

Description

Title of Invention

LOW-FAT OR FAT-FREE PUDDING AND METHOD FOR PRODUCING SAME

Technical Field

[0001]

The invention relates to a pudding that is reduced in fat without degrading the taste and appearance, and also relates to a method for producing such a pudding.

Background Art

[0002]

Puddings are highly palatable desserts. On the other hand, puddings have a relatively high calorie content. In recent years, as consumers have become more health- or calorie-conscious, the consumption of puddings is lagging. However, there is a high need for less fattening desserts. Thus, there is a possibility that if puddings are successfully reduced in calories, the potential market can be expanded.

[0003]

Unfortunately, if the calorie content of a pudding is reduced by reducing the fat content of the pudding or by making the pudding fat-free, the rich taste can be reduced, and the product appeal can also be reduced.

[0004]

JP 2559867 B1 (Patent Literature 1) discloses a method for producing a frozen or cooled dessert using deaggregated casein micelles substantially in place of the whole or part of fat or cream. The literature briefly states that deaggregated casein micelles may be added as a substitute for the whole or part of fat or cream to a pudding (see pages 3 and 9 of the literature). However, the literature is about methods for producing

ice cream but not about methods for producing puddings. In addition, if deaggregated casein micelles are added as a substitute for the whole or part of fat to a pudding, the taste of the pudding will be compromised, and the pudding will lose a high-grade appearance.

[0005]

JP H08-266221 A (Patent Literature 2 listed below) discloses a method for producing low-mineral milk powder, which includes subjecting raw milk to filtration with a nanofiltration (NF) membrane to remove only monovalent minerals such as sodium and potassium. The literature also discloses a method for producing low-mineral milk powder using a combination of nanofiltration (NF) and diafiltration (DF).

[0006]

JP 2597058 B1 (Patent Literature 3 listed below) discloses a food product containing short-chain amylose as a fat substitute. It also discloses a pudding as an example of such a food product (see claim 3 of the literature).

[0007]

JP 2005-537011 W (Patent Literature 4 listed below) discloses an apparatus for separating milk into individual constituents (see paragraph [0001] of the Literature). The literature also discloses ultrafiltration means, nanofiltration means, and reverse osmosis means as the means for separating milk into individual constituents (see paragraph [0016] of the literature).

[0008]

JP 3084530 B1 (Patent Literature 5 listed below) discloses a method for producing a low-fat food product using maltitol as a fat substitute.

[0009]

JP 2009-5626 A (Patent Literature 6 listed below) discloses a pudding that is produced by solidifying a pudding raw material liquid by heating, in which the pudding

raw material liquid contains egg and membrane-treated milk. The literature also discloses that defatted milk as the membrane-treated milk is treated using a nanofiltration membrane, an ultrafiltration membrane, or a microfiltration membrane (see claim 1 of the literature).

Citation List

Patent Literatures

[0010]

Patent Literature 1: JP 2559867 B1

Patent Literature 2: JP H08-266221 A

Patent Literature 3: JP 2597058 B1

Patent Literature 4: JP 2005-537011 W

Patent Literature 5: JP 3084530 B1

Patent Literature 6: JP 2009-5626 A

Summary of Invention

Technical Problem

[0011]

It is an object of the invention to provide a low-fat or fat-free pudding with a custard pudding-like taste and appearance and to provide a method for producing such a pudding.

Solution to Problem

[0012]

Basically, the invention is based on the finding that a pudding whose whiteness and gloss in appearance are equal to or better than those of a conventional custard pudding can be produced by using milk protein concentrate or skim milk in place of fat.

The invention is also based on the finding that the taste or rich taste of such a pudding is not degraded even when such a pudding is low-fat or fat-free. The invention is further based on the finding that when skim milk treated by nanofiltration or diafiltration is used, an unpleasant taste can be reduced, so that a pudding with good texture and good taste can be obtained.

[0013]

A first aspect of the invention relates to a pudding. As illustrated in the examples, the pudding contains one or both of milk protein concentrate (MPC) and skim milk (SM) as an ingredient. In addition, the pudding contains 7% by weight or more of solids not fat, has a fat content of 9% by weight or less, and has a color difference L value of 72 or more.

[0014]

Thus, the pudding of the invention has a high level of whiteness in appearance despite its low fat content. The pudding of the invention can meet the requirements of low-fat or fat-free while keeping a high-grade appearance and likeness to a typical custard pudding.

[0015]

In an embodiment of the invention, the pudding contains 2% by weight or more of milk protein concentrate. As demonstrated in the examples described below, an increase in solids not fat derived from milk protein concentrate is also effective in improving the whiteness of the pudding. In this embodiment, the whiteness of the pudding can be improved by increasing the concentration of solids not fat in the pudding.

[0016]

In another embodiment of the invention, the pudding contains 7% by weight or more of skim milk. The skim milk includes one or both of skim milk treated by nanofiltration and skim milk treated by diafiltration. A pudding with a good taste and

a good appearance and with no unpleasant taste can be produced using skim milk treated by nanofiltration or diafiltration.

[0017]

In another embodiment of the invention, solids not fat and fat are unevenly distributed in the pudding in such a manner that they are more in its surface than in its other parts. In the conventional art, it is common to make a pudding as homogeneously as possible. On the other hand, as demonstrated in the examples, the whiteness of the pudding increases with increasing solids not fat and fat. Thus, in this embodiment, solids not fat and fat are intentionally unevenly distributed in the pudding in such a manner that they are more in its surface than in its other parts, so that the whiteness of its outer part is more improved than that of its inner part. The ratio by weight of solids not fat and fat in a gravitational-center part of the pudding may be represented by G (% by weight). The ratio by weight of solids not fat and fat in a side surface part of the pudding (for example, a side surface part at half of the height of the pudding) may be represented by S (% by weight). In the pudding according to this embodiment, S is 1.1 times or more G.

