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(54) Title: CHEESE AND METHOD FOR ITS MANUFACTURE

(57) Abstract: The invention relates to a soft, semi-soft, semi-hard, or hard cheese that contains a butter oil fraction, and to a method for its manufacture. By means of the butter oil fraction, it is possible to adjust the hardness of the cheese.

CHEESE AND METHOD FOR ITS MANUFACTURE

FIELD OF THE INVENTION

[0001] The invention relates to cheese and to a method for its manufacture. Especially the invention relates to a soft, semi-soft, semi-hard or hard cheese with a softer or harder than usual mouth-feel, and to a method for its manufacture.

BACKGROUND OF THE INVENTION

[0002] The mouth-feel of cheese, generally the softness of the structure has a significant impact on the pleasantness experienced by the consumer. The softer the cheese, the more pleasant the cheese is considered as a whole during consumer testing. Correspondingly, a cheese with an organoleptically hard mouth-feel is usually considered flavourless.

[0003] As is known, the softness of ripened and unripened cheeses may be improved by increasing the water content of the cheese. The water content of the fat-free portion of cheese in particular correlates in a positive manner with the organoleptic softness of the cheese. Increasing the water content reduces the production costs of cheese. Another known method to improve the softness of cheese is to ripen it strongly.

[0004] However, the known methods for the manufacture of soft cheese contain several problems. Increasing the water content shortens the shelf life of cheese significantly, and process control becomes more difficult as the water content increases. Prolonged ripening of cheeses is also problematic. Storage costs increase and, when higher temperatures are used, the risk of taste defects and, thus, spoiled batches increases. Similar problems also arise with semi-soft, semi-hard, and hard cheeses.

[0005] The melting zone of milk fat is around 38°C. Most of the milk fat in a cheese at ambient temperature is solid, and in a cheese at refrigerator temperature this is especially true. It is known to prepare cheese-like products by using processes and methods typical of cheese, but the fat and/or protein of milk is replaced either entirely or partly with another suitable fat or protein or both. Typically, milk fat is replaced by vegetable fat, such as rapeseed oil or fractionated palm oil. These cheese-like products that resemble cheese very much are, depending on the properties of the used fat, very soft even at refrigerator temperature. A problem with products of this type is an atypical, often even defective taste. A particular problem in the field is also that these prod-

ucts cannot be called cheese. The sales of these products is limited and they are in demand primarily when a consumer wishes to pay attention to the compliance of the product with dietary recommendations and not when the consumer buys indulgence products.

[0006] The shelf life of soft cheese is also known to be limited by enzyme activities inherent to milk and included in starters, in particular proteolytic enzyme activities. During the ripening of cheese, various deterioration phenomena also depend on the temperature, acidity, etc. Undesired defective alterations in taste, structure, etc. are emphasized during storage in particular.

[0007] In general, a problem with soft, semi-soft, semi-hard, and hard cheese preparation methods that comprise increasing the water content and/or prolonged ripening is that as the structure of cheese or cheese-like product changes, its taste also changes significantly. The taste is not pure but the cheese or cheese-like product often has a bitter or acrid (rancid, lipolyzed, soapy) taste as a result of lipolysis especially toward the end of its shelf life. In addition, known methods are characterized in that products requiring a long shelf life have structural problems even during their shelf life. Typically, cheese or a cheese-like product 'weeps', in other words, whey is separated, and especially products of long ripening periods have a sticky, salve-like, pasty structural defect due to lipolysis and proteolysis.

[0008] The fractionation of milk fat and the use of fractionated fat in baking industry, confectionery industry, and dairy products are known. Dairy product applications include spreadable food fats and milk-based spreads in which a fraction having a low melting point is used to improve the spreadability, plasticity, hardness, and mouth-feel.

[0009] Published EP application 0 095 001 A1 discloses a method for making a milk-based emulsion by separating high and low melting fractions from butter oil and making an oil-in-water emulsion of these fractions together with a partially skimmed milk fraction. An emulsion made of low melting butter oil may be used to produce soft cheese and one made of high melting butter oil may be used to produce hard cheese.

[0010] Retail trade and consumers demand more and more indulgence products that are soft in structure and, in particular, well preserved. The preservability of conventional soft gourmet cheeses is problematic. Thus, it is desirable to provide products whose organoleptic properties, such as taste and

structural preservability, are improved, whereby the shelf time of the products can be lengthened in the desired manner.

[0011] Unexpectedly, completely flawless in taste and well-preserving cheeses and a method for their manufacture without any specific additional costs have now been invented. The cheeses of the invention are, according to the composition classification of cheese standards, soft, semi-soft, semi-hard or hard cheeses. The improved preservability of the cheeses of the invention makes it possible for these cheeses to have a longer than conventional shelf time in comparison with known cheeses that have been softened by increasing their water content. With the method of the invention, it is possible to make softer than usual cheeses, the preservability of which is nonetheless not shortened.

BRIEF DESCRIPTION OF THE INVENTION

[0012] The invention provides a new cheese that is characterized by what is stated in the independent claim. Preferred embodiments of the invention are disclosed in the dependent claims. The invention also relates to a method for the manufacture of cheese.

[0013] It has been unexpectedly found that the cheese of the invention has a completely flawless taste, it keeps well, and the hardness of the structure of the cheese may be controlled with a butter oil fraction. The cheese of the invention is classified as a soft, semi-soft, semi-hard, or hard cheese. With the invention it is thus possible to obtain a soft, semi-soft, semi-hard, or hard cheese with a softer or harder than usual mouth-feel. In addition, the product of the invention has improved preservability, which makes possible a longer than conventional shelf life in comparison with known cheeses, and structural defects, such as weeping, i.e. whey separation - typical of soft cheeses in particular - and taste defects are minimized.

