing procedure does not enable  
sedimentation to be prevented after processing, in  
particular when the product is sterilized.

35 The milk substitute according to the invention overcomes  
the disadvantages of known products. It is characterized  
in that it contains, by weight, approximately 10 to 12 %

skimmed milk solids, approximately 5 to 9 % whey solids, approximately 68 to 80 % water, approximately 7 to 10 % fats, approximately 0.01 to 0.03 % of carrageenates and approximately 0.1 to 0.3 % of a calcium sequestering agent.

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A product of this type comprises a large proportion of whey as a replacement for milk in the milk substitute composition. This substitution brings about a considerable reduction in the costs of the raw materials used. It also has the advantage that the substitute raw material has a milk origin. Whey may be partially substituted preferably to the extent of approximately half by lactose. In the following, within the context of the present patent application, the term "whey" includes the ideas of whey or whey with added lactose, it being possible for the whey to be demineralized to a varying extent.

Although whey is present in large proportions in the milk substitute, and hence whey proteins, the heat stability of the product is unexpectedly not reduced on account of this. Thus, at high temperatures, the milk substitute reacts substantially like normal milk processed by conventional procedures from the point of view of colour, taste and consistency.

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In addition, the milk substitute does not have or has few calcium ions which are capable of precipitating to form an undesirable deposit. In point of fact, free calcium ions are either well buffered by the at least partially dissociated sequestering agent, or else bound within the casein micelles. In order to ensure that calcium ions are present in a small quantity in the milk substitute, it is moreover opportune to use soft water or demineralized water in its composition.

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The sequestering agent or stabilizing salt is preferably a phosphate or citrate, for example mono-, di- or trisodium

phosphate or mono-, di- or trisodium citrate or mixtures thereof.

The invention additionally concerns a process for  
5 manufacturing the aforementioned milk substitute, wherein the whey solids and milk solids are dissolved and the solution is then heat treated, homogenized, processed and sterilized.

10 The process of the invention is characterized in that, in a first step, whey solids are dissolved in an aqueous medium comprising carrageenate and a calcium sequestering agent, at a temperature of approximately 30 to 65°C, skimmed milk solids are then dissolved in the whey solution in a second  
15 step in the liquid phase at the same temperature and that the said whey solids are allowed to humidify for 10 min to 4 h, it being possible for this humidification operation to occur before or after the skimmed milk solids are dissolved.

20 In order to prepare the milk substitute, it is preferable to use the following proportions of raw materials by weight : approximately 10 to 12 % of skimmed milk powder, approximately 5 to 9 % of whey powder, approximately 7 to  
25 10 % fats which may be selected preferably from palm oil, coconut oil, maize oil or a combination of these. In addition, it is preferable to use approximately 0.1 to 0.3 % of lecithin, approximately 0.02 to 0.03 % of carrageenate, approximately 0.10 to 0.15 % of sequestering  
30 agent for the solution process and approximately 0 to 0.15 % sequestering agent for sterilization, and approximately 68 to 80 % of soft water or preferably demineralized water.

35 The special characteristics of this process lie in the fact that no evaporation stage is provided for processing the milk product from milk powders and whey powder. Two

variants of the process may be envisaged for preparing the milk substitute.

5 A variant using successive batches comprises dissolving both the whey and milk powder in a vat.

A variant combining a stage in batches and an in-line stage assumes that the whey powder is dissolved in a vat and the milk powder is dissolved in-line.

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The advantage of this process is that it guarantees the temperature stability of the final product which is comparable to that of milk, in spite of the presence of large quantities of whey proteins.

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Before commencing to dissolve the milk powders or whey powders, it is necessary to prepare the solubilizing aqueous medium. It comprises, by weight, approximately 68 to 80 % of water, approximately 0.01 to 0.03 % of carrageenate and approximately 0.1 to 0.15 % of sequestering agent. The sequestering agent and the carrageenate may be incorporated in water at a temperature of 30 to 65°C, preferably at approximately 60 to 65°C, in a first vat in two ways : by circulating water through a powder distributor introducing the sequestering agent and the carrageenate or by pre-dissolving the carrageenate and the sequestering agent separately in a small quantity of water before mixing them, with moderate stirring, with all the water to form the solubilizing aqueous medium.

