

Description

Title of Invention: PROCESSED CHEESE AND MANUFACTURING METHOD THEREFOR

Technical Field

The present invention relates to a heat-resistant processed cheese and a manufacturing method therefor. The present invention further relates to a processed cheese which exhibits reduced "stickiness" and improved "meltability in the mouth" and a manufacturing method therefor.

In the present invention, "processed cheese" includes those specified in the Ministerial Ordinance on Milk and Milk products Concerning Compositional Standards, etc. (the Ministry of Health and Welfare Ordinance No. 52, December 27, 1951) and the ingredient standards of Fair Competition Code, such as processed cheese and cheese food, as well as all types of cheeses having an ordinary meaning in the technical field, such as food mainly made from milk and the like.

Background Art

Processed cheeses account for about half of the amount in the recently growing cheese market in Japan. Basic steps in processed cheese manufacturing include a blending step in which natural cheeses are crushed and mixed with emulsifying salts and water, an emulsifying step in which the mixed raw materials are kneaded and stirred under heating to be emulsified, and a cooling and shaping step in which the emulsified cheese is cooled and shaped. Additionally, various food materials and food additives may be added in order to impart physical properties or a flavor to cheese, or treatment such as creaming in which stirring is

continued after emulsification for a predetermined time may be carried out in order to adjust the cheese physical properties of final products.

One of the characteristics of processed cheese which natural cheese lacks is that products in a variety of shapes can be manufactured in conformance with filling containers. Various types of processed cheeses having functionalities such as heat-meltability, stringiness, and heat resistance imparted have been also provided recently. Of these, heat resistance is one of the important functions in using processed cheese in various cooking and industrial processed foods.

Examples of a method for imparting heat resistance to a processed cheese disclosed include a method in which natural cheeses having emulsifying salts and albumin added thereto is heated and emulsified (Patent Literature 1), a method in which natural cheeses having glucomannan added thereto is heated and emulsified (Patent Literature 2), and a method in which egg white is added to natural cheeses (Patent Literature 3).

Also disclosed are, for example, a method in which natural cheeses having emulsifying salts added thereto is heated to 90 to 120°C and melted, and the emulsified cheese is maintained at a high temperature (Patent Literature 4), a method in which an emulsified cheese is sequentially irradiated with microwaves (Patent Literature 5), and a method in which an emulsified cheese is shaped and packaged and then subjected to heat treatment (Patent Literature 6).

Thus, a processed cheese can be obtained by heating and melting various types of natural cheeses as raw materials with emulsifying agents called emulsifying salt, while making use of their flavor characteristics and physico-chemical characteristics. Emulsifying salts are available in various types. Their amount to be used, blending ratios, and subsequent emulsifying conditions can impart various characteristics to final products. Various considerations have been made by now from the viewpoints of flavors of processed cheese and manufacturing method

therefor, control of the physical properties depending on emulsifying conditions ascribed to devices, impartation of functionalities under consideration of usage applications of products, and the like. A large number of techniques have been established through contemplation on control of flavor development, and impartation of heat-melting and stringy characteristics, or conversely, functionalities such as heat-melting resistance.

The typical tastiness of cheese including processed cheese is considered to consist in the unique flavor of cheese itself, impartation of the milk feeling and mild feeling of milk products, and its ability to further enhance the tastiness of cheese dishes by allowing the characteristic functionalities such as appropriate heat-meltability and stringiness to develop. That is, the typical tastiness of cheese seems to be the flavor characteristics and the visual characteristics of heat-melting and stringiness.

When an attention is paid to mouthfeels of cheese, an example of typical cheese having a unique mouthfeel, which is recognized as tastiness of cheese, includes Mozzarella cheese. Mozzarella cheese is characterized by unique chewability and a chewy mouthfeel. It is often eaten as it is or used in salad and the like. It is also characterized by its heat-meltability. Another example includes fresh cheese and spread cheese, which are spreadable on bread and dishes by use of their softness. However, this is considered to be a method for utilizing such cheese to enhance the tastiness of the entire dish by combining cheese with some food materials, rather than to positively impart a mouthfeel for eating as it is. Accordingly, there are still few cases where positively imparting some types of mouthfeel to cheese is recognized as the tastiness of the cheese.

In organizing related arts on the mouthfeel of processed cheese, there are two trends. One includes a technique to impart the "identity of cheese." The technique is provision of a mouthfeel similar to that of natural cheese and processed cheese in

development of cheese food, food mainly made from milk, and furthermore, imitation cheese including general foods. The other includes creation of and search for "a new mouthfeel" of processed cheese. This seeks to positively impart a mouthfeel not possessed by processed cheese so far. For example, a rice-cake-like mouthfeel and a light mouthfeel have been being imparted.

In the meantime, "stickiness," a feeling that cheese sticks to the teeth or oral cavity when eaten as it is, is a characteristic frequently observed in processed cheese in Japan. "Stickiness" is a feeling that cheese persists indefinitely in the mouth, or a feeling that cheese is difficult to eliminate from the mouth. This feeling is recognized as a typical unfavorable mouthfeel of processed cheese.

Techniques to reduce "stickiness", which are unfavorable mouthfeels of processed cheese, and techniques to impart good "meltability in the mouth" of processed cheese have been contemplated in these several years. Examples of the technique include provision of a processing method in which a natural cheese is crushed, tableted, and molded to provide a brittle mouthfeel for easy eating (Patent Literature 7) and a method in which the content of insolubilized casein is controlled to 50% or less and pH to 6.0 or more during processed cheese manufacturing (Patent Literature 8).

Furthermore, as for the trend in the food industry in recent years, foods characterized by a keyword "mouthfeel" have become popular in the market. Of these, a mouthfeel of good "meltability in the mouth," which is represented by "melting pudding" and "half-cooked doughnut," is attracting attention. In order to be evaluated as having good "meltability in the mouth," it is believed that the food needs not only to be soft, but also, although the food gives hardness to a certain extent as the initial mouthfeel, to change the physical properties in the mouth instantaneously or in a short period and to generate a feeling that the food is

eliminated immediately by texture breakage by chewing, increased moisture by saliva, increased temperature by body temperature, and the like.

Citation List

Patent Literature

Patent Literature 1: Japanese Patent Laid-Open No. 52-7465

Patent Literature 2: Japanese Patent Application No. 9-294538

Patent Literature 3: Japanese Patent Laid-Open No. 8-308492

Patent Literature 4: Japanese Patent Laid-Open No. 2001-149008

Patent Literature 5: Japanese Patent Laid-Open No. 2002-369654

Patent Literature 6: Japanese Patent Publication No. 57-55380

Patent Literature 7: International Publication No. WO 2010/008056 A1

Patent Literature 8: Japanese Patent Laid-Open No. 2011-182656

Summary

Technical Problem

The processed cheeses obtained by the methods in Patent Literatures 1 to 3 have heat resistance, but suffer from problems of degradation in the flavor and texture due to addition of albumin and glucomannan, or of egg allergy caused by egg white. Additionally, the methods according to Patent Literatures 4 to 6 require a special step during or after the thermal emulsification. This is not preferable from the viewpoint of production efficiency and causes a problem of hardening the texture of a processed cheese to be obtained even if the cheese has heat resistance.