[0018]

A second aspect of the invention relates to a method for producing a pudding. The method for producing a pudding is basically a method for producing any one of the puddings stated above. The method uses one or both of milk protein concentrate and skim milk as a raw material. The method includes the steps of preparing a raw material solution (by agitation, dispersion, dissolution, or other methods), charging (pouring) the raw material solution into a mold (such as a vessel), and cooling the raw material solution. For continuous mass production or the like, this method preferably includes the steps of preparing a raw material solution, sterilizing the prepared raw material solution, charging the raw material solution into a mold, and cooling the raw material solution. This process enables the production of the pudding according to the

first aspect of the invention.

[0019]

In a preferred embodiment, the method includes spraying water, an acid, or oil on a mold (such as a vessel) and then pouring the raw material solution into the mold. When water is sprayed on the mold, the pudding can have improved mold releasability. When an acid is sprayed on the mold, protein denaturation occurs at the surface part of the pudding, so that the pudding can have improved whiteness at the surface part. When oil is sprayed on the mold, the pudding can have improved gloss, so that the pudding can have improved whiteness.

Advantageous Effects of Invention

[0020]

The invention makes it possible to provide a low-fat pudding whose taste and appearance (whiteness) are kept comparable to those of a conventional product and to provide a method for producing such a pudding.

Description of Embodiments

[0021]

A first aspect of the invention relates to a pudding. As illustrated in the examples, this pudding contains one or both of milk protein concentrate (MPC) and skim milk (SM) as an ingredient. Specifically, despite its low fat content, the pudding of the invention has good taste and good appearance (whiteness), which are equal to or better than those of conventional products. The pudding of the invention, which has a low fat content, is preferably an egg-free pudding.

[0022]

The milk protein concentrate is known and commercially available. Thus, any appropriate known MPC may be used. For example, the MPC can be obtained by

a process including lowering the pH of skim milk to 2 to 4 with sulfuric acid to form a curd containing both casein and whey proteins, separating the proteins by fractionation, then neutralizing the proteins with sodium hydroxide, and spray-drying the neutralized proteins. The MPC preferably contains 60% by weight or more of proteins and 25% by weight or less of lactose.

[0023]

The skim milk is known. Thus, in the present invention, the skim milk to be used may be any appropriate known skim milk. On the other hand, the skim milk preferably includes skim milk treated by nanofiltration (NF) or skim milk treated by diafiltration (DF). The use of skim milk treated by nanofiltration or skim milk treated by diafiltration makes it possible to avoid an unpleasant taste when the pudding is produced using skim milk at a high concentration, and also makes it possible to produce a pudding with a good taste and a good appearance. The pudding of the invention preferably contains 7% by weight or more of skim milk. The skim milk can also be produced using an ion-exchange resin (IE) treatment or an electrodialysis (ED) treatment. In this case, the nanofiltration (NF) treatment, the diafiltration (DF) treatment, the ion-exchange resin (IE) treatment, and the electrodialysis (ED) treatment may be used alone or in any combination.

[0024]

The skim milk treated by nanofiltration can be obtained by subjecting defatted milk to filtration using a nanofiltration (NF) membrane. Defatted milk may mean a product obtained by removing milk fat from raw milk (for example, a product with a milk fat content of less than 6% by weight on a milk solids basis). Defatted milk is intended to include skim milk, concentrated skim milk, and skim milk powder (and a solution of skim milk powder).

[0025]

Examples of the material for the nanofiltration (NF) membrane include

polyamide, cellulose acetate, polyethersulfone, polyester, polyimide, vinyl polymer, polyolefin, polysulfone, regenerated cellulose, and polycarbonate. In the invention, the material for the nanofiltration (NF) membrane is preferably polyamide, cellulose acetate, or polyethersulfone for the purpose of removing minerals. Examples of the form of the nanofiltration (NF) membrane include a flat membrane, a spiral membrane, a hollow fiber membrane, a sheet membrane, and a tubular membrane. The nanofiltration may be performed using a known filtration method and known conditions. For example, the filtration method may be a pressure filtration method or a filtration method under reduced pressure. For example, the NF membrane may be an NF membrane manufactured by The Dow Chemical Company (NF-3838/30-FF (trade name)). Alternatively, the filtration method may be a dead-end filtration method or a cross-flow filtration method. Ice creams are industrially produced by a batch process, and thus in the invention, a cross-flow method is preferably used because fluctuations caused by clogging of the filtration membrane can be suppressed using this method.

[0026]

For example, the nanofiltration membrane has pore sizes in the range of 0.5 to 2 nm, through which monovalent ions and water are mainly allowed to pass. For example, the nanofiltration (NF) is performed under pressure conditions of 0.3 to 3 MPa. The ratio between the retentate and the filtrate depends on the osmotic pressure on the NF membrane being used. In general, the retentate is concentrated until the total solids (TS) of the raw material becomes 1.5 to 2.5 times (for example, 2.0 times).

[0027]

Skim milk treated by diafiltration may be a product obtained by subjecting defatted milk to filtration using a nanofiltration (NF) membrane. The diafiltration (DF) treatment may be a process including adding water to concentrated milk (retentate) or the like, which is obtained by filtration, to dilute it so that the volume of the filtrate (retentate) is increased close to the volume before the filtration and then performing

filtration. In the invention, for example, the DF method may be a process including adding water to concentrated milk or the like obtained by filtration with an NF membrane and then subjecting the mixture to filtration with an NF membrane.

[0028]

The DF process may include a first nanofiltration step including concentrating skim milk by nanofiltration to obtain nano-filtrated concentrated skim milk; a dilution step including diluting the nano-filtrated concentrated skim milk, which is obtained in the first nanofiltration step, to obtain nano-filtered skim milk; and a second nanofiltration step including concentrating the nano-filtrated skim milk, which is obtained in the dilution step, by nanofiltration to obtain demineralized skim milk.

Alternatively, the DF process may include a first nanofiltration step including concentrating a raw material comprising skim milk by nanofiltration to obtain nano-filtrated concentrated skim milk; a reverse osmosis step including subjecting the filtrate, which is obtained in the first nanofiltration step, to reverse osmosis to obtain a filtrate through a reverse osmosis membrane; a demineralized milk production step including mixing the nano-filtrated concentrated skim milk obtained in the first nanofiltration step, the filtrate through the reverse osmosis membrane, and water to form demineralized milk; and a second nanofiltration step including concentrating the demineralized milk, which is obtained in the demineralized milk production step, by nanofiltration to obtain demineralized skim milk.