[0014] The products of the invention are cheeses that comply with the food code, laws, and regulations of EU and Finland, and the Codex General Standard for Cheese of FAO/WHO.

[0015] The invention also provides a method for the manufacture of cheese. All by-products obtained in the method of the invention are normal dairy products, and all secondary flows generated in the method may be utilized. The method does not produce products or secondary flows that should

be processed or separated in any specific manner differing from the conventional.

[0016] Making the cheese of the invention does not require specific equipment other than for adding fat. All other apparatuses used in cheese making are in accordance with known cheese making methods. For example, the production, ripening, and packaging methods and apparatuses of a soft or semi-soft mould cheese of the invention with a softer than usual mouth-feel, such as Aura® and brie, and a semi-hard cheese of the invention with a softer than usual mouth-feel, such as Oltermanni®, and a hard cheese of the invention with a softer than usual mouth-feel, such as emmental, are typical of those used in making said soft, semi-soft, semi-hard, and hard cheeses.

[0017] Without special investments, it is possible to make a softer than usual Aura®-type product that in the opinion of the consumer significantly differs in its organoleptic properties, especially in structure, from the present normal Aura®.

[0018] According to an embodiment of the invention, the water content of the fat-free portion of the cheese does not differ from that of a corresponding known product, so softening the cheese by using low melting fat does not shorten the preservability of cheese.

[0019] In known methods, the replacement of milk fat with a different vegetable fat, generally oil, often causes an atypical, even defective taste. The product is also classified as a cheese-like product and not as cheese. The organoleptic properties, especially taste, of the cheese of the invention and the preservation of the structure have improved, which leads to a longer shelf life of the cheese.

[0020] In addition, it is possible to reduce hygiene risks in the production.

[0021] The invention also relates to a method that is simple, economic, and industrially applicable on a large scale, and does not cause additional costs.

[0022] The invention also relates to cheese with altered organoleptic properties and made with the method of the invention.

[0023] The invention further relates to the use of a butter oil fraction in altering the organoleptic properties of cheese.

BRIEF DESCRIPTION OF FIGURES

[0024] Figure 1 shows the hardness/firmness of cheese in the required maximum strength [MAX (g)]. The figure shows the median, minimum, maximum, and high and low quartiles of samples. Values lower than the low quartile (25%) comprise 25% of the measuring results and values higher than the high quartile (75%) comprise 25% of the measuring results.

DETAILED DESCRIPTION OF THE INVENTION

[0025] The present invention relates to cheese that is characterized in that it contains a butter oil fraction. The structural hardness of the cheese of the invention may be controlled by selecting a desired butter oil fraction. In a specific embodiment of the invention, the mouth-feel of the cheese is softer than expected according to the composition classification made on the basis of the water content of the fat-free portion (MFFB%, Moisture on a Fat-Free Basis). The invention is thus characterized in that the composition classification of the cheese remains the same even though its organoleptic properties have changed in comparison with the typical organoleptic properties of a cheese in said composition class.

[0026] The cheese of the invention may be of any type. A cheese with a desired composition and properties is composed of different fractions and other ingredients. In a specific embodiment of the invention, the cheese is soft, semi-soft, semi-hard, or hard, and softer in mouth-feel than the conventional cheese. The cheese is especially a full fat or high fat soft cheese. More especially, the cheese is a full fat or high fat soft mould cheese.

[0027] It is known in the field to classify cheese by firmness (hardness) and ripeness. According to the established practice in the field, cheeses are classified using their composition on the basis of the water content of the fat-free portion (MFFB%) as follows: extra hard (Parmesan, MFFB% at most 51 wt%), hard (emmental, MFFB% 49 to 56 wt%), semi-hard (edam, Oltermanni®, Polar®, MFFB% 54 to 63 wt%), semi-soft (Aura®, MFFB% 61 to 69 wt%), and soft (camembert, brie, MFFB% at least 67 wt%).

[0028] The terms soft, semi-soft, semi-hard (firm), hard, and extra hard are expressly defined in FAO/WHO Codex General Standard for Cheese A-6-1968. Thus, in this application

soft cheese refers to cheese with a water content of its fat-free portion over 67 wt%,

semi-soft cheese refers to cheese with a water content of its fat-free portion 61 to 69 wt%,

semi-hard cheese refers to cheese with a water content of its fat-free portion 54 to 63 wt%,

hard cheese refers to cheese with a water content of its fat-free portion 49 to 56 wt%,

extra hard cheese refers to cheese with a water content of its fat-free portion less than 51 wt%.

[0029] According to their fat content, cheeses are classified as follows:

high fat: fat in dry matter at least 60 wt%,

full fat: fat in dry matter at least 45 wt%, but less than 60 wt%,

medium fat: fat in dry matter at least 25 wt%, but less than 45 wt%,

partially skimmed: fat in dry matter at least 10 wt%, but less than 25 wt%,

skim: fat in dry matter less than 10 wt%.

[0030] Established cheese names include emmental, gryere, edam, gouda, mini-gouda, blue mould cheese, camembert, cheddar, tilsit, portsalut, romadur, and brie, whey cheese, Finnish full-fat cheese, egg cheese, 'leipäjuusto' (cheese bread), cottage cheese, milk quark, and fromage frais. An established name can be used for a product representative of the name even though the product name does not have an international standard.

[0031] Typical cheese types of the present invention are edam, emmental, gouda, havarti, parmesan, and known trademarks, such as Jarlsberg®, Oltermanni®, Turunmaa®, and Finlandia®. The cheeses are examples of hard and ripened cheeses. Another important product application group for the invention is mould cheeses. In a specific embodiment of the invention, the cheeses are soft, semi-soft, semi-hard, or hard cheeses with a softer than usual mouth-feel. If necessary, it is possible to produce harder than usual soft, semi-soft, semi-hard, or hard cheeses with the invention.