Thus, the processed cheese manufactured with the conventional techniques, despite having heat resistance, suffers from problems of degradation in the flavor, egg allergy, and hardened textures, and problems of requiring a step other than ordinary thermal emulsification and of having poor production efficiency.

Moreover, good "meltability in the mouth" of processed cheese, and "stickiness," which is an unfavorable mouthfeel of processed cheese, are recognized as conflicting feelings. No processed cheese having good meltability in the mouth as well as reduced "stickiness" has yet been developed.

The present inventors have believed that improvement in terms of reduction in "stickiness" of a processed cheese can be achieved by positively imparting a mouthfeel, that is, good "meltability in the mouth," to a processed cheese and have decided to engage in technological development toward reduction in "stickiness" and impartation of "meltability in the mouth."

Thus, it is an object of the embodiments disclosed herein to provide a processed cheese and a manufacturing method therefor, wherein the processed cheese has excellent heat resistance, a good flavor, and a soft texture and can be manufactured by a simple method without including a special step.

It is also an object of the embodiments disclosed herein to provide a processed cheese, a manufacturing method therefor, and a method for improving meltability in the mouth of a processed cheese, wherein the processed cheese has reduced "stickiness," which has been conventionally recognized as an unfavorable mouthfeel of processed cheese, improved "meltability in the mouth," which is a mouthfeel now preferred in the entire food industry, and a brittle mouthfeel characteristic.

Solution to Problem

The present inventors have found, as a result of intensive studies on factors influencing on the heat resistance of processed cheese, a processed cheese having excellent heat resistance obtained by adding a condensed phosphate of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more as an emulsifying salt, and a manufacturing method therefor thereby having completed the present disclosure.

The present inventors have also found that combining the condensed phosphate aforementioned with another specific emulsifying salt can reduce "stickiness," which is an unfavorable mouthfeel of processed cheese, can improve "meltability in the mouth," which is a preferred mouthfeel, and also can improve the mouthfeel of the cheese, thereby having completed the present disclosure.

Furthermore, the present inventors have found that use of the condensed phosphate aforementioned and a natural cheese having a maturity of 30% or more as a raw-material cheese can reduce "stickiness," without combined use of any other emulsifying salt, can improve "meltability in the mouth," which is a preferred mouthfeel, and can improve the mouthfeel of the cheese, thereby having completed the present disclosure.

That is, the present disclosure is as follows:

- (1) There is provided a processed cheese comprising a condensed phosphate which when dissolved or dispersed as a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more.
- (2) The processed cheese according to (1), wherein 0.5 to 5.0% by weight of the condensed phosphate is added to natural cheeses.
- (3) The processed cheese according to (1) or (2) aforementioned, wherein the cheese is shaped into cubes having a side of 10 mm, and has heat resistance of 80% or more when autoclaved at 121°C for 15 minutes;
wherein the heat resistance is calculated in accordance with the following expression:
$$\text{Heat resistance [\%]} = (\text{height of processed cheese after heating [mm]} / \text{height of processed cheese before heating [mm]}) \times 100.$$
- (4) In an embodiment, there is provided a method for manufacturing a processed cheese, wherein a condensed phosphate which when dissolved or dispersed as a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more is added.

(5) The method for manufacturing a processed cheese according to (4) aforementioned, wherein 0.5 to 5.0% by weight of the condensed phosphate is added to natural cheeses.

(6) In another embodiment, there is provided a method for manufacturing a processed cheese having excellent heat resistance by adding a condensed phosphate which when dissolved or dispersed as a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more.

(7) In another embodiment, there is provided a processed cheese characterized by comprising a condensed phosphate which when dissolved or dispersed as a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more and at least one emulsifying salt selected from water-soluble polyphosphates, diphosphates, monophosphates, and citrates.

(8) In another embodiment, there is provided a processed cheese characterized by comprising a condensed phosphate which when dissolved or dispersed as a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more and a natural cheese having a maturity index of 30% or more.

(9) In another embodiment, there is provided a method for manufacturing a processed cheese comprising:

a step of adding a condensed phosphate which when dissolved or dispersed as a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more, at least one emulsifying salt selected from water-soluble polyphosphates, diphosphates, monophosphates, and citrates, and a natural cheese;

a step of mixing and emulsifying the added raw materials to prepare cheese curd; and

a step of cooling the prepared cheese curd.

(10) In another embodiment, there is provided a method for manufacturing a processed cheese comprising:

a step of adding a condensed phosphate which when dissolved or dispersed as a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more and a natural cheese having a maturity index of 30% or more as a raw material;

a step of mixing and emulsifying the added raw materials to prepare cheese curd; and

a step of cooling the prepared cheese curd.

- (11) The method for manufacturing a processed cheese according to (9) or (10) aforementioned, wherein 1.0 to 3.0% by weight of the condensed phosphate is added to natural cheeses.
- (12) The method for manufacturing a processed cheese according to any of (9) to (11) aforementioned, wherein oxidized starch is further added as a raw material.
- (13) The method for manufacturing a processed cheese according to (12) aforementioned, wherein the amount of the added oxidized starch is 0.5 to 20% by weight to natural cheeses.
- (14) In another embodiment, there is provided a method for improving meltability in the mouth of a processed cheese, wherein the cheese is manufactured by adding a condensed phosphate which when dissolved or dispersed as a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more and at least one emulsifying salt selected from water-soluble polyphosphates, diphosphates, monophosphates, and citrates as raw materials of the processed cheese.
- (15) In another embodiment, there is provided a method for improving meltability in the mouth of a processed cheese, wherein the cheese is manufactured by adding a condensed phosphate which when dissolved or dispersed as a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more and a natural cheese having a maturity index of 30% or more as raw materials of the processed cheese.

In an aspect, there is provided a processed cheese comprising a condensed phosphate which when dissolved or dispersed as a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more, and wherein 0.5 to 5.0% by weight of the condensed phosphate is added to a natural cheese to form the processed cheese, wherein the cheese is shaped into cubes having a side of 10 mm and has heat resistance of 80% or more when autoclaved at 121°C for 15 minutes;

wherein the heat resistance is calculated in accordance with the following expression:

Heat resistance [%] = (height of processed cheese after heating [mm] / height of processed cheese before heating [mm]) $\times$ 100.

In another aspect, there is provided a method for manufacturing a processed cheese, the method comprising a step of adding 0.5 to 5.0% by weight of a condensed phosphate to a natural cheese, which when the condensed phosphate is dissolved or dispersed as a 1.0% aqueous solution adjusted to pH 6.0, the condensed phosphate has a turbidity of 2.0 or more.

Advantageous Effects

According to an embodiment of the present disclosure, a processed cheese having excellent heat resistance, a good flavor, and a soft texture and a manufacturing method therefor can be obtained by adding a condensed phosphate of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more without including a special step.

According to another embodiment of the present disclosure, a processed cheese having an improved mouthfeel, a manufacturing method therefor, and a method for improving meltability in the mouth of a processed cheese can be obtained by adding at least one emulsifying salt selected from water-soluble polyphosphates, diphosphates, monophosphates, and citrates or a natural cheese having a maturity index of 30% or more, in addition to the aforementioned condensed phosphate of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more, wherein the processed cheese exhibits reduced "stickiness" in the mouth when eaten, which has been conventionally recognized as an unfavorable mouthfeel of processed cheese as well as improved "meltability in the mouth," which is a preferred mouthfeel.