Alternatively, the DF process may include a first nanofiltration step including concentrating a raw material by nanofiltration to obtain nano-filtrated concentrated milk; a reverse osmosis step including subjecting the filtrate, which is obtained in the first nanofiltration step, to reverse osmosis to obtain a filtrate through a reverse osmosis membrane; a demineralized milk production step including mixing the nano-filtrated concentrated milk, the filtrate through the reverse osmosis membrane, and water to form demineralized milk; and a second nanofiltration step including concentrating the

demineralized milk, which is obtained in the demineralized milk production step, by nanofiltration to obtain demineralized skim milk.

[0029]

In the second nanofiltration, a different NF membrane (for a different osmotic pressure) is preferably used (or appropriately selected) so that the degree of demineralization can be adjusted within a predetermined range. Alternatively, the retentate may be subjected to third or fourth nanofiltration so that the degree of demineralization can be adjusted within a predetermined range. In this manner, plural times of nanofiltration (namely, diafiltration) can be completed.

[0030]

The raw material for the pudding of the invention may contain any one of milk protein concentrate (MPC) and skim milk. The raw material for the pudding of the invention may contain both of milk protein concentrate (MPC) and skim milk.

[0031]

The pudding of the invention contains 7% by weight or more of solids not fat. The content of solids not fat in the pudding of the invention is preferably 11% by weight or more, more preferably 12% by weight or more, even more preferably 14% by weight or more, in particular, preferably 15% by weight or more. When the pudding is substantially free of fat, it preferably contains 11% by weight or more of solids not fat. On the other hand, if the content of solids not fat is too high, the taste, physical properties, or other properties of the pudding may be compromised. Thus, the content of solids not fat in the pudding of the invention is preferably 30% by weight or less, more preferably 25% by weight or less, even more preferably 20% by weight or less.

[0032]

The pudding of the invention may contain 2% by weight or more of milk protein concentrate. The content of milk protein concentrate in the pudding of the invention is preferably 2% by weight or more, more preferably 2.5% by weight or more,

even more preferably 3% by weight or more, in particular, preferably 3.5% by weight or more. When the pudding of the invention is substantially free of fat, it preferably contains 2% by weight or more milk protein concentrate and 11% by weight or more of solids not fat. On the other hand, if the content of milk protein concentrate is too high, the taste, physical properties, or other properties of the pudding may be compromised. Thus, the content of milk protein concentrate in the pudding of the invention is preferably 5% by weight or less, more preferably 4.5% by weight or less, even more preferably 4% by weight or less.

[0033]

The pudding of the invention may contain 12% by weight or more of skim milk when it does not contain milk protein concentrate. The content of skim milk in the pudding of the invention is preferably 13% by weight or more, more preferably 14% by weight or more, even more preferably 15% by weight or more, in particular, preferably 16% by weight or more. When the pudding of the invention is substantially free of fat, it preferably contains 12% by weight or more of skim milk and 11% by weight or more of solids not fat. On the other hand, if the content of skim milk is too high, the taste, physical properties, or other properties of the pudding may be compromised. Thus, the content of skim milk in the pudding of the invention is preferably 30% by weight or less, more preferably 25% by weight or less, even more preferably 20% by weight or less.

The pudding of the invention has a fat content of 9% by weight or less. The fat content of the pudding of the invention is preferably 6% by weight or less, more preferably 3% by weight or less, even more preferably 2% by weight or less, in particular, 1.5% by weight or less. The pudding of the invention may be substantially free of fat.

[0034]

The pudding of the invention has a color difference L value of 72 or more as measured for color difference. Herein, the color difference can be measured using a

color-difference meter (such as Color Analyzer TC-1800J (Tokyo Denshoku Co., Ltd.)). For example, the color difference value may be the L(-) value according to JIS K 7105. The pudding of the invention preferably has the color difference L value of 72.5 or more, more preferably 73 or more, even more preferably 73.2 or more, in particular, preferably 73.4 or more, as measured for color difference.

[0035]

In an embodiment of the invention, the pudding contains 2% by weight or more of milk protein concentrate. As demonstrated in the examples described below, solids not fat derived from milk protein concentrate is more effective in improving the appearance (whiteness) of the pudding than solids not fat derived from skim milk. In this embodiment, therefore, the whiteness of the pudding can be improved without excessively increasing the concentration of solids not fat in the pudding. This embodiment is effective in providing a pudding substantially free of fat. It should however be noted that solids not fat derived from skim milk is more effective in improving the taste of the pudding than solids not fat derived from milk protein concentrate.

[0036]

In another embodiment of the invention, the pudding contains 12% by weight or more of skim milk. As demonstrated in the examples described below, solids not fat derived from skim milk is more effective in improving the taste of the pudding than solids not fat derived from milk protein concentrate. In this embodiment, therefore, even at a low content of fat in the pudding, the whiteness of the pudding can be improved while the taste of the pudding is improved. This embodiment is effective in providing a pudding substantially free of fat. It should however be noted that solids not fat derived from milk protein concentrate is more effective in improving the appearance (whiteness) of the pudding than solids not fat derived from skim milk.

[0037]

In another embodiment of the invention, solids not fat and fat are unevenly distributed in the pudding in such a manner that they are more in its surface than in its other parts. In the conventional art, it is common to make a pudding as homogeneously as possible. On the other hand, as demonstrated in the examples, the whiteness of the pudding increases with increasing solids not fat and fat. Thus, in this embodiment, solids not fat and fat are intentionally unevenly distributed in the pudding in such a manner that they are more in its surface than in its other parts, so that the whiteness of its outer part is more improved than that of its inner part. The ratio by weight of solids not fat and fat in a gravitational-center part of the pudding may be represented by G (% by weight). The ratio by weight of solids not fat and fat in a side surface part of the pudding (for example, a side surface part at half of the height of the pudding) may be represented by S (% by weight). In the pudding according to this embodiment, S is 1.1 times or more G. The S/G value may be 1.2 or more or 1.5 or more. On the other hand, if the S/G value is too large, the taste would be completely different between the inner and surface parts of the pudding. Thus, the S/G value is preferably 2 or less.