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Two methods may be envisaged for incorporating the whey powder in the aqueous solution in the first vessel at 30 to 65°C, preferably at approximately 60 to 65°C. The solution is recirculated through a powder distributor having whey powder, or the powder is added directly to the solution and dissolved with vigorous stirring.

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After dissolving the whey in the aqueous medium, it is necessary to allow the whey solution thus obtained to stand for 10 min to 4 h, preferably for 10 to 45 min at a temperature of approximately 55 to 65°C. This dwell time is necessary for enabling the whey proteins to rehydrate.

Once the rehydration of the proteins has been carried out, the skimmed milk powder may be incorporated in the whey solution. Two variants may be envisaged for ensuring good dissolution of the milk powder in the whey solution : the whey solution may be recirculated from a second vat through a powder distributor introducing milk powder, or the milk powder may be incorporated progressively in the whey solution as it circulates in-line.

According to a variant, it is possible to provide for the whey proteins to be rehydrated directly after the skimmed milk powder is dissolved.

Before continuing operations, a degassing phase is recommended by expansion at approximately 45 to 50°C. After degassing, it is necessary to preheat the milk solution, preferably to approximately 60°C so as to be able to incorporate the fats, in particular vegetable oils. The vegetable oils as well as lecithin are mixed and preheated to approximately 60 to 65°C. The fatty phase is then combined with the milk solution and mixed, preferably with the aid of a static mixer or a colloid mill. In order to ensure rehydration and balancing of the solution, it is allowed to stand. The dwell period is preferably approximately 25 to 35 min if the operation is carried out in a vat, or 15 to 20 min if the milk powder is incorporated in-line.

Following these operations, pasteurization of the solution is carried out which may take two forms. Pasteurization may be carried out indirectly for approximately 1 to 5 s at

approximately 80 to 85°C, for example by means of a tubular exchanger or plate exchanger or carried out in a direct manner for approximately 3 to 5 s at approximately 120 to 130°C by direct steam injection. Pasteurization is  
5 preferably followed by flash expansion at approximately 70 to 80°C.

After pasteurization, the solution is preferably subjected to homogenization in two stages which may be carried out at  
10 a temperature of approximately 70 to 75°C. The first stage is at a pressure of approximately 190 to 210 bar and the second is at approximately 30 to 50 bar.

The temperature of the solution is advantageously lowered  
15 to approximately 4 to 8°C. A sample is taken in order to carry out sterilization tests from which the quantities of water and stabilizing salt to be added to the solution are determined. The stabilizing salt is dissolved in water at a rate of 0 to approximately 0.15 % by weight and  
20 incorporated in the milk solution to ensure standardization of the said solution.

Finally, the containers intended for sale are filled with the milk substitute thus obtained, making sure that an  
25 empty space is left above the level of the liquid to enable the contents of the container to be shaken before use. Sterilization is carried out, preferably, for approximately 12 to 15 min at approximately 115 to 122°C after having reheated the product to approximately 95 to 97°C.

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The following examples illustrate the invention. In these, percentages and parts are by weight, unless indicated to the contrary.

## Example 1

The process for manufacturing the milk substitute below  
comprises a batch-batch sequence. The milk substitute is  
5 composed of the following ingredients in the proportions  
indicated :

- 10.9 % skimmed milk powder
- 7.2 % soft whey powder,
- 10 ● 7.6 % non-hydrogenated palm oil,
- 0.2 % lecithin,
- 0.02 % carrageenate,
- 0.24 % dehydrated disodium hydrogenphosphate  
(sequestering agent).
- 15 ● 73.84 % water.

The carrageenate and 50 % of the sequestering agent are  
dissolved in a first vat containing soft water at 65°C by  
recirculating the water through a powder distributor  
20 containing the two aforementioned ingredients. The whey  
powder is dissolved in the same way by recirculating the  
same water to which carrageenate and sequestering agent  
have been added, using the same powder distributor, this  
time containing whey powder. In order to enable rehydration  
25 of the whey proteins to take place, it is important to  
allow the solution thus obtained to stand for thirty  
minutes at 60°C.