Brief Description of Drawings

[Figure 1] Figure 1 is a graph showing evaluation results of heat resistance of processed cheeses manufactured by conventional methods (comparative products 1 to 6).

[Figure 2] Figure 2 is a graph showing evaluation results of heat resistance of processed cheeses manufactured by a method of the present invention (Example products 1, 2, and 3).

[Figure 3] Figure 3 is graphs showing results of Example 8 and Test Example 9 in Comparative Example 1.

Description of Embodiments

A method to obtain a processed cheese of the present invention will be specifically described hereinbelow.

Examples of the natural cheese used as a raw material of a processed cheese of the present invention include, but are not particularly limited to, Cheddar cheese,

Gouda cheese, Edam cheese, Emmental cheese, Parmesan cheese, Camembert cheese, blue cheese, cream cheese, and cottage cheese. Types and maturity of a natural cheese, which are not particularly limited, may be designed so as to achieve the required physical properties and flavor in a final processed cheese to be obtained. Alternatively, two types or more of natural cheeses may be mixed and used.

A condensed phosphate used as an emulsifying salt in the present invention can be a condensed phosphate of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more. For the condensed phosphate, (1) a condensed phosphate was dissolved and dispersed in pure water under stirring with a stirrer so as to achieve a concentration of 1.0%, and adjusted to pH 6.0 using hydrochloric acid and the like. (2) Pure water was placed in an absorption cell of the standard size (optical path length: 10 mm) and calibrated with a spectrophotometer (manufactured by Hitachi, Ltd.). (3) Subsequently, the aqueous solution prepared in (1) was stirred sufficiently with a stirrer and placed in the absorption cell, and a transmittance at a wavelength of 660 nm was determined. The transmittance (A) can be calculated by $A (\%) = Y / X \times 100$, wherein X is the intensity of the light incident on the sample, and Y is the intensity of the light passed through the sample. Thus, turbidity was calculated in accordance with $\text{Turbidity} = -\text{Log}(A / 100)$ (Log is common logarithm).

Alternatively, a condensed phosphate of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more and a common emulsifying salt having a turbidity of less than 2.0, which is used in processed cheese manufacturing, can be combined, or a condensed phosphate of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more can be combined.

In the present invention, a pH adjuster used in the normal processed cheese manufacturing, such as organic acids, for example, sodium bicarbonate, citric acid, and lactic acid can be used to adjust the pH of a processed cheese. The processed cheese of the present invention is allowed to have a pH, after emulsified and cooled,

ranging from 5.0 to 7.0, preferably from 5.5 to 6.5. After adding 40 g of water to 12 g of a processed cheese and homogenizing with a homoblender (manufactured by NIPPON SEIKI CO., LTD.) for 3 minutes, the pH of the homogenized solution was measured with a pH meter (manufactured by HORIBA, Ltd.).

For emulsifying treatment of the present invention, any cooker used in the normal processed cheese manufacturing, such as kettle cooker, Stephan cooker, twin-screw cooker, and thermo cylinders, can be used without particular limitation. Production also can be made in the same operation as in the normal processed cheese manufacturing depending on each cooker. To describe a specific example, any natural cheese is crushed and mixed, and loaded into a kettle cooker (manufactured by Nichiraku Machinery Co., Ltd.). Water is added so as to allow the water content in the final product to be 43%, and a condensed phosphate of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more is added. Furthermore, sodium bicarbonate as a pH adjuster is added to the mixture. The number of revolutions of the stirring blades of the cooker is set to 150 rpm, and the cheese is warmed by blowing steam into the jacket of the cooker. When the temperature of the cheese reaches 85°C, warming and stirring are stopped. Sampling and cooling the cheese enables a processed cheese to be produced.

For a processed cheese of the present invention, sub-raw materials that can be used in processed cheeses, including milk products such as skim milk powder, butter, cream, whey powder, and butter milk powder, milk constituents, stabilizer, thickening polysaccharides, starch, modified starch, vegetable fat, carbohydrates, spices, and fragrances can be selectively used depending on each purpose, such as adjustment of the physical properties or adjustment of the flavor.

In the present invention, heat resistance was evaluated in accordance with the following method. The processed cheese shaped into cubes having a side of 10 mm

was autoclaved at 121°C for 15 minutes. Then, the heat resistance was calculated in accordance with the following expression:

Heat resistance [%] = (height of processed cheese after heating [mm] / height of processed cheese before heating [mm]) × 100.

The present invention can provide a processed cheese having excellent heat resistance, a good flavor, and a soft texture efficiently only with a normal emulsifying step without requiring a special step. The processed cheese obtained has a flavor equivalent to that of normal processed cheese, and has no problem of egg allergy from blending egg white.

(Second aspect of the present invention)

A second aspect of the present invention will be specifically described hereinbelow.

In the second aspect of the present invention, a processed cheese which exhibits an improved mouthfeel such as reduced "stickiness" and improved "meltability in the mouth" can be obtained by use of "at least one emulsifying salt selected from water-soluble polyphosphates, diphosphates, monophosphates, and citrates," or "a natural cheese having a maturity index of 30% or more" in addition to adding the "condensed phosphate of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more."

Good meltability in the mouth herein means not only that "meltability in the mouth" is good, but also that "stickiness," which has been recognized as an unfavorable mouthfeel of processed cheese, has been reduced.

Also in the second aspect of the present invention, a condensed phosphate used in manufacturing of a processed cheese is the same "condensed phosphate of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more" as aforementioned.

To describe specifically, a condensed phosphate used in the second aspect of the present invention is poorly-water-soluble or non-water-soluble one of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more. The turbidity can be determined by the method as aforementioned. A turbidity of the emulsifying salt of less than 2.0 reduces the mouthfeel. As a condensed phosphate used in the present invention, sodium, potassium, calcium salts, and the like that can be generally used in food can be used without particular limitation, provided that the salts satisfy the turbidity requirement.

The condensed phosphate has an average particle size of 5.0 to 100 μ m when prepared as a 1.0% aqueous solution of pH 6.0. The average particle size can be measured with a laser diffraction-scattering particle size distribution analyzer (manufactured by NIKKISO CO., LTD.), using a particle refractive index of 1.48 (a refractive index of sodium phosphate: a literature value was employed) and a dispersed solvent refractive index of 1.333 (a refractive index of water: a literature value was employed).

The mouthfeel of a processed cheese, which is a very abstract sensory feeling, needs to be evaluated in the present invention. Thus, the present invention employed the Time Intensity Method (TI Method), in which the time length from a point when chewing of the cheese is started to a point when elimination of the cheese is felt as an indicator is used in addition to sensory evaluation usually carried out. That is, good "meltability in the mouth," considered to be behavior of being eliminated in the mouth immediately, is likely to be represented by a shortness of time. In contrast, "stickiness," considered to be behavior of sticking to teeth or oral cavity and persisting indefinitely in the mouth, is likely to be represented by a length of time.