[0038]

A second aspect of the invention relates to a method for producing a pudding. The method for producing a pudding is basically a method for producing any one of the puddings described above. The method uses one or both of milk protein concentrate and skim milk as a raw material. The method includes the steps of preparing a raw material solution (by agitation, dissolution, dispersion, or other methods), charging (pouring) the solution into a mold (such as a vessel), and cooling the solution.

[0039]

For example, the method may include a preparation step including dissolving and/or dispersing main raw materials; a holding step including holding the liquid preparation (raw material solution); an addition step including adding a flavor or a

colorant to the raw material solution; a water-content adjustment step including adjusting the water content of the raw material solution; a homogenization step including homogenizing the raw material solution with an adjusted water content by agitation; a sterilization step including heating the raw material solution; a temperature control step including keeping the raw material solution at a suitable temperature; a charging step including charging the raw material solution into a vessel; and a step of cooling the raw material solution.

[0040]

After the preparation step, the solution is typically held at a temperature of 45°C to 75°C, preferably at a temperature of 50°C to 70°C, more preferably at a temperature of 55°C to 65°C. In this step, the holding time may be long depending on the size (volume) of the tank actually used and the timing (required time) to provide the vessel into which the product is to be charged. In view of relation to spore forming bacteria, for example, the holding time may be from about 0.5 to 6 hours, preferably from about 0.5 to 4 hours, more preferably from about 0.5 to 2 hours.

For example, the sterilization step is often performed using a continuous sterilization method, and the step is preferably performed at a sterilization temperature of from 120°C to 150°C, more preferably from 125°C to 145°C, even more preferably from 130°C to 140°C. In this step, the sterilization time is preferably from 1 to 5 seconds, more preferably from 1 to 4 seconds, even more preferably from 1 to 3 seconds. The continuous sterilization method is preferred because it is suitable for mass production on a commercial scale and is also stable in terms of sanitation and quality. A batch sterilization process may also be used, and such a process is preferably performed at a sterilization temperature of from 90°C to less than 100°C, more preferably from 93°C to 97°C, even more preferably about 95°C. In this process, the sterilization time is preferably from 1 to 10 minutes, more preferably from 2 to 7 minutes, even more preferably about 5 minutes.

[0041]

In a preferred embodiment of the invention, the method for producing a pudding includes spraying water, an acid, or oil on a mold (such as a vessel) and then pouring the raw material solution into the mold. When water is sprayed on the mold, the pudding can have improved mold releasability. When an acid is sprayed on the mold, protein denaturation occurs at the surface part of the pudding, so that the pudding can have improved whiteness at the surface part. When oil is sprayed on the mold, the pudding can have improved gloss, so that the pudding can have improved whiteness.

[0042]

In a preferred embodiment of the invention, the method for producing a pudding includes solidifying the pudding from its surface when the pudding is baked or cooled to a solid. In this case, solids not fat and fat can be localized at the surface part of the pudding, so that the appearance of the pudding can be whitened. For this purpose, for example, it is also preferred that the mold should be cooled to a temperature below room temperature. To rapidly cool the surface of the pudding, for example, the temperature of the mold is also preferably set at -10°C to 20°C, more preferably -10°C to 10°C, even more preferably -5°C to 5°C, and may also be set at 0°C to 10°C. In this case, the surface part of the pudding is first solidified, so that solids not fat and fat are localized at the surface part of the pudding. In the process of cooling the pudding (raw material) solution, the mold for the pudding may be directly cooled so that the pudding solution can be solidified to form a pudding. In this process, the surface part of the pudding is first solidified, so that solids not fat and fat are localized at the surface part of the pudding.

[0043]

Hereinafter, the invention is more specifically described with reference to examples. It will be understood that the examples are not intended to limit the invention and various modifications obvious to one skilled in the art are deemed to be

within the scope of the invention.

[Example 1]

[0044]

Effects of Fat Concentration (6% by weight of solids not fat and 0 to 9% by weight of fat)

Table 1 is a pudding formulation table showing Sample Nos. (1-1) to (1-7) which have different fat concentrations adjusted by changing the amounts of fat and dextrin added. The raw materials used were skim milk (Meiji Dairies Corporation), Liquid Sugar F42 (Meiji Food Material Co., Ltd.), Fat FW2D (Taiyo Yushi Corp.), Dextrin MD2 (Matsutani Chemical Industry Co., Ltd.), Gelling Agent PM21 (Taiyo Kagaku Co., Ltd.), Cornstarch Y (NIHON SHOKUHIN KAKO CO., LTD.), New Carotene Base 250V (San-Ei Gen F.F.I., Inc.), Custard Flavor GIV044050 (Givaudan Japan K.K.), and Milk Flavor DP-01877 (SODA AROMATIC Co., Ltd.). First, main raw materials were dissolved and kept at 70°C for 10 minutes. Thereafter, the flavors and the colorant were added to the solution, and the water content was adjusted. Each preparation was homogenized at 150 kg/cm² and then sterilized at 95°C for 5 minutes. After each preparation was cooled to 70°C, 80 g of the preparation was charged into each mold (vessel). The product was cooled by immersion in iced water and then refrigerated.

[0045]

[Table 1]

Sample No.		(1- 1)	(1- 2)	(1- 3)	(1- 4)	(1- 5)	(1- 6)	(1- 7)
Skip milk(conventional product)	[kg]	6.30	6.30	6.30	6.30	6.30	6.30	6.30
Liquid Suger F42	[kg]	16.30	16.30	16.30	16.30	16.30	16.30	16.30
Fat FW2D	[kg]	0.00	1.45	2.90	4.35	5.80	7.25	8.70
Dextrin MD2	[kg]	9.20	7.67	6.13	4.60	3.07	1.53	0.00
Gelling Agent PM21B	[kg]	0.73	0.73	0.73	0.73	0.73	0.73	0.73
Cornstarch Y	[kg]	0.30	0.30	0.30	0.30	0.30	0.30	0.30
New Carotene Base 250V	[kg]	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Custard Flavor GIV044050	[kg]	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Milk Flavor DP-01877	[kg]	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Water	[kg]	66.95	67.03	67.12	67.20	67.28	67.37	67.45
Total	[kg]	100.00	100.00	100.00	100.00	100.00	100.00	100.00

[0046]

Table 2 shows the color difference and the physical property values for each of Sample Nos. (1-1) to (1-7). The color-difference meter used was Color Analyzer TC1800J (Tokyo Denshoku Co., Ltd.) (The same analyzer was also used in the examples described below). Table 3 shows the results of visual evaluation of the appearance of the puddings of Sample Nos. (1-1) to (1-7).