After having obtained a solution based on whey, the skimmed  
30 milk powder is incorporated at 55°C in a second vat by  
recirculating the said solution through a powder  
distributor containing skimmed milk powder. After this  
operation, the solution is degassed at 45°C.

35 The following stage consists of incorporating lecithin and  
palm oil in the milk solution. In order to do this, the  
solution is reheated to 60°C. The lecithin is mixed with

palm oil and the mixture is heated to 65°C. The fatty phase is then metered out and mixed with the milk solution with the aid of a static mixer. After this operation, the mixture is allowed to stand for about thirty minutes at 55°C.

Pasteurization is then carried out at 85°C for 5 s before subjecting the milk solution to homogenization in two stages, the first at 70°C at a pressure of 200 bar, followed by the second at 30 bar at the same temperature.

In order to test sterilization, the milk solution is cooled to 6°C. On the basis of the sterilization test, the solution is standardized to 26 % of dry matter with demineralized water containing the necessary quantity of sequestering agent in the dissolved form. In order to ensure good dispersion of the sequestering agent, the solution should be well mixed before passing to the following stage.

Cartons are then filled with the milk solution in a continuous and standard manner, leaving an empty space between the liquid and the lid of the carton. After the filling stage, the product is preheated to 95°C, and then sterilized in its package at 118°C for 15 min. The milk substitute in the carton thus obtained is ready to put on sale.

#### Example 2

The following example concerns a milk substitute of which the manufacturing process comprises a batch-line sequence. The milk substitute is composed of the following ingredients in the proportions indicated :

- 10.6 % skimmed milk powder
- 7.2 % soft whey powder,

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- 7.6 % coconut oil,
- 0.8 % maize oil,
- 0.2 % lecithin,
- 0.03 % carrageenate,
- 5 ● 0.24 % dehydrated disodium hydrogenphosphate  
(sequestering agent).
- 73.33 % water.

10 First of all, 50 % of the sequestering agent is dissolved in water, the carrageenate is pre-dissolved in cold water, and the sequestering agent and carrageenate solutions are then mixed at 65°C in a vat with the aid of a mixer with moderate stirring.

15 The whey powder is incorporated in the aqueous solution previously obtained with the aid of a mixer with vigorous stirring. After having incorporated the whey powder, the whey solution is allowed to stand for about thirty minutes at a constant temperature of 60°C.

20 The skimmed milk powder is then dissolved in a continuous manner in-line in the stream of whey solution at 60°C. After incorporating the milk powder, the solution is allowed to stand at 50°C to enable it to degas by  
25 expansion.

Following degassing, the coconut and maize oils, as well as the lecithin, premixed and preheated to 65°C, are mixed continuously with the milk solution obtained, using a  
30 colloid mill. The solution is circulated in the pipework for 15 min before passing to the following stage.

After adding the oil to the milk solution, direct  
35 pasteurization is carried out at 125°C for 4 s and the milk solution is then subjected to a flash expansion.

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Homogenization in two stages as well as the subsequent operations are similar to those described in example 1.

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## Claims

1. A process for preparing a milk substitute composition comprising:  
dissolving a whey solids powder in an aqueous medium comprising calcium sequestering agent and carrageenate components at a temperature of approximately from 30°C to 65°C to obtain a whey-containing medium having an aqueous liquid phase;  
dissolving a skimmed milk solids powder in the whey - containing medium at a temperature of approximately from 30°C to 65°C to obtain a milk substitute composition having an aqueous liquid phase; and  
allowing, before and/or after dissolving the skimmed milk solids powder, the whey solids to soak in the aqueous liquid phase for from 10 minutes to 4 hours for hydrating the whey solids.
2. A process according to claim 1 wherein the whey solids are allowed to soak prior to dissolving the milk solids powder.
3. A process according to claim 2 wherein the whey solids are allowed to soak for from 10 minutes to 45 minutes prior to dissolving the milk solids powder.
4. A process according to claim 1, or 2 or 3 wherein the whey solids are allowed to soak at a temperature of approximately from 55°C to 65°C.
5. A process according to claim 1 further comprising adding a fat to the milk substitute composition to obtain a fat-containing milk substitute composition.
6. A process according to claim 5 further comprising also adding lecithin to the milk substitute composition to obtain a fat-containing milk substitute composition.
7. A process according to claim 6 further comprising, prior to adding the fat and lecithin, degassing the milk substitute composition.
8. A process according to claim 5 further comprising, prior to adding the fat, degassing the milk substitute composition.

