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PROCESS FOR PRODUCING EGG YOLK-CONTAINING LIQUID AND
OIL-IN-WATER TYPE EMULSION

5 Technical Field

The present invention relates to a process for
producing an egg yolk-containing liquid and an oil-in-water
type emulsion. In particular, it relates to a process for
producing an egg yolk-containing liquid that can suitably
10 be used as a material for western-style confectioneries,
which are prepared by adding a large amount of egg yolk and
typically include mousse and custard cream, and a process
for producing an oil-in-water type emulsion by using the
egg yolk-containing liquid, water, oil, an emulsifier, a
15 non-fat milk solid, and the like.

Background Art

Egg yolk is an excellent material for food products
and confectioneries. Proteins of egg yolk are, however,
20 sensitively denatured by mechanical shearing or heating.
Then, during emulsification or sterilization by heating,
egg yolk can easily be deteriorated in mouthfeel, taste and
flavor, and particularly such deterioration in mouthfeel,
taste and flavor is significant in egg yolk rich processes.
25 In addition, heat sterilization of liquid or emulsions

containing egg yolk can cause scorches or scaling in the heat exchanging or holding unit of a heating system.

Therefore, the heating system needs frequent cleaning processes, and a continuous operation is limited and a

5 long-time continuous operation is difficult. Scorches or scales, if produced, can contaminate products which causes degradation of their quality.

For solving these problems, addition of sugar before heating (JP 57-186439 A), and treatment of egg liquid with
10 enzyme (JP 60-62951/1985 A and JP 60-62952 A) have been proposed. However, none of these methods can provide satisfactory taste and flavor for egg yolk or an egg yolk-containing liquid.

15 Disclosure of the Invention

An object of the present invention is to provide a process of an egg yolk-containing liquid and an egg yolk-containing oil-in-water type emulsion using said egg yolk-containing liquid; said egg yolk-containing liquid scarcely
20 showing any changes in the taste upon heating and having favorable mouthfeel with little roughness due to heat denaturation of protein; and said egg yolk-containing oil-in-water type emulsion using said egg yolk-containing liquid causing little scorching or scaling (adhesion) on a
25 heating unit of an apparatus in ultrahigh temperature flash

sterilization (UHT), being highly tolerant to baking in case of being used in custard cream, etc., and scarcely undergoing oil-separation or demulsification.

Under the above-described circumstances, the present
5 inventors intensively studied a process for producing an egg yolk-containing liquid which can be produced such a liquid by heat treatment without degradation of the egg yolk taste and flavor, and a means for subjecting an oil-in-water type emulsion prepared by using said egg yolk to
10 ultrahigh temperature flash sterilization treatment without scorching or scaling. As a result, it was found that the problems can be solved by heating an aqueous dispersion prepared by dispersing egg yolk in water at a specific temperature, and by subjecting an oil-in-water type
15 emulsion prepared by using an egg yolk-containing liquid obtained by heat treatment of the aqueous dispersion to heat pasteurization or sterilization at a specific temperature. Then, a patent application was filed under Japanese Patent Application No. 8-247338 (JP 10-84914 A).
20 As a result of further studies, the present inventors have found that a more remarkable effect is obtained by subjecting an aqueous egg yolk dispersion prepared by dispersing egg yolk in water to first heat treatment at a specific temperature, and further subjecting the resultant
25 egg yolk-containing liquid to a second heat treatment at a

specific temperature. The present invention has been completed based on this finding.

That is, the present invention is directed to a process for producing an egg yolk-containing liquid which is characterized by the steps of subjecting an aqueous dispersion containing egg yolk diluted to a concentration of 80% by weight or less to first heat treatment at a temperature higher than 60°C and not higher than 78°C, and then subjecting the aqueous dispersion whose egg yolk concentration is adjusted to 65% by weight or less to second heat treatment at a temperature of 120°C or higher; and a egg yolk-containing liquid obtained by this process; as well as a process for producing an oil-in-water emulsion which is characterized by the step of using the egg yolk-containing liquid in an amount of 5 to 60% by weight in terms of the egg yolk component.