[0047]

[Table 2]

Sample No.		(1- 1)	(1- 2)	(1- 3)	(1- 4)	(1- 5)	(1- 6)	(1- 7)
Fat content	[% by weight]	0.0	1.5	3.0	4.5	6.0	7.5	9.0
Solids not fat content	[% by weight]	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Total solids content	[% by weight]	28.0	28.0	28.0	28.0	28.0	28.0	28.0
Sodium	[mg%]	26.3	26.3	26.3	26.3	26.3	26.3	26.3
Color difference L value(1)	[-]	65.11	70.21	73.75	74.86	76.60	77.84	79.40
Color difference L value(2)	[-]	66.83	70.92	73.67	74.77	77.08	78.32	79.22
Color difference a value(1)	[-]	6.34	6.82	7.11	6.73	6.94	6.25	6.83
Color difference a value(2)	[-]	5.90	6.73	7.06	6.94	6.99	6.94	6.73
Color difference b value(1)	[-]	28.15	29.74	30.89	30.26	30.75	29.09	29.60
Color difference b value(2)	[-]	28.54	29.48	29.65	30.35	29.78	30.11	29.68
Breaking Strength(1)	[g/cm ²]	18.5		17.2		16.7		19.8
Breaking Strength(2)	[g/cm ²]	19.9		21.2		22.5		24.2
Breaking strain(1)	[%]	34.4		26.7		26.0		24.9
Breaking strain(2)	[%]	42.1		36.8		36.4		32.7
Particle size	[μm]	25.6		32.2		35.4		52.4

[0048]

[Table 3]

Sample No.	Visual evaluation	Likeness to custard pudding
(1- 1)	Its appearance is not like that of a typical custard pudding, and its whiteness is insufficient.	×
(1- 2)	Its appearance is not like that of a typical custard pudding, and its whiteness is insufficient.	×
(1- 3)	Its appearance is like that of a typical custard pudding, but its whiteness is slightly insufficient.	△
(1- 4)	Its appearance is like that of a typical custard pudding, and its whiteness is sufficient and good.	○
(1- 5)	Its appearance is like that of a typical custard pudding, and its whiteness is sufficient and good.	○
(1- 6)	Its appearance is like that of a typical custard pudding, and its whiteness is sufficient and good.	○
(1- 7)	Its appearance is like that of a typical custard pudding, and its whiteness is sufficient and good.	○

[0049]

Table 3 shows that when skim milk (conventional product) is used, a reduction in fat content (Sample Nos. (1-1) and (1-2)) can lead to lack of likeness to the appearance or whiteness of a typical custard pudding. Sample No. (1-3) has an appearance like that of a typical custard pudding. In this example, the pudding contains 6% by weight of solids not fat derived from skim milk. Table 3 also shows that in this example, the pudding should preferably contain 3% by weight or more of fat so that it can have whiteness and a rich taste like a typical custard pudding (see also Table 2). It is concluded that the color difference L value, as a measure of whiteness, should preferably be from 72 to 73 or more.

[Example 2]

[0050]

Effect of Concentration of Skim Milk (7.4 to 17.8% by weight of solids not fat)

It was examined how changes in the concentration of skim milk (solids not fat) influenced the taste and appearance (whiteness) of a fat-free pudding prepared without adding any fat to the raw materials. Among the raw materials used in Example 1, Fat FW2D and Dextrin MD2 were replaced by starch syrup (Meiji Food Material Co., Ltd.). First, according to the formulations shown in Table 4, Sample Nos. (2-1) to (2-6) were

prepared using skim milk (conventional product). The preparation conditions were substantially the same as those in Example 1, except that only the sterilization temperature was changed to 90°C.

[0051]

[Table 4]

Sample No.		(2- 1)	(2- 2)	(2- 3)	(2- 4)	(2- 5)	(2- 6)
Skim milk powder (conventional product)	[kg]	7.40	9.50	11.60	13.65	15.73	17.80
Liquid Sugar F42	[kg]	5.80	7.15	8.50	10.10	11.60	13.10
Starch syrup	[kg]	20.60	16.60	12.60	8.30	4.15	0.00
Gelling Agent PM21B	[kg]	0.73	0.73	0.73	0.73	0.73	0.73
Cornstarch Y	[kg]	0.30	0.30	0.30	0.30	0.30	0.30
New Carotene Base 250V	[kg]	0.02	0.02	0.02	0.02	0.02	0.02
Custard Flavor GIV044050	[kg]	0.10	0.10	0.10	0.10	0.10	0.10
Milk Flavor DP-01877	[kg]	0.10	0.10	0.10	0.10	0.10	0.10
Water	[kg]	64.95	65.50	66.05	66.70	67.27	67.85
Total	[kg]	100.00	100.00	100.00	100.00	100.00	100.00

[0052]

Table 5 shows the color difference and the physical property values for each of Sample Nos. (2-1) to (2-6) with different fat concentrations. Table 6 shows the results of visual evaluation of the appearance of the puddings of Sample Nos. (2-1) to (2-6).

