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PATENT SPECIFICATION

NO DRAWINGS

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COMPLETE SPECIFICATION

Improvements in Liquid Condensed Milk Products and processes for making such products

We, BEATRICE FOODS Co., a corporation organized and existing under the Laws of the State of Delaware, United States of America, of 120 South LaSalle Street, Chicago 3, State of Illinois, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a sweetened condensed reconstituted milk product and a method of preparing same.

According to the invention there is provided a liquid condensed reconstituted milk product containing an amount of skim milk powder dispersed in water, an edible fat in an amount less than the amount of skim milk powder, and sucrose in an amount greater than the total combined amount of the skim milk powder and fat, said product having an initial viscosity not more than 9000 centipoises at the time of manufacture and a subsequent viscosity up to 100,000 centipoises.

The invention also provides a process for preparing a sweetened condensed reconstituted milk product which comprises dispersing skim milk powder in water, heating the dispersion, adding to the dispersion and amount of edible fat less than the amount of skim milk powder, and an amount of sucrose greater than the combined amount of skim milk powder and fat, homogenizing the mixture, sterilizing the mixture, cooling the mixture

and seeding the mixture with lactose crystals when the temperature of the mixture is 90° F. to 110° F.

Preferably, the product is then cooled to about room temperature and canned under aseptic conditions so as to be free of yeast and mold contaminations.

The invention makes it possible to obtain a product containing, for example, 72% by weight total solids, a 60% sucrose-water solution, and having an initial viscosity of 8000 to 9000 centipoises, preferably between 5000 centipoises and 2000 centipoises.

The initial temperature of the water may be from 40° F. to 100° F., but is preferably 70° F.

The temperature of the water-skim milk powder dispersion may be raised to 80° F. to 140° F. when the fat and sucrose are added, but preferably is 100° F. when the fat is added and above 120° F. when the sucrose is added.

The mixture may be homogenized at 80° F. to 140° F., preferably at 120° F., at a pressure of 500 to 2500 psig, preferably 1000 psig.

Sterilizing may be carried out without objectionably increasing viscosity at 180° F. to 200° F. for 8 to 20 minutes, preferably at 190° F. for 10 minutes or 185° F. for 20 minutes.

Preferred methods are set forth in the following Examples in which the percentages given are by weight:

EXAMPLE 1
The mixture used consisted of:

	A	B
Cane sugar (99.57% total solids)	39.6	39.9
Fat (coconut oil 76°)	8.0	8.0
Skim milk powder (99% total solids)	20.035	20.55
Lecithin (as emulsifier)	.047	.047
Water	32.318	31.503
		100.000%

In column A the figures given represent the amount of skim milk powder and cane sugar without included moisture, that is, in anhydrous condition. The figures given in column B represent the amount of skim milk powder and cane sugar with included moisture.

The mixture was prepared by introducing the water at a temperature of 70° F. into a round 30 inch diameter pasteurizing vat provided with a suitable agitator and then adding the skim milk powder and dispersing the powder in the water. There was added, after heating of this dispersion to 100° F., the vegetable fat containing the lecithin dissolved therein. The mixture was then heated to 120° F., and the granulated cane sugar was added. The sequence of this step was critical. At 120° F. the mixture was homogenized at 1000 psig. The homogenized product was sterilized by heating to 190° F. for 10 minutes in a covered vat, and flash cooled in a vacuum pan to 100° F. Sterilized alpha lactose hydrate in the form of fine crystals of 3 microns diameter was seeded into the finished product in amount of 0.045% of the finished product by weight, while the product was at 100° F. Thereafter, the product was cooled down to 70° F. in a vacuum pan and aseptically canned, by placing it in a can and sealing the can.

The finished product contained
 42% cane sugar
 21.5% milk solids not fat
 8.5% fat (including the lecithin)
 28% water

or 72% total solids content, and the sugar-water solution present has a concentration of 60%.

The amount of water in the original mixture is always adjusted so that the resulting processing removes water to result in approximately 72% total solids, i.e., 0.000526 pounds water per degree Fahrenheit cooling per

pound finished product is added initially in addition to the water needed to make a 72% total solids mixture.