Best Mode for Carrying out the Invention

In the present invention, as egg yolk, raw egg yolk or frozen egg yolk is preferably used in view of taste and flavor. Dried egg yolk, sugar-added and heated egg yolk, and enzyme-treated egg yolk may be used but, in general, they are inferior in taste or flavor to raw or frozen egg yolk and not so preferred as a raw material.

Egg yolk is dispersed into water to form an aqueous

dispersion. Preferably, the aqueous dispersion contains egg yolk in an amount of 80% by weight or less, preferably 20% by weight to 80% by weight. When the amount is lower than the lower limit, the amount of egg yolk is too small
5 to provide a final product with an economical merit. On the other hand, when the amount exceeds the upper limit, aggregations are liable to be caused by heating.

For dispersing egg yolk into water, stirring should be sufficiently carried out to make the whole homogeneous.
10 Particularly, in case of using egg yolk which has been gelled by frozen denaturation, stirring should be thoroughly carried out so that the egg yolk is homogeneously dissolved or dispersed in water. In order to ensure the homogeneity of an aqueous dispersion of egg yolk,
15 if necessary, the aqueous dispersion may be homogenized with a homogenizer

The aqueous dispersion of egg yolk is then subjected to first heat treatment. The first heat treatment is carried out in a temperature range higher than 60°C and not
20 higher than 78°C. When the heating temperature range is not higher than 60°C, the desired effect is hardly obtained. When the range exceeds 78°C, aggregations are liable to be formed. For carrying out the first heat treatment, it is desired to avoid local heating of the liquid to be treated
25 (the aqueous dispersion of egg yolk), and specifically a

local rise in temperature is preferably suppressed to 90°C or lower. Preferred examples of a method for avoiding the local heating include heating at a temperature rising rate of 0.05°C to 6°C per minute.

5 Preferred examples of a method for heating at such a temperature rising rate include to carry out the heat treatment using a heating medium at a temperature of higher than "the temperature of the aqueous dispersion phase", but not higher than "the temperature of the aqueous dispersion
10 phase + 8°C". If the difference between the temperature of the heating medium used in the heating and that of the aqueous dispersion is too much, that is, if the heating is carried out using a heating medium at a temperature higher than "the temperature of the aqueous dispersion phase +
15 8°C", aggregations are liable to be formed in the aqueous dispersion phase or viscosity of the aqueous dispersion phase is liable to increase.

As to the heat treatment time, preferably the aqueous dispersion phase is held at the given temperature range for
20 5 to 300 minutes. When the heat treatment time is shorter than 5 minutes, the desired effect by heating is hardly obtained. When the aqueous dispersion phase is held for longer than 300 minutes, any additional effect by heating is hardly expected. Upon dispersing egg yolk into water,
25 unnecessary heating should be avoided. However, it is

possible to add egg yolk to water, followed by dispersing the egg yolk with raising temperature by heating.

A method for the first heat treatment is not limited to specific technique and any heating technique including
5 batch-wise heating, continuous heating, direct heating, indirect heating, microwave heating, high-frequency heating, electric heating, and the like can be employed.

Particularly, when the heat treatment is carried out by using a heating medium such as steam, however, attention
10 should be given to the heating rate of the liquid to be treated (the aqueous dispersion of egg yolk) and the temperature difference between the liquid to be treated and the heating medium used. In case of employing microwave heating, high-frequency heating, or electric heating, the
15 temperature rising rate is of importance, and preferably, the heating is carried out intermittently so that a local rise in temperature of the heating medium can be prevented.

According to the present invention, it is preferred to incorporating gas such as air into the egg yolk-containing
20 liquid at a concentration of 20 to 200% by volume based on the liquid, followed by carrying out the first heat treatment, because the heating rate can necessarily be suppressed by the heat insulating effect of the gas and the liquid separation effect to provide gentle heating.

25 Further, according to the present invention, a salt

may be added to the egg yolk-containing liquid so as to improve the homogeneity of the liquid during and after the first heat treatment. Such an effect can be obtained by addition of a salt at a concentration of 0.05% by weight or
5 more based on the egg yolk-containing liquid. When the concentration exceeds more than 3% by weight, any further effect can hardly be expected. Examples of the salt include phosphates such as hexametaphosphates, etc., and sodium bicarbonate.