Examples of the natural cheese used in the present invention include, as in the first aspect of the present invention, but are not particularly limited to, natural

cheeses, such as semi-hard cheeses including Gouda cheese and Cheddar cheese normally used as raw materials of processed cheese, and hard cheeses including Parmesan cheese. These can be used singly or in mixture of two or more. The blending ratio can be determined in accordance with the flavor required in a final processed cheese obtained.

A higher maturity index of the natural cheese tends to represent a more preferable mouthfeel. Even a slightly lower maturity index does not particularly matter because combination of a condensed phosphate used in the processed cheese of the present invention with another emulsifying salt and a devised blending ratio can render the mouthfeel more preferable.

Use of a highly matured natural cheese having a maturity index of 30% or more, however, can provide a processed cheese having good meltability in the mouth, even if a condensed phosphate used in the present invention is not combined with another emulsifying salt.

The maturity index is calculated by the following expression:

$$\text{Maturity index (\%)} = (\text{Soluble nitrogen content} / \text{total nitrogen content}) \times 100$$

The total nitrogen content and the soluble nitrogen content were quantified by the following method.

To 10 g of a sample cheese weighed, 40 ml of a 0.5 M sodium citrate solution and 30 ml of warm water were added and homogenized. The solution obtained was fixed at a volume of 200 ml and used as a sample cheese solution.

As for the total nitrogen content, 10 ml of the sample solution aforementioned was taken as it was. As for the soluble nitrogen content, taken was 100 ml of the sample solution aforementioned, to which 10 ml of 1.41 N hydrochloric acid and 15 ml of water was added to bring the pH to 4.4. After precipitation of casein, the supernatant was filtered and 10 ml of the filtrate was used as a sample solution. Each sample was subjected to the Kjeldahl method to quantify the nitrogen content.

In the second aspect of the present invention, a condensed phosphate of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more is used as in the first aspect. The phosphate can be combined with another emulsifying salt to the extent that no problem with the mouthfeel occurs. Examples of the emulsifying salt to be combined include phosphates such as water-soluble polyphosphates, diphosphates, and monophosphates, and citrates. These can be used singly or in combinations of two or more. Basically, combining an emulsifying salt in a small amount not more than half the amount of the condensed phosphate mainly composed of poorly-water-soluble or non-water-soluble phosphate can achieve a preferable mouthfeel, but this does not always apply because a mouthfeel depends on combinations. Of course, combining an emulsifying salt is not necessarily required. When a highly matured natural cheese having a maturity index of 30% or more as a raw material as aforementioned is used, combining the condensed phosphate aforementioned with another emulsifying salt is not required.

Other sub-raw materials which can be used in the second aspect of the present invention are not particularly limited, as in the first aspect. Any raw materials can be blended provided that they are those used in manufacturing of processed cheese. Examples of other sub-raw materials include food additives, such as emulsifying agents other than emulsifying salts that can be used in processed cheese, stabilizers (thickening polysaccharides, modified starch such as oxidized starch, cellulose, and the like), and fragrances, as well as dairy materials as a milk protein source, food such as starch, gelatin, and agar, butter, other animal fats and oils, and vegetable fats and oils for fat adjustment, and seasonings used for flavoring.

Of these sub-raw materials, oxidized starch is preferably used as a physical-property modifier for processed cheese because the starch further improves meltability in the mouth and further reduces stickiness of a processed cheese to be obtained. Examples of the oxidized starch used as a starch source include, but are

not limited to, corn starch, potato starch, tapioca, and sago palm which have been subjected to oxidization. The amount of oxidized starch to be blended, if used, is preferably 0.5 to 20% by weight, more preferably 1 to 5% by weight to the natural cheese.

The other sub-raw materials aforementioned, which do not positively contribute to formation of the mouthfeel and structure of the product of the present invention, can be used to the extent that the materials cause no problem with the mouthfeel.

In the present invention, these raw materials are emulsified using a cooker used for emulsification for the normal processed cheese. Examples of the cooker include batch type such as kettle cooker and Stephan cooker, and continuous type such as thermo cylinders.

Emulsification is preferably carried out at 50 to 1500 rpm for example, whether the condensed phosphate is combined with another emulsifying salt or not.

In combining the condensed phosphate with another emulsifying salt, emulsification is more preferably carried out at 50 to 150 rpm for example, because the mouthfeel may be degraded by high shearing.

Alternatively, when the condensed phosphate is not combined with another emulsifying salt, but a highly matured natural cheese having a maturity index of 30% or more is used, emulsification is preferably carried out at 50 to 1500 rpm for example, because the filling property may become undesirable by low shearing.

After the raw materials are mixed and emulsified to prepare cheese curd as above, the mixture is cooled as the normal processed cheese to thereby obtain a processed cheese of the present invention.

Furthermore, since the processed cheese of the present invention has a distinguishing mouthfeel, in order to make the most of such a mouthfeel in food scenes, for example, the cheese shaped into portions or blocks which are cut before

eating, allows the effect of the present invention to be further exerted, and it can be said that the shapes are desired forms. The shapes of cheese, however, are not particularly limited to these shapes. Any other shapes and forms such as slices, cubes, and shreds have no problems.

The invention is described in more detail hereinbelow according to Examples of the present invention and the like, but the present invention is not intended to be limited to these.

Examples

[Test Example 1]

1.5 kg of Cheddar cheese (produced in New Zealand) and 1.5 kg of Gouda cheese (produced in Australia) were crushed and mixed. 3.0 kg of the mixed cheese was loaded into a kettle cooker (manufactured by Nichiraku Machinery Co., Ltd.). Water was added to achieve a water content of 43%, and 60 g of an emulsifying salt JOHA C, shown in Table 1, was added. To this mixture, sodium bicarbonate was also added as a pH adjuster. The number of revolutions of the stirring blades of the cooker was set to 150 rpm, and the mixture was warmed by blowing steam into the jacket. When the temperature of the processed cheese reached 85°C, warming and stirring were stopped. Then, after sampling, cooling was carried out to produce a processed cheese (Comparative product 1). The obtained processed cheese had a pH of 6.0.

[Table 1]

Main components and turbidity of 1.0% aqueous solution of the emulsifying salt

Emulsifying salt	JOHA C	JOHA SE	Sodium citrate
Manufacturer	BK Giulini Corp.	BK Giulini Corp.	Mitsubishi Tanabe Pharma Corporation
Main components	Sodium diphosphate Sodium monophosphate Sodium polyphosphate	Sodium diphosphate Sodium polyphosphate	Sodium citrate
Turbidity	0	0	0

[Test Example 2]

1.5 kg of Cheddar cheese (produced in New Zealand) and 1.5 kg of Gouda cheese (produced in Australia) were crushed and mixed. 3.0 kg of the mixed cheese was loaded into a kettle cooker (manufactured by Nichiraku Machinery Co., Ltd.). Water was added to achieve a water content of 43%, and 60 g of an emulsifying salt JOHA C, shown in Table 1, was added. To this mixture, sodium bicarbonate was also added as a pH adjuster. The number of revolutions of the stirring blades of the cooker was set to 150 rpm, and the mixture was warmed by blowing steam into the jacket. When the temperature of the processed cheese reached 85°C, stirring was continued with this temperature maintained until the maximum viscosity was reached. When the maximum viscosity was reached, warming and stirring were stopped. Then, after sampling, cooling was carried out to produce a processed cheese (Comparative product 2). The obtained processed cheese had a pH of 5.8.