Referring to the foregoing example:

The fat content can be increased with proportional decrease of the skim milk powder, the sugar remaining the same, namely, a 60% sugar-water solution or higher.

The mixture at the sterilizing temperature is flash cooled in the vacuum pan, resulting in removal of moisture and cooling to 70° F. so as to produce a finished product having 72% total solids, which is preferable, and about a 60% sugar-water solution.

Flash cooling over a greater range, e.g., from 190° F. down to 60° F., from 200° F. down to 70° F., or from 200° F. down to 60° F., removed more moisture, resulting in a higher solids content in the finished product. Flash cooling over a narrower range does not remove as much moisture, resulting in lower total solids content in the finished product. Preferably, flash cooling is employed to cool the product from about 190° F. down to 70° F., and thus remove moisture to give a desirable finished product having 72% total solids.

At 90° F. to 110° F. seeding with sterile lactose is employed, preferably at about 100° F. The sterile alpha lactose hydrate is a 225 mesh grind (will pass through a sieve having 225 openings to the square inch), and the size of the crystals may range from 3 to 5 microns, preferably 4 microns, in diameter. The amount of lactose added is about 0.4 pound of lactose per about 1000 pounds of finished product. Addition of a substantially greater amount of lactose has no additional beneficial effect.

After this seeding, the product is further cooled to 68° F. to 80° F. in a vacuum pan, preferably to about 70° F.

The can filling and sealing are effected under aseptic conditions, or under conditions which will be free of yeast and mold contaminations.

In some cases, milk protein will increase in viscosity on heating, dependent on its temperature treatment history as a fresh milk to form the powdered skim milk or milk solids not fat. Temperatures from 160° F. to 190° F. in the manufacture of skim milk powders sometimes cause the reconstituted milk to develop high viscosity when made into a sweetened condensed product of this invention. To overcome this, sodium citrate or sodium phosphate, e.g., disodium phosphate in small amount of 0.002% to 0.1%, preferably 0.05%, based on the weight of the mixture of sugar, skim milk powder, fat and water, is added to the skim milk powder during the addition of the milk powder to the water, preferably at the time when the skim milk powder is initially dispersed in the water, as described above. If the milk powder is one which, by testing, increases in viscosity on heating at a sterilizing temperature of about 190° F. for 15 minutes, then the adjusting salt, e.g., sodium citrate or the sodium phosphate, is added as just described. Sodium phosphate, e.g., disodium acid phosphate, in the amount above recited for the citrate, may be used as explained, but the sodium citrate is preferred.

The products of this invention have a viscosity between about 2000 and 9000 centipoises at 70° F. or room temperature, preferably between about 2000 and 5000 centipoises.

Sometimes, to obtain desired viscosity in the finished product with skim milk powder prepared at low temperatures and to prevent producing a too low viscosity in the finished product, the viscosity is adjusted with 0.005% by weight calcium chloride based on the total weight of the mixture of sugar, skim milk powder, fat and water, or an amount within the range of 0.002% to 0.1% by weight. Thus, with skim milk powder prepared at low temperatures it is adjusted with 0.005% by weight calcium chloride when initially dispersed in the water, as described above, and homogenized at preferably 2800 psig, and at a temperature of 80° F. to 140° F. Thereafter, the homogenized mixture is processed using the subsequent steps as described in Example 1 following the forming of the reconstituted skim milk-water dispersion.

EXAMPLE 2

In this example, as in Example 1, a round 30 inch diameter pasteurizing vat with a 1½ inch valve for blending and sterilizing was used. The vat was provided with a scraper blade for agitation to prevent burning or sticking, particularly in the case of high viscosity products. It has been found that blending is best conducted with agitation in the vat. The product was canned under an atmosphere of superheated steam, which resulted in a temperature increase of about 8° F. at a canning speed of about 20 cans per minute.

In preparing the product, the same ingredients were used in the same amounts as in Example 1 except that butter fat was used in place of lecithin. Water was introduced to the vat in amount so that the total solids prior to processing was approximately 68.10% (5.79 pounds extra water per 100 pounds of final product having 72% total solids was used). The addition of milk solids not fat in the form of skim milk powder was made to the water having a temperature of 60° F., and when these milk solids were dispersed free of lumps by the agitation, the mixture was heated to 100° F. and the butterfat was then added. This mixture was heated to 120° F. and the cane sugar was added.