10 Then, after the first heat treatment, the egg yolk-containing liquid is subjected to the second heat treatment by holding the liquid in a temperature range not higher than 155°C, preferably from 120 to 155°C, for 1 to 20
15 seconds. For such second heat treatment, an ultra-high temperature flash sterilization treatment (UHT treatment) apparatus is preferably used. Such treatment includes direct steam heating such as a steam injection type and a steam infusion type.

The egg yolk-containing liquid thus-treated by the
20 first heat treatment and the second heat treatment does not lose the effect of the heat treatment, even if it is stored by cooling. Such egg yolk-containing liquid can be used for producing an oil-in-water type emulsion having any desired functionality as well as taste and flavor such as
25 whipping cream and cream for kneading into pastry by

addition of water, oil, emulsifier(s) and, if necessary, a non-fat milk solid. The oil-in-water type emulsion has a variety of uses and the use thereof is not specifically limited. In some cases, the oil-in-water type emulsion
5 itself is subjected to pasteurization or sterilization treatment depending upon a particular use.

The sterilization treatment is preferably ultra-high temperature flash sterilization treatment and examples thereof include direct steam heating such as those of steam
10 injection type and a steam infusion type. This treatment is advantageous because heating time required for raising a temperature to a sterilization temperature is shortened to minimize the damage of contents.

The egg yolk-containing liquid obtained according to
15 the present invention and the oil-in-water type emulsion produced by using the liquid have less taste or flavor change of heated egg yolk and their taste and flavor are much closer to those of raw egg yolk in comparison with a conventional egg yolk-containing liquid and oil-in-water
20 type emulsion produced by using such conventional liquid. Further, they have less graininess of denatured proteins. Thus, mouthfeel, taste and flavor of the egg yolk-containing liquid obtained according to the present invention and the oil-in-water type emulsion produced by
25 using the liquid are significantly improved. Accordingly,

a sufficient amount of egg yolk can be used so that the egg yolk-containing liquid obtained according to the present invention and the oil-in-water type emulsion produced by using the liquid can generally be used as not only a raw material for western-style confectioneries but also a raw material for a wide variety of food products. In particular, it should be noted that the sterilization, which is of most importance for ensuring the safety of food products, is sufficiently achieved according to the present invention. In addition, the present invention is effective for significantly reducing scorching and scaling at a heating unit, which would otherwise be a problem with the sterilization of an egg yolk-containing oil-in-water type emulsion. Thus, according to the present invention, an oil-in-water type emulsion containing a sufficient amount of egg yolk with good taste and flavor can stably and continuously be produced.

The oil-in-water type emulsion can be produced according to a known formulation and a known process. Examples of a fat and oil material to be used for the oil phase include vegetable oils such as rapeseed oil, soybean oil, sunflower seed oil, cotton seed oil, peanut oil, rice bran oil, corn oil, safflower oil, olive oil, kapok oil, sesame oil, evening primrose oil, palm oil, shea butter, sal butter, cacao butter, coconut oil, and palm kernel oil,

etc., and animal oils such as milk fat, beef tallow, lard, fish oil, whale oil, etc. These oils and fats can be used alone or in combination thereof. Further, their processed fats and oils (having a melting point of about 15 to about 5 40°C) including hydrogenated oils, fractionated oils, interesterification oils, etc., can also be used.

The aqueous phase may be a known aqueous phase obtained by mixing water with whole milk, skimmed milk powder, whole milk powder, or soybean protein, or the like. 10 The protein solid may be used in an amount of 0.5 to 6.0% by weight based on the total amount of cream. Any emulsifier generally used for whipping cream may be used. Examples thereof include one or more selected from lecithin, sugar ester, monoglyceride, sorbitan fatty acid ester, 15 polyglycerol fatty acid ester, etc. They may be used alone or in combination. In addition to the above components, if necessary, a stabilizer can be used. Examples of the stabilizer include gums and cellulose.

The oil phase and the aqueous phase are preliminarily 20 emulsified with each other and then subjected to homogenization, pasteurization, re-homogenization, cooling, and aging to give the desired emulsion. Homogenization or stirring may be carried out before and/or after the above pasteurization or sterilization step. The homogenization 25 may be either the pre- or the post-homogenization, or a

combination thereof, i.e., two-stage homogenization.