[0053]

[Table 5]

Sample No.		(2- 1)	(2- 2)	(2- 3)	(2- 4)	(2- 5)	(2- 6)
Fat content	[% by weight]	0.0	0.0	0.0	0.0	0.0	0.0
Solids not fat content	[% by weight]	7.0	9.0	11.0	13.0	15.0	17.0
Total solids content	[% by weight]	28.0	28.0	28.0	28.0	28.0	28.0
Sodium	[mg%]	45.3	54.0	62.7	71.3	79.9	88.5
Color difference L value	[-]	68.16	71.13	73.02	73.70	75.29	75.75
Color difference a value	[-]	5.66	6.06	6.23	6.21	6.79	6.88
Color difference b value	[-]	28.33	28.65	28.68	27.97	28.19	28.10
Breaking strength(1)	[g/cm ²]	25.6	29.9	31.9	28.0	30.3	26.2
Breaking strength(2)	[g/cm ²]	26.2	28.0	31.8	29.0	27.7	26.0
Breaking strength(3)	[g/cm ²]	27.1	30.9	30.0	27.4	28.0	27.9
Breaking strain(1)	[%]	38.5	40.6	38.3	38.0	36.2	30.8
Breaking strain(2)	[%]	41.7	38.0	39.6	38.8	34.1	32.9
Breaking strain(3)	[%]	41.3	40.4	38.0	35.1	36.2	35.1

[0054]

[Table 6]

Sample No.	Sensory evaluation and visual evaluation	Likeness to custard pudding
(2- 1)	It has a low level of custard pudding-like rich taste, and is significantly sloppy. Its whiteness is insufficient.	×
(2- 2)	It has a slightly low level of custard pudding-like rich taste, and tastes sloppy. Its whiteness is insufficient.	×
(2- 3)	It has a custard pudding-like rich taste but tastes somewhat salty. Its whiteness is slightly insufficient.	△
(2- 4)	It has a custard pudding-like rich taste, but tastes salty or unpleasant. Its whiteness is slightly insufficient.	△
(2- 5)	It has a custard pudding-like rich taste, but tastes salty or unpleasant significantly. Its whiteness is sufficient and good.	△
(2- 6)	It has a custard pudding-like rich taste, but tastes salty or unpleasant excessively. Its whiteness is sufficient and good.	×

[0055]

Even with fat-free formulations, Sample Nos. (2-3) to (2-6) have a custard pudding-like rich taste because they have a higher concentration of solids not fat (milk constituents). The color difference L value, as a measure of whiteness, should be from 72 to 73 or more, and thus Sample Nos. (2-5) and (2-6) have sufficient whiteness. However, Sample Nos. (2-5) and (2-6) taste salty or unpleasant significantly and do not have a good taste.

[0056]

Next, according to the formulations shown in Table 7, Sample Nos. (3-1) to (3-6) were prepared using skim milk treated by nanofiltration (NF). The preparation conditions were substantially the same as those in Example 1, except that only the sterilization temperature was changed to 90°C.

[0057]

[Table 7]

Sample No.		(3- 1)	(3- 2)	(3- 3)	(3- 4)	(3- 5)	(3- 6)
Skim milk (product treated by NF)	[kg]	7.40	9.50	11.60	13.65	15.73	17.80
Liquid Sugar F42	[kg]	5.80	7.15	8.50	10.10	11.60	13.10
Starch syrup	[kg]	20.60	16.60	12.60	8.30	4.15	0.00
Gelling Agent PM21B	[kg]	0.73	0.73	0.73	0.73	0.73	0.73
Cornstarch Y	[kg]	0.30	0.30	0.30	0.30	0.30	0.30
New Carotene Base 250V	[kg]	0.02	0.02	0.02	0.02	0.02	0.02
Custard Flavor GIV044050	[kg]	0.10	0.10	0.10	0.10	0.10	0.10
Milk Flavor DP-01877	[kg]	0.10	0.10	0.10	0.10	0.10	0.10
Water	[kg]	64.95	65.50	66.05	66.70	67.27	67.85
Total	[kg]	100.00	100.00	100.00	100.00	100.00	100.00

[0058]

[Table 8]

Sample No.		(3- 1)	(3- 2)	(3- 3)	(3- 4)	(3- 5)	(3- 6)
Fat content	[% by weight]	0.0	0.0	0.0	0.0	0.0	0.0
Solids not fat content	[% by weight]	7.0	9.0	11.0	13.0	15.0	17.0
Total solids content	[% by weight]	28.0	28.0	28.0	28.0	28.0	28.0
Sodium	[mg%]	36.0	42.0	48.1	54.1	60.0	66.0
Color difference L value	[-]	68.66	70.70	71.67	73.41	74.40	75.61
Color difference a value	[-]	5.08	5.36	5.73	5.44	6.05	5.70
Color difference b value	[-]	27.78	27.73	27.65	27.14	28.12	27.12

[0059]

[Table 9]

Sample No.	Sensory evaluation and visual evaluation	Likeness to custard pudding
(3- 1)	It has a low level of custard pudding-like rich taste, and is significantly sloppy. Its whiteness is insufficient.	×
(3- 2)	It has a slightly low level of custard pudding-like rich taste, and tastes sloppy. Its whiteness is insufficient.	×
(3- 3)	It has a slightly low level of custard pudding-like rich taste, and tastes sloppy. Its whiteness is insufficient.	×
(3- 4)	It has a custard pudding-like rich taste, but tastes somewhat salty. Its whiteness is sufficient and good.	△
(3- 5)	It has a custard pudding-like rich taste, but tastes salty or unpleasant. Its whiteness is sufficient and good.	○
(3- 6)	It has a custard pudding-like rich taste, but tastes salty or unpleasant significantly. Its whiteness is sufficient and good.	△

[0060]

Sample Nos. (3-4) and (3-5), which are produced using skim milk with its monovalent mineral (such as Na, K, and Cl) content reduced by nanofiltration (NF), have a custard pudding-like rich taste and sufficient whiteness, and also have a good taste while being less salty or unpleasant.

[0061]

Finally, according to the formulations shown in Table 10, Samples Nos. (4-1) to (4-6) were prepared using skim milk treated by diafiltration (DF). The preparation conditions were substantially the same as those in Example 1, except that only the sterilization temperature was changed to 90°C.