[0032] Blue mould cheeses are generally semi-soft cheeses (water content of the fat-free portion 61 to 69 %). A soft cheese-type (MFFB% >67%) product (Blå Castello) has been in the market for years. This product differs clearly from Aura and other semi-soft blue mould cheeses, and its preparation, ripening, and packaging methods and apparatuses are those typically used in the production of soft cheeses (brie, for instance).

[0033] According to a specific embodiment of the invention, the softer than usual soft, semi-soft, semi-hard, or hard cheese of the invention does not organoleptically differ in composition from normal cheese, the difference is only in the structure and mouth-feel. The blue mould cheese of the invention having a softer than usual mouth-feel as described in example 1, for example, is statistically significantly ($p < 0.05$) softer than the comparison cheese by approximately 20%. The hardness/firmness of the cheeses was measured with a TAXT structure measuring method. The TAXT method is described in publications Sousa M.J., McSweeney, P.L.H. "Studies on the ripening on Cooleney, an Irish farmhouse Camembert-type cheese," Irish Journal of Agricultural and Food Research 40 (2001) 83–95, Hallab, R., Kohen, C., Grandison, M.A., Lewis, H.J., Grandison A.S., "Assessment of the quality of cottage cheese produced from standard and protein-fortified skim milk," International Journal of Dairy Technology 60(2) (2007) 69–73, and Almena Aliste, M., Kindstedt, P.S., "Effect of increasing pH on texture of full and reduced-fat cream cheese," Australian Journal of Dairy Technology, 60(3) (2005) 225–230.

[0034] The cheese of the invention is characterized in that it contains a butter oil fraction. In a specific embodiment of the invention, the entire fat content of the milk raw material of the cheese contains 0.1 to 100% of butter oil fraction. Preferably, the milk fat contains 50 to 100%, more preferably 100 % of butter oil fraction. In another specific embodiment of the invention, the butter oil fraction is a low melting, medium melting, or high melting butter oil fraction. The melting point of the low melting butter oil fraction is approximately 5 to 12°C, the melting point of the medium melting butter oil fraction is approximately 18 to 22°C, and the melting point of the high melting butter oil fraction is approximately 38 to 42°C. In a preferred embodiment of the invention, the cheese comprises a butter oil fraction with a low melting point, whereby a softer than usual soft, semi-soft, semi-hard, or hard cheese is obtained. As mentioned above, a harder than usual soft, semi-soft, semi-hard, or hard cheese may be obtained by using a high melting butter oil fraction.

[0035] In connection with the present invention, milk raw material refers to milk components having different fat, protein, and lactose contents. Milk raw material may also be supplemented with ingredients used generally in cheese making, such as fat, protein, or sugar fractions. Thus, milk may be full-fat milk, cream, partially skimmed milk, or skim milk, ultrafiltered milk, diafil-

tered milk, microfiltered milk, or milk recombined from milk powder, organic milk, or a combination thereof.

[0036] In the present invention, butter oil cream refers to a mixture comprising a butter oil fraction and part of the milk raw material. Preferably, skim milk is used as the milk raw material of the butter oil cream. The fat content of the butter oil cream may vary from 10 to 50%, but most preferably 25 to 30%, especially 25% fat contents are used.

[0037] In the present invention, whey cream refers to a whey mixture comprising a butter oil fraction and whey. The whey may be acid or rennet whey. The fat content of this emulsion, whey cream, may vary from 10 to 50%, but most preferably 25 to 30%, especially 25% fat contents are used.

[0038] In the present invention, kettle milk refers to the milk composed of the butter oil fraction, the entire milk raw material and possibly whey, to which a starter and possibly rennet and other necessary ingredients are added. In the present invention, a mixture made of butter oil cream, for instance 25-percent butter oil cream, and skim milk is used as kettle milk. In another preferred embodiment, the kettle milk is a mixture of whey cream and skim milk. In yet another preferred embodiment, the skim milk is partly or entirely (0.1 to 100%), preferably by 20%, replaced with ultrafiltered or microfiltered protein concentrate, milk powder and/or recombined milk powder. Kettle milk may thus be composed of milk components having different fat and protein contents.

[0039] Normal cheese is made by standardizing the fat content of the milk raw material at a desired level. The most commonly used method is to separate the entire amount of milk, and to return from the separator to the skim milk an amount of cream that produces the required fat content to the mixture. The same may be done by mixing skim (fat-free) milk and full fat milk at a desired ratio.

[0040] As described above, the milk fat in the milk raw material is in the present invention replaced to a degree of 0.1 to 100% by a butter oil fraction. In an embodiment of the invention, the entire milk fat content is replaced by a low melting butter oil fraction, in which case the low melting butter milk fraction has been added to skim milk to prepare the butter milk cream, and this butter milk cream has further been added to skim milk to obtain kettle milk. In another embodiment of the invention, some of the milk fat is replaced by a low melting butter oil fraction, and instead of the above-mentioned skim milk, the

milk raw material is milk with a standardized fat content. This type of milk raw material can be used in the preparation of either butter milk cream or kettle milk or both.

[0041] In yet another preferred embodiment, the butter oil fraction is added directly to the entire kettle milk amount, that is, to the entire milk raw material, or a combination of it and whey to obtain an emulsion, colloidal mixture or dispersion in a known manner, preferably by high pressure spraying.

[0042] According to the invention, it is also possible to obtain a harder than usual soft, semi-soft, semi-hard, and hard cheese, when the milk fat is replaced with a high melting butter oil fraction.