Examples

The following examples illustrate the present invention in detail but are not intended to limit or restrict the scope of the inventive idea.

Example 1

An aqueous dispersion phase of a mixture containing 60% by weight of raw egg yolk and 40% by weight of water was heated with gentle stirring from 40°C to 75°C at a temperature rising rate of 1°C per minute by using warm water at a temperature of "the aqueous dispersion phase temperature + 3°C", and then held at 75°C for 15 minutes, to complete the first heat treatment. The aqueous dispersion was then heated at 140°C for 3 seconds with a VTIS manufactured by Alfa Laval to complete the second heat treatment, and cooled to obtain an egg yolk-containing liquid. The egg yolk-containing liquid thus prepared had excellent taste or flavor without taste or flavor resulted by heating. The egg yolk-containing liquid was in a homogeneous state with no aggregations observed.

Example 2

An aqueous dispersion phase of a mixture containing 70% by weight of frozen egg yolk and 30% by weight of water was vigorously stirred so that 50% by volume of air based

on the aqueous dispersion was incorporated in the dispersion. The dispersion was then heated to 65°C and held at 65°C for 10 minutes to complete the first heat treatment. Water was then added to the dispersion so that
5 the content of the egg yolk component was adjusted to 50% by weight, and the dispersion was subjected to the second heat treatment at 130°C for 10 seconds and then cooled to obtain an egg yolk-containing liquid. At this time, the heating temperature was very easily controlled to fulfill
10 the temperature rising requirement. The egg yolk-containing liquid was in a homogeneous state with no aggregations and had good taste and flavor.

Example 3

An aqueous dispersion phase of a mixture containing
15 40% by weight of raw egg yolk, 59.5% by weight of water, and 0.5% by weight of sodium polyphosphate was heated from 40°C to 70°C at a temperature rising rate of 3°C per minute by using warm water at a temperature of "the aqueous dispersion phase temperature + 6°C", and then held at 70°C
20 for 10 minutes to complete the first heat treatment. The aqueous dispersion was then heated at 145°C for 5 seconds to complete the second heat treatment, and cooled to obtain an egg yolk-containing liquid. The egg yolk-containing liquid was in a homogeneous state with no aggregations and
25 had good taste and flavor.

Example 4

The egg yolk containing liquid obtained in Example 1 was stored in a refrigerator for one day and then used to form whipping cream in the following process.

5 Composition:

	Vegetable Oil *1	45.0 wt%
	Skimmed Milk Powder	4.0
	Egg Yolk-Containing Liquid Product	30.0
	Water	20.5
10	Soybean Lecithin	0.2
	Sugar Ester *2	0.2
	Sodium Hexametaphosphate	0.1

*1: Rapeseed and palm hydrogenated oil having a melting point of 31°C

15 *2: HLB value of 5

The above components were mixed with a homomixer at 70°C for 30 minutes and then sterilized with a VTIS manufactured by Alfa Laval at 145°C for 4 seconds, and homogenized at a homogenization pressure of 0.5 MPa, and
20 then cooled to 5°C. The resulting cream was in a good state with no aggregations, and no scorch was formed at the heating unit of the sterilizer. In a Kenwood mixer manufactured by Aicohsha. Co., 500 g of the resulting whipping cream and 40 g of sugar were mixed and whipped.

25 The results are shown below.

Results:

	Whipping Time	2.5 minutes
	Overrun	100%
5	Shape Retaining Property (15°C)	No sagging or leaking
	Taste and Flavor	good

As shown above, no taste or flavor resulted from heating of egg yolk and no feeling of graininess were recognized, and the product had excellent taste, flavor and mouthfeel and excellent quality.

Example 5

The egg yolk-containing liquid obtained in Example 2 was used to form cream for kneading into pastry in the following process.