The mixture was then homogenized at 1000 psig through a wire mesh cone, and the product sterilized by heating to 190° F. and holding for 10 minutes. The product was then flash cooled in a vacuum pan to 110° F. and, as the product cooled, the sterile lactose was added while the product was at 90° F.

The product was cooled to 80° F. in a vacuum pan and canned.

EXAMPLE 3

The steps of Example 2 were repeated with the exception that the homogenization took place at 800 psig in the homogenizer.

EXAMPLE 4

The steps of Example 2 were repeated with the exception that the homogenization took place at 1200 psig in similar equipment.

EXAMPLE 5

In this Example, using high heat skim milk powder, which was found to increase greatly in viscosity at the sterilizing temperature of 190° F. for 10 minutes, sodium citrate was added, in the amount of 0.025% by weight of the original mixture of sugar, skim milk powder, fat and water, to the water in the vat before the skim milk powder was introduced.

While the temperature of the water in the foregoing Examples was 60° F., in additional examples temperatures of 90° F. to 45° F. were used. It was found that hydration without lumps occurred most favourably at room temperature, and in further examples, temperatures at 60° F., 65° F. and 70° F. were used successfully.

It was observed in the foregoing examples that the fat had a minor depressant effect on the foam formed, which effect was increased by adding a small amount of lecithin to the fat before the same was added to the dispersion. That is, it was found in the foregoing examples of this invention, that where the fat or oil inherently contained lecithin, as in the case of the milk fat in Example 2, or where the lecithin was added, as in Example 1, that the foam depressant effect was directly proportional to the amount of present or added lecithin. After the mixture

of the aqueous dispersion of skim milk powder and the oil had been formed, the sugar was added and, as stated, all of the ingredients of the product were added in the proportions set forth in Example 1.

It was observed that since it was most desirable to use all of the product moisture to hydrate the skim milk powder, the preferred order of addition of ingredients to the process vat was (a) introduce all of the water and salts if they are added, (b) add the skim milk powder to the water at room temperature (60° F. to 70° F. water), (c) add the fat to depress any foam formed with the dispersion at a temperature of 100° F. to 110° F., and (d) add the sugar with the dispersion at a temperature of 120° F. to 130° F. to achieve faster solubility.

In the canning operation in the foregoing examples, the cans and lids were sterilized and, as stated, the filling and sealing were accomplished so as to eliminate contamination. The cans and lids were sterilized with superheated steam at 480° F., and the filling and closing was done under the same atmosphere. There was a mean temperature increase, as stated above, of about 8° F. occasioned from the filling and closing operation. The equipment was operated using sterile air under pressure adequate to obtain sufficient product flow so as to fill cans at the rate of 30 per minute, and depending upon the product viscosity, pressures up to 40 psig were used to fill the cans.

The seeding of the lactose was accomplished by injecting lactose-laden air beneath the surface of the sweetened condensed milk previously cooled to about 100° F. The lactose used was lactose sterilized in closed cans at 160° F. for 24 hours, and the crystals were placed in a hopper covered with a reinforced filter disc. By creating a vacuum below the hopper, air was drawn through the filter disc and the lactose and into the vacuum pan below the product surface level. The air released into the vacuum with explosive force, scattering the lactose through the product.

The product was subjected to vigorous agitation continuously as the product was cooled in the vacuum pan, i.e., by flash cooling.

As stated above, lactose used for seeding was 225 mesh and was alpha lactose hydrate. It was added in an amount of 0.045% of the finished product by weight, as above described. Also, as explained in the foregoing examples, after the seeding operation step, the product was cooled rapidly to 70° F. in the vacuum pan before canning.