[0043] A preferred embodiment of the invention relates to a throughout the interior ripened softer than usual hard or semi-hard cheese which is made using whey cream. The use of whey cream ensures that the curdling properties of casein do not change during the preparation process (homogenization) of the cheese.

[0044] The invention therefore also relates to a method for the preparation of the above-mentioned cheese, and the method comprises the following steps:

mixing a butter oil fraction with part of the milk raw material, whey or a combination thereof,

heating the obtained mixture to approximately 50°C,

emulsifying the mixture to obtain an emulsion,

optionally heat treating and cooling the emulsion,

adding the obtained emulsion to the milk raw material or the rest of the milk raw material to obtain kettle milk,

heat treating the kettle milk and cooling it to approximately 30°C,

adding a starter and possibly rennet and other required additives to the kettle milk,

curdling, cutting, stirring, possibly heating, pressing, salting, and ripening the kettle milk.

[0045] The invention also relates to a method for the manufacture of the above-mentioned cheese, and the method comprises the following steps:

mixing a butter oil fraction with kettle milk composed of the milk raw material and possibly whey,

heat treating the kettle milk and cooling it to approximately 30°C,

adding a starter and possibly rennet and other required additives to the kettle milk,

curdling, cutting, stirring, possibly heating, pressing, salting, and ripening the kettle milk.

[0046] In a preferred embodiment of the invention, the invention relates to a method for the manufacture of a softer than usual semi-soft blue mould cheese, and the method comprises the following steps:

mixing a low melting butter oil fraction with skim milk,

heating the obtained mixture to approximately 50°C,

emulsifying the mixture through strong stirring to obtain an emulsion,

optionally heat treating and cooling the emulsion,

adding the obtained cooled butter oil cream to skim milk to obtain kettle milk,

heat treating the kettle milk and cooling it to approximately 30°C,

adding a starter, blue mould starter, and rennet to the kettle milk,

cutting, and stirring the obtained curd, draining it in moulds, salting, and ripening it.

[0047] In another preferred embodiment of the invention, the invention relates to a method for the manufacture of a softer than usual hard cheese, and the method comprises the following steps:

mixing a low melting butter oil fraction with whey,

heating the obtained mixture to approximately 45°C,

emulsifying the mixture to obtain an emulsion,

adding the obtained whey cream to skim milk to obtain kettle milk,

heat treating the kettle milk and cooling it to approximately 30°C,

adding a starter and rennet to the kettle milk,

cutting, stirring, heating, pressing, salting, and ripening the obtained curd.

[0048] The method of the invention uses art known per se in the field to obtain the emulsion, colloidal mixture, or dispersion, when the milk fat in the milk raw material or part of it is replaced with a required amount of butter oil fraction. It is possible to use known methods such as strong stirring, homogenization, and high pressure spraying to form the emulsion, colloidal mixture, or dispersion.

[0049] The method of the invention uses art known per se for the heat treatment of the milk raw materials, including cream. Examples of heat treatments used in the method of the invention include pasteurization, high pasteurization, or heating at a temperature lower than the pasteurization temperature for a sufficiently long time. Especially worth mentioning are UHT treatment (milk 138°C, 2 to 4 s), ESL treatment (milk 130°C, 1 to 2 s), pasteurization (e.g. milk 72°C, 15 s), or high pasteurization (95°C, 5 min). The heat treatment may be direct (vapour in milk, milk in vapour) or indirect (tube heat exchanger, plate heat exchanger, scraped-surface heat exchanger). The method of the invention preferably uses pasteurization.

[0050] The method of the invention preferably uses butter oil cream to add the low melting butter oil fraction, whereby soft or semi-soft mould cheese is obtained, and high pressure spraying, whereby semi-hard cheese, such as Oltermanni®, or hard emmental is obtained.

[0051] Before making the cheese, the milk raw material is standardized, that is, the fat content and, if necessary, the protein content of the milk is adjusted to a correct ratio and the milk is heat treated in a suitable manner, for instance pasteurized. However, it is also possible to use unpasteurized milk. Different bacteria separation processes may also be used. The thus obtained milk raw material is transferred to a cheese vat at a suitable temperature, for instance 31°C. Butter oil cream or whey cream or the like, in other words, the milk raw material in the butter oil fraction, starter, possibly rennet, and other necessary additives and ingredients are added to the vat. Cheese making steps after this are: coagulation, that is, curdling of milk, cutting the curd, stirring and possible heating of the cheese curd mixture, draining the curd or pressing it into a desired form, salting the cheeses, and storage, that is, ripening. The intention is to obtain a suitable granulate size and hardness for the selected cheese type in the vat. By stirring and heating and using other such methods, the curd can be made such that the pressing/draining in a later step produces a good-quality cheese in water and fat content.

[0052] Blue mould cheeses are made with a method that differs from that of most other cheeses. For instance, when making Aura®, homogenized, approximately 25-percent butter oil cream is added to skim milk in an amount sufficient to make the final fat of the milk used in making the cheese typical of the cheese in question. In an embodiment of the method of the invention, a mixture with approximately 25% fat is made from skim milk and a low

melting butter oil fraction. This mixture is homogenized and combined with skim milk in the same manner as in the preparation of Aura®. By replacing the skim milk with partially skimmed cream in making the above-mentioned butter oil cream, it is possible to replace only part of the milk fat with a low melting butter cream fraction. The milk raw material may also be non-homogenized.

[0053] An example of an especially preferred embodiment of the invention for the manufacture of a well preserving semi-soft mould cheese with a softer than usual mouth-feel is described in Example 1 and of a well preserving hard cheese with a softer than usual mouth-feel is described in Example 2.