[Test Example 3]

1.5 kg of Cheddar cheese (produced in New Zealand) and 1.5 kg of Gouda cheese (produced in Australia) were crushed and mixed. 3.0 kg of the mixed cheese was loaded into a Stephan cooker (manufactured by Nichiraku Machinery Co., Ltd.). Water was added to achieve a water content of 43%, and 60 g of an emulsifying salt

JOHA C, shown in Table 1, was added. To this mixture, sodium bicarbonate was also added as a pH adjuster. The number of revolutions of the stirring blades of the cooker was set to 1,500 rpm, and the mixture was warmed by blowing steam into the jacket. When the temperature of the processed cheese reached 85°C, warming and stirring were stopped. Then, after sampling, cooling was carried out to thereby produce a processed cheese (Comparative product 3). The obtained processed cheese had a pH of 5.9.

[Test Example 4]

1.5 kg of Cheddar cheese (produced in New Zealand) and 1.5 kg of Gouda cheese (produced in Australia) were crushed and mixed. 3.0 kg of the mixed cheese was loaded into a kettle cooker (manufactured by Nichiraku Machinery Co., Ltd.). Water was added to achieve a water content of 43%, and 60 g of an emulsifying salt JOHA C, shown in Table 1, was added. This mixture, after sodium bicarbonate as a pH adjuster was added thereto, was kneaded and loaded into a thermo cylinder (manufactured by IWAI KIKAI KOGYO CO., LTD.). The number of revolutions of the stirring blades of the cooker was set to 300 rpm, and the mixture was warmed by blowing steam into the jacket. When the temperature of the processed cheese reached 85°C, warming and stirring were stopped. Then, after sampling, cooling was carried out to thereby produce a processed cheese (Comparative product 4). The obtained processed cheese had a pH of 5.9.

[Test Example 5]

1.5 kg of Cheddar cheese (produced in New Zealand) and 1.5 kg of Gouda cheese (produced in Australia) were crushed and mixed. 3.0 kg of the mixed cheese was loaded into a kettle cooker (manufactured by Nichiraku Machinery Co., Ltd.). Water was added to achieve a water content of 43%, and 60 g of an emulsifying salt

JOHA SE, shown in Table 1, was added. To this mixture, sodium bicarbonate was also added as a pH adjuster. The number of revolutions of the stirring blades of the cooker was set to 150 rpm, and the mixture was warmed by blowing steam into the jacket. When the temperature of the processed cheese reached 85°C, warming and stirring were stopped. Then, after sampling, cooling was carried out to thereby produce a processed cheese (Comparative product 5). The obtained processed cheese had a pH of 5.8.

[Test Example 6]

1.5 kg of Cheddar cheese (produced in New Zealand) and 1.5 kg of Gouda cheese (produced in Australia) were crushed and mixed. 3.0 kg of the mixed cheese was loaded into a kettle cooker (manufactured by Nichiraku Machinery Co., Ltd.). Water was added to achieve a water content of 43%, 60 g of an emulsifying salt JOHA C, shown in Table 1, and 20 g of egg white were added. To this mixture, sodium bicarbonate was also added as a pH adjuster. The number of revolutions of the stirring blades of the cooker was set to 150 rpm, and the mixture was warmed by blowing steam into the jacket. When the temperature of the processed cheese reached 85°C, warming and stirring were stopped. Then, after sampling, cooling was carried out to thereby produce a processed cheese (Comparative product 6). The obtained processed cheese had a pH of 6.1.

The processed cheese samples produced in Test Examples 1 to 6 (Comparative products 1 to 6) were evaluated on their heat resistance, flavor, and texture. Furthermore, the flavor and texture were sensory-evaluated by six trained panelists in accordance with a routine method (hereinafter, the same applies). The total evaluation, in consideration of the results of the heat resistance, flavor, and texture, was represented by “A”, “B”, “C” and “D” from the best to the worst.

The results of heat resistance evaluation on Comparative products 1 to 6 were shown in Figure 1. Comparative products 1 to 5 had heat resistance as low as 50% or less. Comparative product 2 had slightly higher heat resistance due to the creaming effect, compared to the processed cheese of Comparative product 1. Comparative product 6, to which egg white had been added, had the highest heat resistance, almost 100%, compared to Comparative products 1 to 5, but the flavor of the processed cheese was degraded. Comparative product 6 also has an egg allergy problem.

The results of evaluation on the heat resistance, pH, flavor, and texture were shown in Table 2. These results show that Comparative products 1 to 5 had low heat resistance and Comparative product 6 had high heat resistance but had a poor flavor. Further, Comparative product 6 also has an egg allergy problem. The results as above reveal that it is difficult to produce a cheese which combines excellent heat resistance, a good flavor, and a soft texture using an emulsifying salt of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of less than 2.0.

[Table 2]

Evaluation results on the heat resistance, pH, flavor, and texture of the processed cheese produced using various emulsifying salts

Comparative product	Heat resistance [%]	pH	Flavor	Texture	Total evaluation
1	20	6.0	Good cheese flavor	Soft	D
2	50	5.8	Strong sourness	Hard	D
3	30	5.9	Good cheese flavor	Soft	D
4	30	5.9	Good cheese flavor	Soft	D
5	30	5.8	Good cheese flavor	Soft	D
6	95	6.1	Degraded flavor	Soft	D

(Example 1)

1.5 kg of Cheddar cheese (produced in New Zealand) and 1.5 kg of Gouda cheese (produced in Australia) were crushed and mixed. 3.0 kg of the mixed cheese was loaded into a kettle cooker (manufactured by Nichiraku Machinery Co., Ltd.). Water was added to achieve a water content of 43%, and 60 g of an emulsifying salt A shown in Table 3 was added. To this mixture, sodium bicarbonate was also added as a pH adjuster. The number of revolutions of the stirring blades of the cooker was set to 150 rpm, and the mixture was warmed by blowing steam into the jacket. When the temperature of the processed cheese reached 85°C, warming and stirring were stopped. Then, after sampling, cooling was carried out to thereby produce a processed cheese (Example product 1). The obtained processed cheese had a pH of 6.1.

[Table 3]

**Main components and turbidity of 1.0% aqueous solution of the emulsifying salt
impart heat resistance to a processed cheese**

Emulsifying salt	A	B
Main components	Sodium polyphosphate Sodium monophosphate	Sodium diphosphate Calcium phosphate Sodium polyphosphate
Average turbidity	4.0	3.0
Standard deviation	0.30	0.25

(Example 2)

1.5 kg of Cheddar cheese (produced in New Zealand) and 1.5 kg of Gouda cheese (produced in Australia) were crushed and mixed. 3.0 kg of the mixed cheese was loaded into a kettle cooker (manufactured by Nichiraku Machinery Co., Ltd.). Water was added to achieve a water content of 43%, and 60 g of an emulsifying salt B shown in Table 3 was added. To this mixture, sodium bicarbonate was also added as a pH adjuster. The number of revolutions of the stirring blades of the cooker was set to 150 rpm, and the mixture was warmed by blowing steam into the jacket. When the temperature of the processed cheese reached 85°C, warming and stirring were stopped. Then, after sampling, cooling was carried out to thereby produce a processed cheese (Example product 2). The obtained processed cheese had a pH of 5.9.