15	Composition:	
	Vegetable Oil *1	10.0 wt%
	Skimmed Milk Powder	8.0
	Egg Yolk-Containing Liquid	50.0
	Granulated Sugar	12.0
20	Water	19.9
	Soybean Lecithin	0.05
	Sugar Ester *2	0.05

*1: Soybean and palm hydrogenated oil with a melting point of 31°C

25 *2: HLB value of 15

The above components were mixed by using a homomixer at 70°C for 30 minutes and then sterilized with a VTIS manufactured by Alfa Laval at 145°C for 4 seconds, and homogenized at a homogenization pressure of 0.3 MPa, and then cooled to 5°C. The resulting cream was in a good state with no aggregations, and no scorch was formed at the heating unit of the sterilizer. The resulting cream for kneading into pastry cream used to form mousse. The resulting mousse had no taste or flavor resulted from heating egg yolk or no graininess, and exhibited excellent taste, flavor, and mouthfeel and excellent quality.

Comparative Example 1

According to the same composition as that in Example 1, 60% of raw egg yolk and 40% of water were mixed and heated with stirring from 45°C to 75°C with steam at 100°C and then held for 15 minutes. At this time, the temperature rising rate was 8°C per minute. At this time, scaling was formed on the inner wall of a jacketed tank used. Aggregations were also formed in the egg yolk mixture. When the mixture was heat-treated at 140°C for 5 seconds, the aggregations were still remained.

Comparative Example 2

An egg yolk-containing liquid was obtained in the same manner as that of Example 1 except that the second heat treatment was omitted. The product was used to prepare

whipping cream in the same manner as that of Example 4.

The resulting cream showed a whipping time of 1 minute and 20 seconds, an overrun of 80%, no sagging or leaking for the shape retaining property (15°C), and good taste and

5 flavor. However, when emulsion stability of the liquid product was compared by a stirring test, the cream of this example showed plasticization in 2 minutes, while the cream of Example 1 was stable for more than 5 minutes. Thus, the product of Example 1 was remarkably superior to that of
10 this example.

Comparative Example 3

An aqueous dispersion phase of a mixture containing 70% by weight of raw egg yolk and 30% by weight of water was heated with gentle stirring from 40°C to 60°C at a
15 temperature rising rate of 3°C per minute by using warm water at a temperature of "the aqueous dispersion phase temperature + 5°C". When the temperature reached 60°C, cooling was immediately started, and the dispersion was cooled to 5°C. The egg yolk-containing liquid was used to
20 prepare cream for kneading in pastry in the same manner as that of Example 5. As a result, scorches and scales were formed at the heating unit of VTIS, which made a continuous operation difficult. The cream also had a scorched flavor.

Comparative Example 4

25 When the first heat treatment was carried out,

according to the same manner as that in Example 1, and then a second heat treatment at 160°C for 5 seconds was carried out, aggregations were formed in the egg yolk-containing liquid.

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Industrial Applicability

As described hereinabove in detail, according to the present invention, two stages of heat treatments under certain conditions are used in the production of the egg yolk-containing liquid product, and thus-produced egg yolk-containing liquid is used to produce the oil-in-water type emulsion. The resulting product has good taste and flavor, and the heating process such as pasteurization can be free from scorching and scaling. Such advantages are more remarkable than a product obtained by a process of one stage heat treatment.

CLAIMS

1. A process for producing an egg yolk-containing liquid which is characterized by the steps of subjecting an aqueous dispersion containing egg yolk diluted to a concentration of 80% by weight or less to first heat treatment at a temperature higher than 60°C and not higher than 78°C, and then subjecting the aqueous dispersion whose egg yolk concentration is adjusted to 65% by weight or less to second heat treatment at a temperature of 120°C or higher.

2. The process according to claim 1, wherein, in the first heat treatment, a local rise in temperature of the aqueous dispersion is suppressed to 90°C or lower.

3. The process according to claim 1 or 2, wherein the second heat treatment is carried out at a temperature of 155°C or lower.

4. The process according to any one of claims 1 to 3, wherein the aqueous dispersion is allowed to contain 20 to 200% by volume of gas and subjected to the heat treatment.

5. The process according to any one of claims 1 to 4, wherein the aqueous dispersion contains 0.05 to 3% by weight of a salt.

6. An egg yolk containing-liquid produced by the process according to any one of claims 1 to 5.

7. A process for producing an oil-in-water emulsion

which is characterized by the step of using the egg yolk-containing liquid according to claim 6 in an amount of 5 to 60% by weight in terms of the egg yolk component.