[0054] In the invention it is also possible to use different starters and starter mixtures in making the cheese mass. The starter is a one-strain, multi-strain, mixed strain or mixed multi-strain starter. Most usual starters include a mesophilic starter, for example, starters obtained from the companies Christian Hansen and Danisco, a propionibacterium, for example Valio PJS, and a taste giving adjunct, for example Valio Lb 161. An example of another cheese type is Oltermanni® that is made using a mesophilic starter, typically CHN 19. The starter and its amount depend on the cheese type and used conditions. The amount of the starter is conventionally 0.5 to 2%, typically 0.7 to 0.8%.

[0055] An example of a preferred embodiment of the method of the invention is to add to kettle milk a bulk starter (1% of the milk amount), blue mould starter (0.5 ppm of the milk amount) and rennet (0.06 ppm of the milk amount) when making a blue mould cheese of the invention with a softer than usual mouth-feel. According to the invention, it is also possible to replace the bulk starter with a DVS starter (0.01 to 0.03% of the milk amount).

[0056] In mould cheeses blue and white mould starters are used. As the starter for a blue mould cheese, a mesophilic lactococcal starter and a blue mould culture and rennet are used. In white mould cheeses, the mould typically grows on the surface of the cheese (*Penicillum camembert*; Brie, camembert). An example of an interior cheese mould is *P. roqueforti* of blue mould cheeses (Roquefort, danablu, gorgonzola, stilton).

[0057] Cheeses made with the method of the invention are salted in brine or with dry salt, and ripened in the manner known in the art.

[0058] The ripening time of mould cheese in ripening boxes is approximately three weeks at a temperature of 10°C. After sufficient mould formation, the cheeses are cooled and cold stored (1 to 3°C) to prevent excessive mould growth and delivered for sale.

[0059] The method of the present invention is suitable for the manufacture of all types of cheeses. A cheese of a required composition and properties is composed of different fractions and other ingredients. The method is suitable for the manufacture of a soft, semi-soft, semi-hard, and hard cheese with a softer than usual mouth-feel. The method is especially suitable for the manufacture of a soft full fat and high fat cheese. Even more especially, it is used to prepare a soft full fat and high fat mould cheese.

[0060] The water content of cheese largely determines the preservability of cheese types. Cheese fat content and the water content of the fat-free portion largely determine the consistency of the cheese mass.

[0061] The fat content of the final cheese phase may vary from below 5% to even over 50% (w/w), typically it is 10 to 30%, and preferably 25 to 30%. The milk fat in the cheese of the invention may be replaced either completely or partly with a butter oil fraction.

[0062] The organoleptic properties of the well-preserving cheese of the invention do not degrade during storage. The method is easy to implement in production conditions without significant extra costs.

[0063] The method of the invention is also suitable for modern component manufacture, in which milk components of different fat, protein, and lactose contents are combined in a known manner only just before cheese-making.

[0064] The method of the present invention may be applied to both batch and continuous production. Preferably the method of the invention is implemented as a batch process.

[0065] The invention also relates to a cheese with altered organoleptic properties and which is made with the above-mentioned methods of the invention. A particular embodiment of the invention relates to a cheese with a mouth-feel that is softer than that of a cheese in the same composition class.

[0066] As presented above, the hardness or firmness of the structure of cheese may be adjusted using a butter oil fraction without degrading the taste properties and preservability of the cheese. Thus, the invention also relates to the use of a butter oil fraction in altering the organoleptic properties of cheese. In an embodiment of the invention, the butter oil fraction is used to adjust the hardness of the cheese. In another embodiment of the invention, a low melting butter oil fraction is used to obtain a cheese with a mouth-feel that is softer than the typical mouth-feel of the cheese type in question.

[0067] The following examples illustrate the invention, but do not limit it to these embodiments.

Example 1: The preparation of a semi-soft Aura®-type mould cheese with a softer than usual mouth-feel

[0068] For the preparation of a blue mould cheese, "butter oil cream" was made from skim milk and a low melting butter oil fraction. In the preparation of the butter oil cream, 75% of skim milk and 25% of butter oil were used. The raw materials were mixed and heated to approximately 50°C. The mixture was emulsified by strong stirring. The emulsified mixture was pasteurized (72°C/10 min) and homogenized (160 bar/30 bar). The mixture was cooled to +4°C. The fat content of the butter oil cream was approximately 25%.

[0069] For the preparation of kettle milk for blue mould cheese, 55 l of butter oil cream was combined with 195 l of skim milk. The addition was done to the milk flow prior to pasteurization (72°C/15 s). The temperature of the kettle milk was adjusted to 34°C. To the vat were added, 2.5 l of an LD bulk starter (1 wt% of the milk amount), blue mould starter (0.5 ppm of the milk amount) and rennet (0.06 ppm of the milk amount). The curd was cut when a sufficient hardness had been achieved (approximately 30 min). After cutting the curd was let stand (approximately 30 min), after which a careful stirring was started (approximately 100 min). After stirring, the mass was inserted in moulds, salted, and ripened for approximately three weeks at 10°C.

[0070] A comparison cheese was made like the test cheese, but 25-percent cream was used instead of butter oil cream.

Hardness/firmness of the cheese with the TAXT structure measuring method

[0071] The hardness/firmness of tempered (20°C, at least 16 h, number of pieces n = 12 to 14) cheeses was measured with the TAXT structure measuring method. The hardness/firmness of the blue mould cheese according to the invention prepared in example 1 was compared with a typical Aura® cheese. In the TAXT method, a measuring head (diameter 5 mm) penetrates the sample to a depth of 10 mm at a standard rate of 1 mm/s. The required maximum strength (g) represents the hardness/firmness of the sample. The difference in samples was examined statistically using the Tukey HSD test.