In preparing the products of this invention with standard circulation mixers, all of the water must be initially available to form the skim milk powder dispersion. The sugar is preferably added in dry granular form,

i.e., as regular granulated cane sugar, after the dispersion of water and milk solids has been produced. While the fat may be added before or simultaneously with or after the sugar, it is preferably added before the sugar, as this reduces foaming. If a portion of the amount of water of reconstitution were withheld to make a sugar syrup for subsequent addition to the dispersion, the skim milk powder, because of insufficient water, would lump or ball and make the mass extremely viscous when using standard circulation mixers. This is highly objectionable because the finished product is then not smooth. This is, the skim milk powder does not hydrate adequately because there is insufficient free water available for its complete hydration and such water could not be drawn from the subsequently added sugar syrup. Therefore, the granulated sugar was added to the reconstituted skim milk when it has been substantially completely hydrated. This is a critical consideration in preparing the products of this invention, where standard circulation mixers are used.

If a high-speed, high-shear mixing blade is used to disperse the skim milk powder in a homogeneous colloidal dispersion, the product may be made by using sugar syrup rather than granular sugar, and the use of all the water to facilitate the hydration of the skim milk powder becomes unnecessary.

EXAMPLE 6

A procedure similar to that of Example 1 was employed except that a sucrose sugar syrup was used instead of cane sugar to give an amount of sugar the same, as that employed in Example 1 on a dry weight basis. In order to incorporate the skim milk powder in the sugar syrup, a high-speed, high-shear mixing machine was used, which dispersed the skim milk powder in a homogeneous colloidal dispersion free of the lumps and balling normally encountered with circulation mixers. The mixture was homogenized at 1000 psig.

EXAMPLE 7

A mixture containing:

42% Cane sugar
21.5% Skim milk powder
8.5% Fat (including lecithin)
28.0% Water

or 72% total solids content, and the sugar-water solution present having a concentration of 60% was made by mixing the water and skim milk powder at 90° F., heating to 120° F., and adding the sugar and fat. The mixing was accomplished only by the use of a high-speed, high-shear mixing blade, which rapidly reduced the mixture to a colloidal dispersion. The product was then homogenized at 1000 psig, vat pasteurized at 190° F. for 10 minutes with scraper blade agita-

tion, vat cooled to 100° F., and seeded with lactose in an amount equal to 0.045% (by weight) of the product, then cooled to 70° F. and canned, all as described above.

- 5 Reference has been made hereinabove to butter fat and coconut oil, but it is to be understood that other oils and fats may be used, such as peanut oil, cottonseed oil, soybean oil, sesame oil, palm oil, palm kernel oil, dehydrated butterfat, and, in fact, any of the well-known edible vegetable fats, and the same may or may not be hydrogenated.

It is preferred to use granulated cane sugar or beet sugar as the sugar constituent.

- 15 In using the lecithin as described herein, about 0.05% of the total mix is preferably used, as set forth in Example 1. Not more than about 0.1% is used, and not less than about 0.04% is employed.

- 20 The viscosities mentioned hereinabove are at the time of manufacture of the product, i.e., the initial viscosity. It has been found that the packaged product, on standing, i.e., in storage, tends to thicken and may reach a viscosity maximum of 100,000 centipoises. However, continued agitation of such product reduces the viscosity to a level as low as 50,000 centipoises. Thus, the viscosity range may vary from 100,000 to 50,000 centipoises on the same product.

- 30 The product of this invention is smooth and free of sediment, i.e., there is no precipitation out of proteins or lactose and there is no free fat separation. It is useful for coffee in place of cream or milk, for infant feeding, suitably diluted with water, for baking, and for making candy. Also, the product has many uses such as are well known for sweetened condensed milk.

40 WHAT WE CLAIM IS:—

1. A liquid condensed reconstituted milk product containing an amount of skim milk powder dispersed in water, an edible fat, in an amount less than the amount of skim milk powder, and sucrose in an amount greater than the total combined amount of the skim milk powder and fat, said product having an initial viscosity not more than 9000 centipoises at the time of manufacture and a subsequent viscosity up to 100,000 centipoises.

2. A product as claimed in claim 1, containing separately added crystalline lactose.

3. A product as claimed in claim 1 or claim 2, which contains about 72% by weight total solids.

4. A product as claimed in any one of claims 1 to 3, containing sodium citrate, sodium phosphate or calcium chloride.

5. A product as claimed in any one of claims 1 to 4, containing lecithin.

6. A sweetened condensed milk product as claimed in any one of claims 1 to 5, containing, by weight, 42% sucrose, 21.5% skim milk powder, 8.5% edible fat, and 28% water.