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9. A process according to claim 5 or 6 or 8 or 7 further comprising heat treating the fat-containing milk substitute composition to obtain a pasteurized composition and homogenizing the pasteurized composition.
10. A process according to claim 5 wherein the aqueous medium is prepared to comprise the sequestering agent and carrageenate components in amounts so that by weight based upon the fat-containing milk substitute composition weight, the sequestering agent and carrageenate components are in amounts, respectively, of approximately from 0.1% to 0.3% and of approximately from 0.01% to 0.03% and wherein the aqueous medium is in an amount and the whey solids and skimmed milk solids are dissolved in amounts so that, by weight based upon the fat containing milk substitute composition weight, the whey solids are in an amount of approximately from 5% to 9% and the skimmed milk solids are in an amount of approximately from 10% to 12% and wherein the fat is added so that, by weight based upon the fat-containing milk substitute composition weight, the fat is in an amount of approximately from 7% to 10%.
11. A process according to claim 10 further comprising also adding lecithin to the milk substitute composition to obtain the fat-containing milk substitute composition and wherein the lecithin is added so that by weight based upon the fat-containing milk substitute composition weight, the lecithin is in an amount of approximately from 0.1% to 0.3%.
12. A process according to claim 1 further comprising dissolving lactose with the whey solids in the aqueous medium.
13. A process according to claim 12 further comprising adding a fat to the milk substitute composition to obtain a fat-containing milk substitute composition

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and wherein the aqueous medium is prepared to comprise the sequestering agent and carrageenate components in amounts so that, by weight based upon the fat-containing milk substitute composition weight, the sequestering agent and carrageenate components are in amounts, respectively, of approximately from 0.1% to 0.3% and of approximately from 0.01% to 0.03% and wherein the aqueous medium is in an amount and the whey solids and skimmed milk solids are dissolved in amounts so that, by weight based upon the fat-containing milk substitute composition weight, the whey solids are in an amount of approximately from 2.5% to 4.5% and the skimmed milk solids are in an amount of approximately from 10% to 12% and wherein the fat is added so that by weight based upon the fat-containing milk substitute composition weight, the fat is in an amount of approximately from 7% to 10%.

14. A process according to claim 1 wherein the aqueous medium is prepared with soft water.
15. A process according to claim 1 wherein the sequestering agent is selected from the group consisting of a phosphate salt and a citrate salt.
16. A process according to claim 1 wherein the sequestering agent is selected from the group consisting of monosodium phosphate, disodium phosphate, trisodium phosphate, monosodium citrate, disodium citrate and trisodium citrate.
17. A process according to claim 1 wherein the whey solids powder is distributed from a powder distributor into the aqueous medium circulated through the powder distributor and to a vessel for dissolving the whey solids powder in the aqueous medium.
18. A process according to claim 1 wherein the whey solids powder is added to and stirred into the aqueous medium in a vat for dissolving the whey solids powder in the aqueous medium.

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19. A process according to claim 1 wherein the skimmed milk powder is distributed from a powder distributor into the whey-containing medium circulated through the powder distributor and to a vat for dissolving the skimmed milk powder in the whey-containing medium.
20. A process according to claim 1 wherein the whey-containing medium is passed through a line and the skimmed milk powder is incorporated in-line into the whey containing medium in the line for dissolving the skimmed milk powder in the whey-containing medium.
21. A process according to claim 1 further comprising circulating water to a powder distributor and distributing carrageenate and sequestering agent from a powder distributor into water circulated through the powder distributor and to a vat for preparing the aqueous medium.
22. A process according to claim 1 further comprising dissolving a carrageenate in an amount of water and separately dissolving the sequestering agent in an amount of water to obtain two separate solutions and then combining and mixing the two solutions for preparing the aqueous medium.

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