(Example 3)

1.5 kg of Cheddar cheese (produced in New Zealand) and 1.5 kg of Gouda cheese (produced in Australia) were crushed and mixed. 3.0 kg of the mixed cheese was loaded into a kettle cooker (manufactured by Nichiraku Machinery Co., Ltd.). Water was added to achieve a water content of 43%, and 30 g of an emulsifying salt A shown in Table 3 and 30 g of sodium diphosphate were added. To this mixture,

sodium bicarbonate was also added as a pH adjuster. The number of revolutions of the stirring blades of the cooker was set to 150 rpm, and the mixture was warmed by blowing steam into the jacket. When the temperature of the processed cheese reached 85°C, warming and stirring were stopped. Then, after sampling, cooling was carried out to thereby produce a processed cheese (Example product 3). The obtained processed cheese had a pH of 5.9.

The results of heat resistance evaluation on Example products 1 to 3 were shown in Figure 2. Example products 1, 2, and 3 exhibited high heat resistance. There were no influences on the flavor, and the products had a soft texture.

The results of evaluation on the heat resistance, pH, flavor, and texture were shown in Table 4. As clearly from these results, Example products 1, 2, and 3 exhibited high heat resistance. There were no influences on the flavor, and the products had a good flavor and a soft texture. These results revealed that use of a condensed phosphate of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more enables a cheese which combines excellent heat resistance, a good flavor, and a soft texture to be obtained.

[Table 4]

Results of evaluation on the heat resistance, pH, flavor, and texture of the processed cheese produced using a condensed phosphate of which a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more

Example product	Heat resistance [%]	pH	Flavor	Texture	Total evaluation
1	80	6.1	Good cheese flavor	Soft	A
2	90	5.9	Good cheese flavor	Soft	A
3	100	5.9	Good cheese flavor	Soft	A

(Example 4)

1.5 kg of Cheddar cheese (produced in Australia) and 1.5 kg of Gouda cheese (produced in Australia) were crushed and mixed. 3.0 kg of the mixed cheese was loaded into a kettle cooker (manufactured by Nichiraku Machinery Co., Ltd.). Water was added to achieve a water content of 42%, and 0.2% by weight (6 g) of, 0.5% by weight (15 g) of, 1.0% by weight (30 g) of, 3.0% by weight (90 g) of, 5.0% by weight (150 g) of, or 6.0% by weight (180 g) of an emulsifying salt B shown in Table 3 was added to the natural cheese. To this mixture, sodium bicarbonate was also added as a pH adjuster. The number of revolutions of the stirring blades of the cooker was set to 150 rpm, and the mixture was warmed by blowing steam into the jacket. When the temperature of the processed cheese reached 85°C, warming and stirring were stopped. Then, after sampling, cooling was carried out to thereby produce a processed cheese.

Evaluation was made on the heat resistance, pH, flavor, and texture of the processed cheeses produced in Example 4. The results are shown in Table 5.

[Table 5]

Results of evaluation on the heat resistance, pH, flavor, and texture of the processed cheese produced at various concentrations of an emulsifying salt

Emulsifying salt [%] to the natural cheese	Heat resistance [%]	pH	Flavor	Texture	Total evaluation
0.2	80	5.8	Good cheese flavor	Soft	B
0.5	90	5.9	Good cheese flavor	Soft	A
1.0	90	5.9	Good cheese flavor	Soft	A
3.0	90	6.2	Good cheese flavor	Soft	A
5.0	95	6.1	Good cheese flavor	Soft	A
6.0	95	6.0	Too salty	Slightly hard and brittle	D

It has been revealed that, as shown in Table 5, the processed cheese samples having 0.5% to 5.0% by weight of an emulsifying salt B blended therein to the natural cheese exhibited a high heat resistance, and furthermore, had a good flavor and a soft texture. In contrast, a processed cheese sample having 0.2% by weight of an emulsifying salt B blended therein to the natural cheese had a good flavor and texture, but exhibited slightly low heat resistance. Alternatively, a processed cheese sample having 6.0% by weight of an emulsifying salt B blended therein to the natural cheese had heat resistance, but was slightly salty and had a slightly hard and brittle texture. Accordingly, it has been revealed that blending 0.5 to 5.0% by weight of an emulsifying salt B to the natural cheese enables a processed cheese to be obtained, the processed cheese having a particularly high heat resistance, a good flavor, and a soft texture.

(Example 5)

10 kg of Gouda cheese having a maturity index of 30% using as a natural cheese was crushed. Furthermore, 1 kg of unsalted butter was added for fat adjustment. After 200 g of an emulsifying salt A shown in Table 6, 50 g of citric acid anhydride as a pH adjuster, and 20 g of locust bean gum (manufactured by Unipeptine Inc.) were added to this mixture, water was added to achieve a final water content of 40% by weight. The mixture was heated to 88°C and melted at 1000 rpm using a high-shear Stephan cooker. After the temperature reached 88°C, stirring was maintained at the same number of revolutions for two minutes. The heated processed cheese was filled into a 400 g carton and cooled in a refrigerator at 5°C for 24 hours or more to thereby obtain the processed cheese intended (Example 5).

[Table 6]

Emulsifying salt	A	B	C
Components	Na polyphosphate Na monophosphate	Na polyphosphate K polyphosphate	Na diphosphate Ca phosphate Na polyphosphate
Average turbidity	4.0	2.3	3.0
Standard deviation	0.30	0.22	0.25

(Example 6)

5 kg of Gouda cheese having a maturity index of 25% and 5 kg of Cheddar cheese having a maturity index of 25% using as natural cheeses, were crushed. To this mixture, 200 g of an emulsifying salt B shown in Table 6, 30 g of Joha Cnew (manufactured by BK Giulini GmbH), 50 g of citric acid anhydride as a pH adjuster, 500 g of oxidized starch (manufactured by Matsutani Chemical Industry Co., Ltd.) as a physical-property modifier, and 20 g of locust bean gum (manufactured by Unipeptine Inc.) were added. Then, water was added to achieve a final water content of 47% by weight. The mixture was heated to 88°C and melted at 100 rpm

using a low-shear kettle cooker. After 88°C was reached, stirring was maintained at the same number of revolutions for two minutes. The heated processed cheese was filled into a 400 g carton and cooled in a refrigerator at 5°C for 24 hours or more to obtain the processed cheese intended (Example 6).