[0072] Table 1 shows the penetration measurement results and Figure 1 the maximum force [Max (g)] representing the hardness/firmness of the sample. The comparison cheese was Aura®. The test cheese of the invention was statistically significantly (Tukey HSD test, $p < 0.05$) approximately 20% softer than the comparison cheese.

Table 1: Penetration measurement results of cheeses

Softness	Mean (g)	SD (g)	CV (%)	N (pcs)	Min (g)	Max (g)
Comparison	355.85	42.007	11.80	12	262.02	420.43
Test cheese	265.26	30.793	11.61	13	224.90	315.40

Example 2: The preparation of a softer than usual hard cheese of the invention (emmental)

[0073] For the preparation of emmental cheese, a mixture, soft whey cream with a fat content of 25%, was prepared from high heated whey (95°C, 20 min), 75%, and a low melting butter oil fraction, 25%, through strong stirring. The raw materials were mixed at a temperature of 45°C and homogenized (40 bar).

[0074] To prepare kettle milk, the soft whey cream (1 467 l) and skim milk (11 633 l) were combined. The fat content of the kettle milk was 3.1%. The kettle milk was pasteurized (72°C, 15 s) and cooled to a curdling temperature (32°C) and led to a cheese vat.

[0075] In the cheese vat, starters (*Lactobacillus helveticus*, *Streptococcus thermophilus*, and propionibacteria) were added to the kettle milk. To improve curdling, calcium chloride and an appropriate rennet were added. The cheese was prepared in the normal manner, in other words, curdled, cut, heated with a typical program, stirred, and an appropriate amount of water was added to obtain the required cheese curd during approximately 180 min. The curd was moved to a discharge vat. After a suitable pressing time (10 to 20 h), the cheese was moved to salting in blocks of approximately 40 to 80 kg, and salted in brine (1 to 2 days), packed in a plastic film, and moved to ripening.

[0076] The water content of the fat-free portion (MFFB%) of the hard cheese prepared according to the method of the invention corresponded to the water content, 53 to 54%, of the fat-free portion of a conventional emmental cheese, and the fat content of the cheese was approximately 30%. The cheese was well preserving, but due to the soft fat its mouth-feel corresponded to the structure of a semi-hard cheese of a clearly higher water content and of a fat-free portion water content of 56 to 57%.

[0077] The softer than usual hard cheese made with the method of the invention (emmental) endures well long transport (approximately 5 weeks) and the buffer storage required by logistics (approximately 4 weeks), and the cheese still has a mouth-feel that is nearly as soft as that of a semi-hard cheese that does not endure the above-mentioned transport without change.

Example 3

[0078] Blue mould cheese was prepared as described in example 1, but in making the butter oil cream only 50% of the milk fat was replaced by a low melting butter oil fraction. In the preparation of the butter oil cream, 87.5% of cream was used with a fat content of 15%, and 12.5% of low melting butter oil fraction. The raw materials were mixed, emulsified, and homogenized according to example 1. The fat content of the butter oil cream was approximately 25%.

[0079] Kettle milk was prepared by combining the butter oil cream (55 l) and standardized milk (195 l), and blue mould cheese was prepared according to example 1. Half of the fat in the test cheese was made of a softer milk fat fraction. The cheese was harder than in example 1, but softer than the Aura® used as comparison cheese.

Example 4

[0080] Blue mould cheese was prepared as described in example 1, but 20% of the skim milk in the preparation of kettle milk was replaced by a UF protein concentrate.

[0081] Cheeses were also prepared in which 20% of the skim milk was replaced by an MF protein concentrate, milk (milk condensed by evaporation), milk powder, or recombined milk powder.

Example 5

[0082] Kettle milk was prepared by combining, during the filling of the cheese vat, a low melting butter oil fraction with skim milk by high pressure spraying (80 bar) at a temperature of approximately 30°C. Starters were added to the kettle milk, and emmental cheese was prepared as described in example 2.

CLAIMS

1. A semi-hard, hard, or extra hard cheese which contains a low melting or medium melting butter oil fraction.

2. A cheese as claimed in claim 1, which contains a low melting butter oil fraction.

3. A cheese as claimed in claim 2, in which the melting area of the low melting butter oil fraction is approximately 5 to 12°C.

4. A semi-soft or soft cheese which contains a high melting butter oil fraction.

5. A cheese as claimed in any one of claims 1 to 4, in which the fat proportion of the entire milk raw material contains 0.1 to 100%, preferably 50 to 100%, more preferably 100% of butter oil fraction.

6. A cheese as claimed in claim 5, in which the milk raw material comprises full-fat milk, cream, partially skimmed milk, skim milk, ultrafiltered milk, diafiltered milk, microfiltered milk, recombined milk from milk powder, organic milk, or a combination thereof.

7. A cheese as claimed in claim 6, which comprises a 10 to 50-percent, preferably 25 to 30-percent, especially 25-percent buttermilk cream formed of a milk raw material, preferably skim milk, and a butter oil fraction.

8. A cheese as claimed in claim 5, which comprises 10 to 50-percent, preferably 25 to 50-percent, especially 25-percent whey cream formed of whey and a butter milk fraction.

9. A cheese as claimed in any one of claims 1 to 8, the fat content of which varies from below 5% to over 50% (w/w), typically the fat content is 10 to 30%, preferably 25 to 30%, especially 25%.

10. A cheese preparation method comprising the following steps:

mixing a butter oil fraction with a portion of a milk raw material, whey or a combination thereof,

heating the obtained mixture to approximately 50°C,

emulsifying the mixture to obtain an emulsion,

optionally heat treating and cooling the emulsion,

adding the obtained emulsion to the milk raw material or the rest of it to obtain kettle milk,

heat treating the kettle milk and cooling it to approximately 30°C,

adding a starter, optionally rennet, and other required additives to the kettle milk,

curdling, cutting, stirring, optionally heating, pressing, salting, and ripening the kettle milk.