[0062]

[Table 10]

Sample No.		(4- 1)	(4- 2)	(4- 3)	(4- 4)	(4- 5)	(4- 6)
Skim milk (product treated by DF)	[kg]	7.40	9.50	11.60	13.65	15.73	17.80
Liquid Sugar F42	[kg]	5.80	7.15	8.50	10.10	11.60	13.10
Starch syrup	[kg]	20.60	16.60	12.60	8.30	4.15	0.00
Gelling Agent PM21B	[kg]	0.73	0.73	0.73	0.73	0.73	0.73
Cornstarch Y	[kg]	0.30	0.30	0.30	0.30	0.30	0.30
New Carotene Base 250V	[kg]	0.02	0.02	0.02	0.02	0.02	0.02
Custard Flavor GIV044050	[kg]	0.10	0.10	0.10	0.10	0.10	0.10
Milk Flavor DP-01877	[kg]	0.10	0.10	0.10	0.10	0.10	0.10
Water	[kg]	64.95	65.50	66.05	66.70	67.27	67.85
Total	[kg]	100.00	100.00	100.00	100.00	100.00	100.00

[0063]

[Table 11]

Sample No.		(4- 1)	(4- 2)	(4- 3)	(4- 4)	(4- 5)	(4- 6)
Fat content	[% by weight]	0.0	0.0	0.0	0.0	0.0	0.0
Solids not fat content	[% by weight]	7.0	9.0	11.0	13.0	15.0	17.0
Total solids content	[% by weight]	28.0	28.0	28.0	28.0	28.0	28.0
Sodium	[mg%]	32.4	37.3	42.2	47.1	52.0	57.0
Color difference L value	[-]	65.25	68.39	70.11	71.37	73.12	73.94
Color difference a value	[-]	4.15	4.42	4.39	4.82	4.90	4.55
Color difference b value	[-]	25.58	26.08	25.60	25.52	25.43	24.85
Breaking strength(1)	[g/cm ²]	24.7	22.9	26.1	24.5	20.9	29.1
Breaking strength(2)	[g/cm ²]	24.9	21.9	25.1	26.0	19.6	29.3
Breaking strength(3)	[g/cm ²]	23.2	22.2	24.8	25.3	20.3	24.7
Breaking strain(1)	[%]	50.4	45.5	46.2	40.4	30.8	40.8
Breaking strain(2)	[%]	54.0	44.1	41.8	39.5	33.3	41.8
Breaking strain(3)	[%]	49.4	44.7	44.5	41.8	31.9	37.5

[0064]

[Table 12]

Sample No.	Sensory evaluation and visual evaluation	Likeness to custard pudding
(4- 1)	It has a low level of custard pudding-like rich taste, and is significantly sloppy. Its whiteness is insufficient.	×
(4- 2)	It has a low level of custard pudding-like rich taste, and is significantly sloppy. Its whiteness is insufficient.	×
(4- 3)	It has a slightly low level of custard pudding-like rich taste, and tastes sloppy. Its whiteness is insufficient.	×
(4- 4)	It has a custard pudding-like rich taste, and has no salty or unpleasant taste. Its whiteness is slightly insufficient.	△
(4- 5)	It has a custard pudding-like rich taste, and has no salty or unpleasant taste. Its whiteness is sufficient and good.	○
(4- 6)	It has a custard pudding-like rich taste, and has no salty or unpleasant taste. Its whiteness is sufficient and good.	○

[0065]

Sample Nos. (4-5) and (4-6), which are produced using skim milk with its monovalent mineral (such as Na, K, and Cl) content reduced by diafiltration (DF), have a custard pudding-like rich taste and sufficient whiteness, and also have a good taste while being less salty or unpleasant.

[Example 3]

[0066]

Effect of Concentration of Milk Protein Concentrate (7 to 11% by weight of solids not fat)

It was examined how an increase in solids not fat (milk constituents), which was achieved by adding milk protein concentrate (MPC) to the raw materials and without adding any fat thereto, influenced the taste and appearance (whiteness) of a pudding. According to the formulations shown in Table 13, Sample Nos. (5-1) to (5-5) were prepared using MPC 480 (Fonterra Co-operative Group Limited), MPC 4861 (Fonterra Co-operative Group Limited), and lactose (Leprino Foods Company) in addition to the raw materials used in Example 2. The skim milk used was a conventional product. The preparation conditions were the same as those in Example 2.

[0067]

[Table 13]

Sample No.		(5- 1)	(5- 2)	(5- 3)	(5- 4)	(5- 5)
Skim milk (conventional product)	[kg]	8.00	8.00	8.00	8.00	8.00
MPC 480 (low Na type)	[kg]	0.00	2.00	4.00	0.00	0.00
MPC 4861 (high Na type)	[kg]	0.00	0.00	0.00	2.00	4.00
Starch syrup	[kg]	12.50	8.50	4.50	8.50	4.50
Sugar	[kg]	6.40	7.53	8.65	7.53	8.65
Lactose	[kg]	4.00	4.00	4.00	4.00	4.00
Gelling Agent PM21B	[kg]	0.73	0.73	0.73	0.73	0.73
New Carotene Base 250V	[kg]	0.02	0.02	0.02	0.02	0.02
Custard Flavor GIV044050	[kg]	0.10	0.10	0.10	0.10	0.10
Milk Flavor DP-01877	[kg]	0.10	0.10	0.10	0.10	0.10
Water	[kg]	68.09	68.96	69.84	68.96	69.84
Sodium bicarbonate	[kg]	0.06	0.06	0.06	0.06	0.06
Total	[kg]	100.00	100.00	100.00	100.00	100.00

[0068]

[Table 14]

Sample No.		(5- 1)	(5- 2)	(5- 3)	(5- 4)	(5- 5)
Fat content	[% by weight]	0.0	0.0	0.0	0.0	0.0
Solids not fat content	[% by weight]	7.0	9.0	11.0	9.0	11.0
Total solids content	[% by weight]	28.3	28.3	28.3	28.3	28.3
Sodium	[mg%]	33.2	33.4	33.7	35.49	37.79
Color difference L value	[-]	64.14	69.41	71.22	68.64	70.90
Color difference a value	[-]	4.56	4.89	4.61	4.87	5.29
Color difference b value	[-]	27.82	27.60	26.43	27.68	27.40
Breaking strength	[g/cm ²]	24.2	18.6	13.1	11.4	8.4
Breaking strain	[%]	42.2	32.7	33.6	28.8	44.7

[0069]

[Table 15]

Sample No.	Sensory evaluation and visual evaluation	Likeness to custard pudding
(5- 1)	It has a low level of custard pudding-like rich taste, and is significantly sloppy. Its whiteness is insufficient.	×
(5- 2)	It has a custard pudding-like rich taste, and has no salty or unpleasant taste. Its whiteness is slightly insufficient.	△
(5- 3)	It has a custard pudding-like rich taste, but tastes somewhat salty. Its whiteness is sufficient and good.	△
(5- 4)	It has a somewhat soft texture, and smells somewhat bad. Its whiteness is slightly insufficient.	△
(5- 5)	It has a significantly soft texture, and smells bad. Its whiteness is sufficient and good.	×

[0070]

When the solids not fat (milk constituents) were increased by adding MPC, the breaking strength was reduced, which affected the texture, and a bad smell was produced, so that the products had no good taste.