(Example 7)

5 kg of Gouda cheese having a maturity index of 10% and 5 kg of Cheddar cheese having a maturity index of 25% using as natural cheeses, were crushed. To this mixture, 200 g of an emulsifying salt C shown in Table 6, 50 g of Joha PZ7 (manufactured by BK Giulini GmbH), 30 g of citric acid anhydride as a pH adjuster, 700 g of oxidized starch (manufactured by Matsutani Chemical Industry Co., Ltd.) as a physical-property modifier, and 20 g of locust bean gum (manufactured by Unipeptine Inc.) were added. Then, water was added to achieve a final water content of 47% by weight. The mixture was heated to 88°C and melted at 80 rpm using a low-shear kettle cooker. After 88°C was reached, stirring was maintained at the same number of revolutions for two minutes. The heated processed cheese was filled into a 400 g carton and cooled in a refrigerator at 5°C for 24 hours or more to obtain the processed cheese intended (Example 7).

(Example 8)

5 kg of Gouda cheese having a maturity index of 20% and 5 kg of Cheddar cheese having a maturity index of 20% using as natural cheeses, were crushed. To this mixture, 200 g of an emulsifying salt A shown in Table 6, 50 g of Joha S9 (manufactured by BK Giulini GmbH), 30 g of citric acid anhydride as a pH adjuster, 700 g of oxidized starch (manufactured by Matsutani Chemical Industry Co., Ltd.) as a physical-property modifier, and 20 g of locust bean gum (manufactured by Unipeptine Inc.) were added. Then, water was added to achieve a final water

content of 47% by weight. The mixture was heated to 88°C and melted at 80 rpm using a low-shear kettle cooker. After 88°C was reached, stirring was maintained at the same number of revolutions for two minutes. The heated processed cheese was filled into a 400 g carton and cooled in a refrigerator at 5°C for 24 hours or more to obtain the processed cheese intended (Example 8).

(Example 9)

10 kg of Gouda cheese having a maturity index of 25% using as a natural cheese was crushed. To this, 200 g of an emulsifying salt B shown in Table 6, 30 g of Joha Cnew (manufactured by BK Giulini GmbH), 50 g of citric acid anhydride as a pH adjuster, and 20 g of locust bean gum (manufactured by Unipeptine Inc.) were added. Then, water was added to achieve a final water content of 42% by weight. The mixture was heated to 88°C and melted at 100 rpm using a low-shear kettle cooker. After 88°C was reached, stirring was maintained at the same number of revolutions for two minutes. The heated processed cheese was filled into a 400 g carton and cooled in a refrigerator at 5°C for 24 hours or more to obtain the processed cheese intended (Example 9).

(Comparative Example 1)

5 kg of Gouda cheese having a maturity index of 25% and 5 kg of Cheddar cheese having a maturity index of 25% using as natural cheeses were crushed. To this mixture, 200 g of Joha S9 (manufactured by BK Giulini GmbH) and 50 g of Joha Tnew (manufactured by BK Giulini GmbH) shown in Table 7 as emulsifying salts were added, and then, water was added to achieve a final water content of 47% by weight. The mixture was heated to 88°C and melted at 1000 rpm using a high-shear Stephan cooker. After 88°C was reached, stirring was maintained at the same number of revolutions for a minute. The heated processed cheese was filled into a

400 g carton and cooled in a refrigerator at 5°C for 24 hours or more to obtain the processed cheese intended (Comparative Example 1).

[Table 7]

Emulsifying salt	Joha Cnew	Joha S9	Joha Tnew	Joha PZ7
Components	Na polyphosphate Na diphosphate	Na polyphosphate Na monophosphate	Na monophosphate	Na citrate Na polyphosphate K monophosphate
Average turbidity	0	0	0	0

(Comparative Example 2)

10 kg of Gouda cheese having a maturity index of 30% using as a natural cheese, was crushed. Furthermore, 1 kg of unsalted butter was added for fat adjustment. After 200 g of Joha S9 (manufactured by BK Giulini GmbH) shown in Table 7 as an emulsifying salt, 50 g of citric acid anhydride as a pH adjuster, and 20 g of locust bean gum (manufactured by Unipektine Inc.) were added to this mixture, water was added to achieve a final water content of 40% by weight. The mixture was heated to 88°C and melted at 1000 rpm using a high-shear Stephan cooker. After 88°C was reached, stirring was maintained at the same number of revolutions for two minutes. The heated processed cheese was filled into a 400 g carton and cooled in a refrigerator at 5°C for 24 hours or more to obtain the processed cheese intended (Comparative Example 2).

(Comparative Example 3)

5 kg of Gouda cheese having a maturity index of 25% and 5 kg of Cheddar cheese having a maturity index of 25% using as natural cheeses, were crushed. To this mixture, 200 g of Joha PZ7 (manufactured by BK Giulini GmbH) shown in Table 7 as an emulsifying salt was added followed by addition of 700 g of oxidized

starch (manufactured by Matsutani Chemical Industry Co., Ltd.) as a physical-property modifier. Then, water was added to achieve a final water content of 47% by weight. The mixture was heated to 88°C and melted at 200 rpm using a low-shear Stephan cooker. After 88°C was reached, stirring was maintained at the same number of revolutions for a minute. The heated processed cheese was filled into a 400 g carton and cooled in a refrigerator at 5°C for 24 hours or more to obtain the processed cheese intended (Comparative Example 3).

(Comparative Example 4)

5 kg of Gouda cheese having a maturity index of 20% and 5 kg of Cheddar cheese having a maturity index of 20% using as natural cheeses, were crushed. To this mixture, 200 g of Joha PZ7 (manufactured by BK Giulini GmbH) shown in Table 7 as an emulsifying salt, 30 g of citric acid anhydride as a pH adjuster, 700 g of oxidized starch (manufactured by Matsutani Chemical Industry Co., Ltd.) as a physical-property modifier, and 20 g of locust bean gum (manufactured by Unipeptine Inc.) were added. Then, water was added to achieve a final water content of 47% by weight. The mixture was heated to 88°C and melted at 80 rpm using a low-shear kettle cooker. After 88°C was reached, stirring was maintained at the same number of revolutions for two minutes. The heated processed cheese was filled into a 400 g carton and cooled in a refrigerator at 5°C for 24 hours or more to obtain the processed cheese intended (Comparative Example 4).

[Test Example 7]

- Measurement of the turbidity

The emulsifying salts used in Examples 5 to 9 and Comparative Examples 1 to 4 were dissolved and dispersed in water so as to achieve a concentration of 1.0% by weight. The obtained dispersed solution was adjusted to pH 6.0. The 1.0% by

weight dispersed solution of the emulsifying salt adjusted to pH 6.0 was stirred well with a stirrer and then, sampled in an absorption cell of a standard size (optical path length: 10 mm). The transmittance A of light at a wavelength of 660 nm was determined using a spectrophotometer (manufactured by Hitachi, Ltd.), and the turbidity was determined by $\text{Turbidity} = -\text{Log}(A / 100)$. The results were shown in Tables 6 and 7.