11. A method as claimed in claim 10, in which the butter oil fraction is emulsified into the milk raw material, whey, or a combination thereof in one or more steps.

12. A method as claimed in claim 10 or 11, in which the emulsification is done by homogenization, strong stirring, or high pressure spraying, preferably by homogenization.

13. A method as claimed any one of claims 10 to 12 for the preparation of a blue mould cheese, the method comprising the following steps:

mixing a low melting butter oil fraction with skim milk,

heating the obtained mixture to approximately 50°C,

emulsifying the mixture through strong stirring to obtain an emulsion,

optionally heat treating and cooling the emulsion,

adding the obtained cooled butter oil cream into skim milk to obtain kettle milk,

heat treating the kettle milk and cooling it to approximately 30°C,

adding a starter, blue mould starter and rennet to the kettle milk,

cutting the obtained curd, stirring it, draining it in moulds, salting and ripening it.

14. A method as claimed in any one of claims 10 to 12 for the preparation of emmental cheese, the method comprising the following steps:

mixing a low melting butter oil fraction with whey,

heating the obtained mixture to approximately 45°C,

emulsifying the mixture to obtain an emulsion,

adding the obtained whey cream into skim milk to obtain kettle milk,

heat treating the kettle milk and cooling it to approximately 30°C,

adding a starter and rennet to the kettle milk,

cutting the obtained curd, and stirring, heating, pressing, salting and ripening it.

15. A method as claimed in claim 13 for the manufacture of a blue mould cheese, the method comprising preparing 10 to 50-percent, preferably

25 to 30-percent, especially 25-percent butter oil cream from a low melting butter oil fraction and skim milk through strong stirring.

16. A method as claimed in claim 14 for the manufacture of an emmental cheese and comprising preparing 10 to 50-percent, preferably 25 to 30-percent, especially 25-percent whey cream from a low melting butter oil and whey through high pressure spraying.

17. A cheese manufacturing method comprising the following steps:

mixing a butter oil fraction into kettle milk formed of a milk raw material and possibly whey,

heat treating the kettle milk and cooling it to approximately 30°C,

adding to the kettle milk a starter, optionally rennet, and other required additives,

curdling the kettle milk, and cutting, stirring, optionally heating, pressing, salting, and ripening it.

18. A method as claimed in claim 17, in which the butter oil fraction is emulsified into the kettle milk in one or more steps.

19. A method as claimed in claim 17 or 18, in which the emulsification is done by homogenization, strong stirring, or high pressure spraying, preferably by homogenization.

20. A method as claimed in any one of claims 10 to 19, the method being performed by component manufacture, in which milk and whey components with different fat, protein, and lactose contents are combined into kettle milk.

21. A method as claimed in any one of claims 10 to 20, the method being a continuous or batch process, preferably batch process.

22. A cheese having altered organoleptic properties and made with the method of any one of claims 10 to 21.

23. A cheese as claimed in claim 22, the cheese having a softer mouth-feel than a cheese in the same composition class.

24. The use of a butter oil fraction in altering the organoleptic properties of cheese.

25. The use as claimed in claim 24, in which a low melting butter oil fraction is used.

26. The use as claimed in claim 24 or 25 for the adjustment of the hardness of cheese.

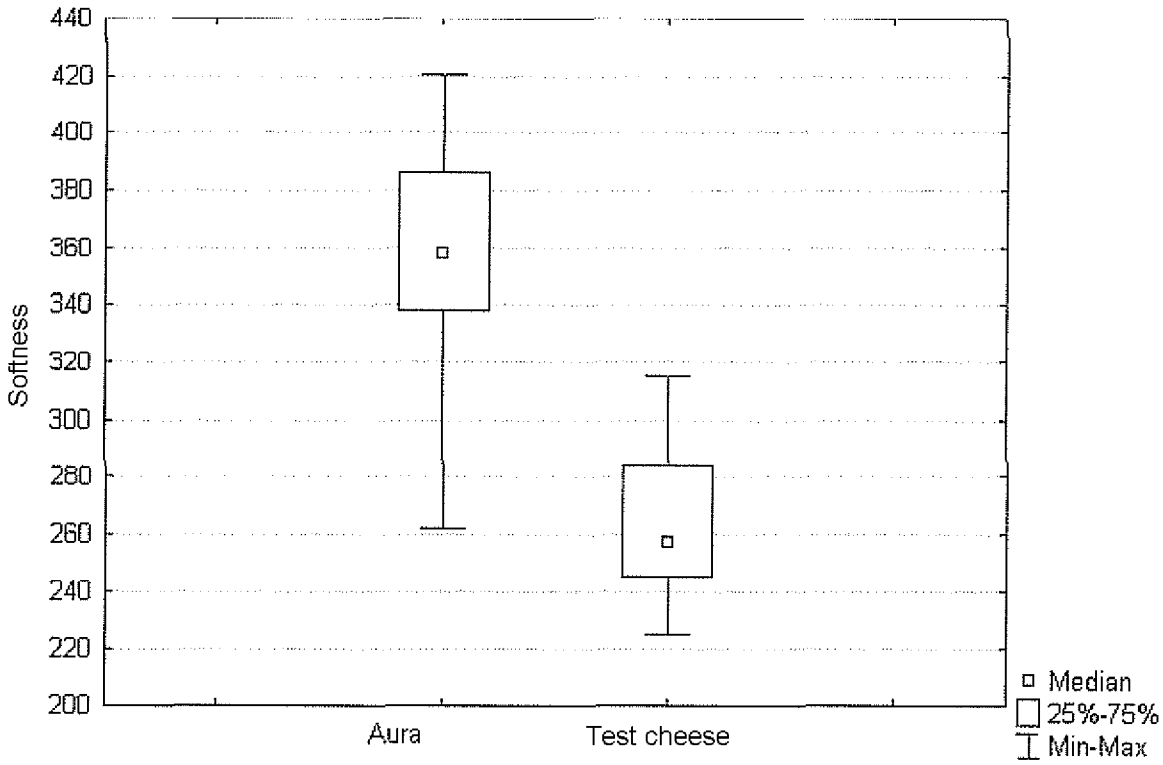
440
420
400
380
360
340
320
300
280
260
240
220
200
Softness
Aura
Test cheese
Median
25%-75%
Min-Max