[Example 4]

[0071]

Effect of Concentration of Fat Substitute (0 to 4% by weight of solids not fat)

It was examined how addition of a fat substitute, which was performed without adding any fat to the raw materials, influenced the taste and appearance (whiteness) of a pudding. Among the raw materials used in Example 2, the starch syrup was replaced by inulin (Fuji Nihon Seito Corporation), Dextrin VIS TOP D-2600 (San-Ei Gen F.F.I., Inc.), or Dextrin MD2 (Matsutani Chemical Industry Co., Ltd.) as a fat substitute, and Sample Nos. (6-1) to (6-5) were prepared according to the formulations shown in Table 16. The preparation conditions were the same as those in Example 2.

[0072]

[Table 16]

Sample No.		(6- 1)	(6- 2)	(6- 3)	(6- 4)	(6- 5)
Skim milk (conventional product)	[kg]	6.30	6.30	6.30	6.30	6.30
Inulin	[kg]	0.00	2.00	4.00	0.00	0.00
Dextrin D2600	[kg]	0.00	0.00	0.00	2.00	4.00
Dextrin MD2	[kg]	9.20	7.20	5.20	7.20	5.20
Liquid Sugar F42	[kg]	16.30	16.30	16.30	16.30	16.30
Gelling Agent PM21B	[kg]	0.73	0.73	0.73	0.73	0.73
Cornstarch Y	[kg]	0.30	0.30	0.30	0.30	0.30
New Carotene Base 250V	[kg]	0.02	0.02	0.02	0.02	0.02
Custard Flavor GIV044050	[kg]	0.10	0.10	0.10	0.10	0.10
Milk Flavor DP-01877	[kg]	0.10	0.10	0.10	0.10	0.10
Water	[kg]	66.95	66.95	66.95	66.95	66.95
Total	[kg]	100.00	100.00	100.00	100.00	100.00

[0073]

[Table 17]

Sample No.		(6- 1)	(6- 2)	(6- 3)	(6- 4)	(6- 5)
Fat content	[% by weight]	0.0	0.0	0.0	0.0	0.0
Solids not fat content	[% by weight]	6.0	6.0	6.0	6.0	6.0
Total solids content	[% by weight]	28.0	28.0	28.0	28.0	28.0
Sodium	[mg%]	26.3	26.3	26.3	26.3	26.3
Color difference L value	[-]	65.89	66.18	66.02	66.00	66.46
Color difference a value	[-]	5.57	5.70	5.61	5.59	5.34
Color difference b value	[-]	28.17	28.26	28.10	27.85	27.89
Breaking strength (1)	[g/cm ²]	18.3	20.5	20.3	19.5	15.8
Breaking strength (2)	[g/cm ²]	22.5	23.2	26.1	19.1	13.7
Breaking strain (1)	[%]	29.4	30.1	29.2	31.2	33.9
	[%]	40.4	38.2	40.2	38.2	39.3

[0074]

[Table 18]

Sample No.	Sensory evaluation and visual evaluation
(6- 1)	It has a low level of custard pudding-like rich taste, and is significantly sloppy. Its whiteness is insufficient.
(6- 2)	It has a custard pudding-like rich taste, and has a proper texture. Its whiteness is insufficient.
(6- 3)	It has a custard pudding-like rich taste, but has a somewhat heavy texture. Its whiteness is insufficient.
(6- 4)	It has a custard pudding-like rich taste, and has a proper texture. Its whiteness is insufficient.
(6- 5)	It has a custard pudding-like rich taste, but has a somewhat soft texture. Its whiteness is insufficient.

[0075]

When a fat substitute was added, a custard pudding-like rich taste was obtained, but the color difference L value, as a measure of whiteness, was less than 72 or 73 with respect to all of Sample Nos. (6-1) to (6-5), and typical pudding-like whiteness was not obtained.

[0076]

The results of all examples described above show that even when containing no fat, puddings produced using NF skim milk (skim milk treated by nanofiltration) and/or DF skim milk (skim milk treated by diafiltration) have a custard pudding-like rich taste and sufficient whiteness and also have a good taste and a good appearance while being less salty or unpleasant.

Industrial Applicability

[0077]

The pudding of the invention is useful in the field of food industry.

Claims

1. A pudding comprising one or both of milk protein concentrate and skim milk as an ingredient,
the pudding containing at least 7% by weight of solids not fat,
the pudding having a fat content of at most 9% by weight, and
the pudding having a color difference L value of at least 72.
2. The pudding according to claim 1, which contains at least 2% by weight of the milk protein concentrate.
3. The pudding according to claim 1, which contains at least 7% by weight of the skim milk,
wherein the skim milk comprises one or both of skim milk treated by nanofiltration and skim milk treated by diafiltration.
4. The pudding according to claim 1, wherein S (% by weight) is at least 1.1 times G (% by weight), G (% by weight) representing the ratio by weight of solids not fat and fat in a gravitational-center part of the pudding, and S (% by weight) representing ratio by weight of solids not fat and fat in a side surface part of the pudding.
5. A method for producing a pudding, comprising:
a step of mixing raw materials containing one or both of milk protein concentrate and skim milk to form a raw material solution;
a step of charging the raw material solution into a mold after the step of mixing; and
a step of cooling the raw material solution after the step of charging,

wherein the pudding contains at least 7% by weight of solids not fat, has a fat content of at most 9% by weight, and has a color difference L value of at least 72.

6. The method according to claim 5, wherein the step of charging comprises spraying water, an acid, or oil on the mold and then pouring the raw material solution into the mold after the step of mixing.