[Test Example 8]

- Sensory evaluation

Samples prepared in accordance with Examples 5 to 9 and Comparative Examples 1 to 4 were sensory-evaluated by six trained panelists. Evaluation points included "meltability in the mouth" and "stickiness" of the processed cheese. These points were rated in four grades as, from the best to the worst, "A", "B", "C" to "D". The good "meltability in the mouth" of a processed cheese means not only that the cheese is soft, but also that hardness to some extent is felt at first, the physical properties vary by chewing and the like in a short period, and a feeling that the cheese is eliminated immediately is generated. The large change from the start of eating to swallowing and the shortness of the change period are important. The "meltability in the mouth" of samples were rated as, from the best "A" to "B", and toward the worst "C" to "D". On the other hand, "stickiness" of a processed cheese means a feeling that the cheese persists indefinitely in the mouth and is difficult to eliminate from the mouth, and a feeling that the cheese sticks to the teeth or oral cavity instantaneously or for a short period before swallowing. Since a mouthfeel having less "stickiness" is preferred, samples having no or little "stickiness" were rated as "A" to "B", and samples having some or much "stickiness" were rated as "C" to "D". The total evaluation, in consideration of both indices "meltability in the

mouth" and "stickiness," was represented by "A", "B", "C" to "D" from the best to the worst. The results are shown in Table 8.

[Table 8]

Results of the sensory evaluation

	Example 5	Example 6	Example 7	Example 8	Example 9
Meltability in the mouth	A	B	B	A	B
Stickiness	A	A	B	A	B
Total evaluation	A	B	B	A	B

	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4
Meltability in the mouth	D	D	C	C
Stickiness	D	C	C	C
Total evaluation	D	D	C	C

As clearly seen from the results shown in Table 8, the processed cheese of Examples 5 to 9 had excellent "meltability in the mouth" and significantly reduced "stickiness." Particularly in Examples 5 and 8, which were made from a natural cheese having a maturity index of 30% as the raw material, the processed cheeses obtained had a significantly excellent mouthfeel

In contrast, processed cheese samples of Comparative Examples 1 to 4 had poor "meltability in the mouth," "stickiness," and an inferior mouthfeel.

[Test Example 9]

• Time Intensity Method (TI Method)

Processed cheese samples prepared in accordance with Example 8 and Comparative Example 1 were evaluated using the Time Intensity Method (TI Method) by three trained panelists. The difference between a sample having good "meltability in the mouth" and a sample having poor "meltability in the mouth" and the difference between a sample having no or little "stickiness" and a sample having some or much "stickiness" in the sensory evaluation results aforementioned were

evaluated over time, from when each evaluator placed a sample into the mouth and started chewing to when the evaluator swallowed it, using a lever having a scale from 0 to 9 scores of each evaluation point. The evaluation scores were plotted on a graph for comparative evaluation. The evaluation was carried out as follows: the lever was lifted to 9 at the moment when the sample was placed in the mouth, gradually lowered in accordance with the change in the mouth by chewing, and stopped at the moment of swallowing. To standardize the data, the scores from the moment when the sample was placed in the mouth to when the sample was swallowed (intensity) were corrected so as to fall within a range from 0 to 10. The number and extent of chewing, the moment of swallowing, and the like, however, are largely different with each individual. Thus, comparison between each sample was carried out separately for each evaluator. The results are shown in Figure 3.

By comparison of trends in Example 8 and Comparative Example 1 as shown in Figure 3, it was observed that the time taken for intensity to reach 0 is shorter in Example 8 and the time taken to reach 0 tends to be longer in Comparative Example 1 although there was difference among evaluators.

Good "meltability in the mouth" is considered to be behavior of being eliminated in the mouth immediately, and thus, it is revealed that the retention time in the mouth is shorter in Example 8 from the results shown in Figure 3. Consequently, it is likely that "meltability in the mouth" is felt good and "meltability in the mouth" of the sensory evaluation result achieves a good score in Example 8.

Similarly, "stickiness" is considered to be behavior of sticking to the teeth or oral cavity and persisting indefinitely in the mouth, and thus, it is found that the retention time in the mouth is longer in Comparative Example 1 from the results shown in Figure 3. Consequently, it is likely that occurrence of "stickiness" is felt and "stickiness" of the sensory evaluation result has a poor score.

The results of Test Example 9 are likely to represent the relative evaluation results between each sample by one evaluator although there was difference among evaluators, and the results also agree with the sensory evaluation results.

The results hereinabove clearly reveal that the processed cheese of the present invention (Example 8) has more excellent meltability in the mouth and reduced "stickiness" than the processed cheese manufactured using an emulsifying salt other than a condensed phosphate used in the present invention (Comparative Example 1).

Industrial Applicability

The processed cheese obtained by the present invention, which has excellent heat resistance as well as a good flavor and a soft texture, can be used in various cooking and industrial processed foods requiring heat resistance of cheese. Additionally, the processed cheese of the present invention can be manufactured by a simple method without including a special step.

The present invention can provide a processed cheese which exhibits reduced "stickiness," which has been recognized as an unfavorable mouthfeel of processed cheese, and good "meltability in the mouth," which is now preferred in the entire food industry. Therefore, the processed cheese of the present invention is promising for a wide variety of usages.

Claims

[Claim 1]

A processed cheese comprising a condensed phosphate which when dissolved or dispersed as a 1.0% aqueous solution adjusted to pH 6.0 has a turbidity of 2.0 or more, wherein 0.5 to 5.0% by weight of the condensed phosphate is added to a natural cheese to form the processed cheese, and wherein the cheese is shaped into cubes having a side of 10 mm and has heat resistance of 80% or more when autoclaved at 121°C for 15 minutes;

wherein the heat resistance is calculated in accordance with the following expression:

Heat resistance [%] = (height of processed cheese after heating [mm] / height of processed cheese before heating [mm]) × 100.

[Claim 2]

A method for manufacturing a processed cheese, the method comprising a step of adding 0.5 to 5.0% by weight of a condensed phosphate to a natural cheese, which when the condensed phosphate is dissolved or dispersed as a 1.0% aqueous solution adjusted to pH 6.0, the condensed phosphate has a turbidity of 2.0 or more.

[Claim 3]

A processed cheese according to claim 1, characterized by comprising at least one emulsifying salt selected from water-soluble polyphosphates, diphosphates, monophosphates, and citrates, wherein 1.0 to 3.0% by weight of the condensed phosphate is added to the natural cheese.

[Claim 4]

A processed cheese according to claim 1, characterized by comprising a natural cheese having a maturity index of 30% or more, wherein 1.0 to 3.0% by weight of the condensed phosphate is added to the natural cheese.

[Claim 5]

A method for manufacturing a processed cheese according to claim 2, comprising:
a step of adding at least one emulsifying salt selected from water-soluble polyphosphates, diphosphates, monophosphates, and citrates, and a natural cheese;
a step of mixing and emulsifying the added raw materials to prepare cheese curd; and
a step of cooling the prepared cheese curd,
wherein 1.0 to 3.0% by weight of the condensed phosphate is added to the natural cheese.

[Claim 6]

A method for manufacturing a processed cheese according to claim 2, comprising:
a step of adding a natural cheese having a maturity index of 30% or more as a raw material;
a step of mixing and emulsifying the added raw materials to prepare cheese curd; and
a step of cooling the prepared cheese curd,
wherein 1.0 to 3.0% by weight of the condensed phosphate is added to the natural cheese.

[Claim 7]

The method for manufacturing a processed cheese according to claim 5 or 6, wherein oxidized starch is further added as a raw material.

[Claim 8]

The method for manufacturing a processed cheese according to claim 7, wherein the amount of added oxidized starch is 0.5 to 20% by weight to the natural cheese.