7. A product as claimed in any one of claims 1 to 6, where sucrose-water solution is present in 60% concentration in the final product.

8. A process of preparing a sweetened condensed reconstituted milk product according to claim 1, comprising ~~dispensing~~ *dispersi* skim milk powder in water, heating the dispersion, adding to the dispersion an amount of edible fat less than the amount of skim milk powder, and an amount of sucrose greater than the combined amount of skim milk powder and fat, homogenizing the mixture, sterilizing the mixture, cooling the mixture and seeding the mixture with lactose crystals when the temperature of the mixture is 90° F. to 110° F.

9. A process as claimed in claim 8, wherein the lactose-seeded product is cooled to a temperature of 60° to 80° F. and thereafter canned under aseptic conditions.

10. A process as claimed in claim 9, wherein the skim milk powder is dispersed in water at an initial temperature of 40° to 100° F.

11. A process as claimed in any of claims 8 to 9, wherein the water-skim milk powder dispersion is heated to a temperature of 80° F. to 110° F.

12. A process as claimed in any of claims 8 to 11, wherein the mixture is homogenized at a temperature of 80° to 140° F. at a pressure above 500 psig.

13. A process as claimed in any of claims 8 to 12, wherein the homogenized mixture is sterilized at a temperature of 180° F. to 200° F. for 8 to 20 minutes.

14. A process as claimed in any of claims 8 to 13, wherein the cooling of the mixture to the seeding temperature is effected by flash cooling.

15. A process as claimed in any of claims 8 to 14, wherein sodium citrate, sodium phosphate or calcium chloride is added to the skim milk water dispersion to control the viscosity of the final product.

16. A process as claimed in any of claims 8 to 15, wherein lecithin is added after heating the dispersion to depress foaming of the product.

17. A process as claimed in any of claims 8 to 16, wherein the sucrose is cane sugar.

18. A process as claimed in claim 8, wherein the water-skim milk powder dispersion is prepared with the water at 70° F., the edible fat is added at a temperature of 110° F. of the dispersion, the sucrose is added at a temperature of 120° F. of the dispersion, the dispersion is homogenized at a temperature of 120° F. at a pressure between 500 and 2500 psig, the mixture is sterilized at about 190° F. for 10 minutes and then flash cooled in a vacuum pan to 100° F., at which temperature sterile alpha lactose hydrate crystals having a particle size between about 3 and



tion, vat cooled to 100° F., and seeded with lactose in an amount equal to 0.045% (by weight) of the product, then cooled to 70° F. and canned, all as described above.

Reference has been made hereinabove to butter fat and coconut oil, but it is to be understood that other oils and fats may be used, such as peanut oil, cottonseed oil, soybean oil, sesame oil, palm oil, palm kernel oil, dehydrated butterfat, and, in fact, any of the well-known edible vegetable fats, and the same may or may not be hydrogenated.

It is preferred to use granulated cane sugar or beet sugar as the sugar constituent.

In using the lecithin as described herein, about 0.05% of the total mix is preferably used, as set forth in Example 1. Not more than about 0.1% is used, and not less than about 0.04% is employed.

The viscosities mentioned hereinabove are at the time of manufacture of the product, i.e., the initial viscosity. It has been found that the packaged product, on standing, i.e., in storage, tends to thicken and may reach a viscosity maximum of 100,000 centipoises. However, continued agitation of such product reduces the viscosity to a level as low as 50,000 centipoises. Thus, the viscosity range may vary from 100,000 to 50,000 centipoises on the same product.

The product of this invention is smooth and free of sediment, i.e., there is no precipitation out of proteins or lactose and there is no free fat separation. It is useful for coffee in place of cream or milk, for infant feeding, suitably diluted with water, for baking, and for making candy. Also, the product has many uses such as are well known for sweetened condensed milk.