Figure 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2008/050609

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: A23C

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

FI, SE, NO, DK

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

EPO-Internal, BIOSIS, FSTA, FROSTI, CAPlus

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	EP 0454268 A2 (FRIESLAND FRICO DOMO COOP) 30 October 1991 (30.10.1991)	
X	claims, examples	1, 2, 5-9, 24, 26
Y		3, 7-9, 20, 22, 23, 25
	EP 0095001 A1 (BRATLAND ARTHUR) 30 November 1983 (30.11.1983)	
X	claims, examples, p. 3 line 16 - p. 4 line 8, cited in the application	10-12, 17-21
Y		4, 7-23, 25
Y	GB 1253644 A (MACCOLLOM MARJORIE STILES) 17 November 1971 (17.11.1971), claims; p. 3, lines 68-81	4
Y	WAGENINGEN UNIVERSITY. Cheese production. [online],[retrieved on 2009-01-20] Retrieved from the Internet: http://web.archive.org/web/20070929083024/http://www.food-info.net/uk/dairy/cheese-production.htm, whole document	10-23
Y	EP 1106071 A2 (KRAFT FOODS INC) 13 June 2001 (13.06.2001), claims	3

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 January 2009 (26.01.2009)	19 February 2009 (19.02.2009)

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2008/050609

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3899605 A (SCHAAP JOHANNES EMMUS) 12 August 1975 (12.08.1975), whole document	1-26
A	JP 2001190221 A (SNOW BRAND MILK PROD CO LTD) 17 July 2001 (17.07.2001), & abstract [online] EPOQUENET EPODOC & WPI & machine translation into English [online] [retrieved on 2009-01-15]. claims; paragraph [0008]	1-26
A	GB 2324236 A (UNIV NORTH LONDON) 21 October 1998 (21.10.1998), whole document	1-26
A	FR 2156503 A1 (HUTIN HENRI FROMAGERIES - HUTIN HENRI FROMAGERIES) 01 June 1973 (01.06.1973), & abstract [online] EPOQUENET WPI	1-26

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2008/050609

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Extra Sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

The application lacks unity within the meaning of Rule 13.1 PCT. According to Rule 13.1 PCT, an application shall relate to one invention only or to a group of inventions so linked as to form a single general inventive concept. Further, according to rule 13.2 PCT, the requirement of unity of invention is fulfilled only when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. The expression "special technical features" means those technical features that define a contribution which each of the claimed inventions, considered as a whole, makes over the prior art.

The technical feature common to independent claims 10, 17, 22 and 24 is the use of a butter oil fraction in cheese. This feature is, however, not shared by the independent claims 1 and 4, in which the cheese is more specified. Neither do the claims 1 and 4 share between each other one or more of the same or corresponding technical features.
Consequently, the international application includes the following three inventions:

Invention I: Claims 1-3; and claims 5-9 when referring to claim 1

The invention relates to a semi-hard, hard, or extra hard cheese, which contains a low melting or a medium melting butter oil fraction.

Invention II: Claim 4; and claims 5-9 when referring to claim 4

The invention relates to a semi-soft or soft cheese, which contains a high melting butter oil fraction.

Invention III: Claims 10-26

The invention relates to preparation methods of cheeses containing a butter oil fraction.
The invention also relates to a cheese having altered organoleptic properties and made with the method of any one of claims 10 to 21.
The invention further relates to the use of a butter oil fraction in altering the organoleptic properties of cheese.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/FI2008/050609

Patent document cited in search report	Publication date	Patent family members(s)	Publication date
EP 0454268 A2	30/10/1991	JP 6062735 A	08/03/1994
		US 5268190 A	07/12/1993
		IE 911379 A1	06/11/1991
		DK 454268T T3	24/06/1996
		DE 69117569T T2	01/08/1996
		NL 9001692 A	18/11/1991
		NL 9001001 A	18/11/1991
EP 0095001 A1	30/11/1983	AT 29646T T	15/10/1987
GB 1253644 A	17/11/1971	None	
EP 1106071 A2	13/06/2001	AU 784071B B2	02/02/2006
		AU 7210500 A	14/06/2001
		CA 2327424 A1	07/06/2001
US 3899605 A	12/08/1975	PH 10634 A	21/07/1977
		JP 50123848 A	29/09/1975
		IT 995288 B	10/11/1975
		GB 1439184 A	09/06/1976
		DE 2344763 A1	21/03/1974
		BE 804484 A2	05/03/1974
		FR 2197522 A1	29/03/1974
		NL 7212074 A	07/03/1974
JP 2001190221 A	17/07/2001	None	
GB 2324236 A	21/10/1998	None	
FR 2156503 A1	01/06/1973	None	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2008/050609

CLASSIFICATION OF SUBJECT MATTER

Int.Cl.
A23C 19/00 (2006.01)
A23C 19/068 (2006.01)
A23C 13/14 (2006.01)
A23C 15/14 (2006.01)