WHAT WE CLAIM IS:—

1. A liquid condensed reconstituted milk product containing an amount of skim milk powder dispersed in water, an edible fat, in an amount less than the amount of skim milk powder, and sucrose in an amount greater than the total combined amount of the skim milk powder and fat, said product having an initial viscosity not more than 9000 centipoises at the time of manufacture and a subsequent viscosity up to 100,000 centipoises.

2. A product as claimed in claim 1, containing separately added crystalline lactose.

3. A product as claimed in claim 1 or claim 2, which contains about 72% by weight total solids.

4. A product as claimed in any one of claims 1 to 3, containing sodium citrate, sodium phosphate or calcium chloride.

5. A product as claimed in any one of claims 1 to 4, containing lecithin.

6. A sweetened condensed milk product as claimed in any one of claims 1 to 5, containing, by weight, 42% sucrose, 21.5% skim milk powder, 8.5% edible fat, and 28% water.

7. A product as claimed in any one of claims 1 to 6, where sucrose-water solution is present in 60% concentration in the final product.

8. A process of preparing a sweetened condensed reconstituted milk product according to claim 1, comprising ~~dispensing~~ *dispensing* skim milk powder in water, heating the dispersion, adding to the dispersion an amount of edible fat less than the amount of skim milk powder, and an amount of sucrose greater than the combined amount of skim milk powder and fat, homogenizing the mixture, sterilizing the mixture, cooling the mixture and seeding the mixture with lactose crystals when the temperature of the mixture is 90° F. to 110° F.

9. A process as claimed in claim 8, wherein the lactose-seeded product is cooled to a temperature of 60° to 80° F. and thereafter canned under aseptic conditions.

10. A process as claimed in claim 9, wherein the skim milk powder is dispersed in water at an initial temperature of 40° to 100° F.

11. A process as claimed in any of claims 8 to 9, wherein the water-skim milk powder dispersion is heated to a temperature of 80° F. to 110° F.

12. A process as claimed in any of claims 8 to 11, wherein the mixture is homogenized at a temperature of 80° to 140° F. at a pressure above 500 psig.

13. A process as claimed in any of claims 8 to 12, wherein the homogenized mixture is sterilized at a temperature of 180° F. to 200° F. for 8 to 20 minutes.

14. A process as claimed in any of claims 8 to 13, wherein the cooling of the mixture to the seeding temperature is effected by flash cooling.

15. A process as claimed in any of claims 8 to 14, wherein sodium citrate, sodium phosphate or calcium chloride is added to the skim milk water dispersion to control the viscosity of the final product.

16. A process as claimed in any of claims 8 to 15, wherein lecithin is added after heating the dispersion to depress foaming of the product.

17. A process as claimed in any of claims 8 to 16, wherein the sucrose is cane sugar.

18. A process as claimed in claim 8, wherein the water-skim milk powder dispersion is prepared with the water at 70° F., the edible fat is added at a temperature of 110° F. of the dispersion, the sucrose is added at a temperature of 120° F. of the dispersion, the dispersion is homogenized at a temperature of 120° F. at a pressure between 500 and 2500 psig, the mixture is sterilized at about 190° F. for 10 minutes and then flash cooled in a vacuum pan to 100° F., at which temperature sterile alpha lactose hydrate crystals having a particle size between about 3 and



5 microns in diameter are added to the extent of 0.045% by weight of the finished product, and wherein the product is then cooled to 68° F. to 70° F. and thereafter aseptically canned.

19. A process as claimed in any of claims 8 to 18, wherein the water-skim milk powder dispersion is formed before the addition of the sucrose.

20. A process as claimed in claim 19, in which the sucrose is granulated cane sugar.

21. A process as claimed in claim 19, wherein the sucrose is granulated beet sugar.

22. A modification of the process as claimed in claim 8, in which the skim milk powder is dispersed in a solution of the sucrose in the water at a temperature of

70° F. to 100° F., using a high-speed, high-shear mixing blade.

23. A process as claimed in claim 22, wherein the final mixture is cooled in a sterilizing vat to 100° F. using scraper blade agitation, seeded with 0.045% by weight alpha lactose hydrate, vat cooled to 70° F., and canned.

24. A liquid condensed milk product as herein described.

25. A process of preparing a sweetened condensed milk product as herein described.

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