

## SPECIFICATION

TITLE OF INVENTION: STARCH COMPOSITION FOR FOOD

## 5 TECHNICAL FIELD

[0001]

The present invention relates to a starch composition for food.

## 10 BACKGROUND ART

[0002]

As a food material that uses starch, there is one described in Patent Document 1.

Patent Document 1 (Japanese Unexamined Patent Publication  
15 No. 2019-154279) describes an agar composition having a structure in which molecules of agar, a starch hydrolyzate having a weight average molecular weight of 8000 to 800000, and a polymerized phosphate are entangled with one another (Claim 1).

20

RELATED DOCUMENT

PATENT DOCUMENT

[0003]

[Patent Document 1] Japanese Unexamined Patent Publication  
25 No. 2019-154279

[Patent Document 2] Japanese Unexamined Patent Publication  
No. H08-009871

## SUMMARY OF THE INVENTION

## TECHNICAL PROBLEM

[0004]

5           The inventors of the present invention examined the technology described in the Patent Document 1, and it was found that there is room for improvement from the viewpoint of reducing the generation of lumps when it is attempted to apply the composition to a food, and from the viewpoint of improving  
10   the production yield and texture of a food.

          The present invention provides a composition which, when applied to a food, is less likely to form lumps in the food, and from which a food that is excellent in terms of production yield and texture is obtained.

## 15   SOLUTION TO PROBLEM

[0005]

          According to the present invention, there are provided the following starch composition for food and a process for producing the starch composition.

20   [0006]

          [1] A starch composition for food, including the following components (a) and (b):

          (a) a starch; and

          (b) an emulsifier,

25           in which at least a portion of the component (a) and at least a portion of the component (b) form an amylose-lipid complex in the starch composition for food,

the component (a) has a peak molecular weight of equal to or more than  $2.7 \times 10^5$  and equal to or less than  $2.3 \times 10^6$ ,

the component (b) is at least one selected from the group consisting of a monoglycerin fatty acid ester and a sucrose fatty acid ester having an HLB of equal to or more than 4 and equal to or less than 16,

a free enthalpy of the amylose-lipid complex per dry mass of the composition as measured by differential scanning calorimetry is equal to or more than 0.1 J/g and equal to or less than 20 J/g,

a degree of swelling in cold water at 25°C of the starch composition for food is equal to or more than 5.0 and equal to or less than 40, and

a soluble fraction amount at 25°C of the starch composition for food is more than 0% by mass and equal to or less than 20% by mass.

[2] The starch composition for food according to [1], in which the component (a) is a starch that has not been subjected to any of an acid-treatment, an oxidization treatment, and an enzymatic treatment.

[3] The starch composition for food according to [1] or [2], in which the component (a) is one or two or more starches selected from the group consisting of tapioca starch, crosslinked tapioca starch, pea starch, potato starch, wheat starch, and corn starch.

[4] A process for producing the starch composition for food according to any one of [1] to [3], the process including:

obtaining a mixture including the components (a) and (b);  
and

obtaining the starch composition for food by subjecting the  
mixture to a pregelatinization treatment to form the amylose-  
5 lipid complex.

[5] The process according to [4], in which in the obtaining  
a mixture, a blending amount of the component (b) is equal to or  
more than 0.1 parts by mass and equal to or less than 10 parts  
by mass with respect to 100 parts by mass of the component (a).

10 [6] The process according to [4] or [5], in which in the  
obtaining a mixture, a blending amount of the component (a) is  
equal to or more than 75% by mass and equal to or less than  
99.8% by mass with respect to a total composition.

[7] The process according to any one of [4] to [6], in  
15 which the obtaining the starch composition for food includes  
heating and pressurizing the mixture with an extruder to  
granulate the mixture.

#### ADVANTAGEOUS EFFECTS OF INVENTION

20 [0007]

According to the present invention, a composition which,  
when applied to a food, is less likely to form lumps in the  
food, and from which a food that is excellent in terms of  
production yield and texture is obtained, can be provided.

25

#### DESCRIPTION OF EMBODIMENTS

[0008]

Hereinafter, embodiments of the present invention will be described. Unless particularly stated otherwise, the term "to" in a numerical value range indicates being equal to or more than a value and equal to or less than another value, both the values at the two ends being included. Furthermore, in the present embodiment, a composition may include each component singly or in combination of two or more kinds thereof.

[0009]

(Starch Composition for Food)

10 In the present embodiment, the starch composition for food (hereinafter, also simply referred to as "composition") includes the following components (a) and (b), and at least a portion of the component (a) and at least a portion of the component (b) form an amylose-lipid complex in the composition:

- 15 (a) a starch, and  
(b) an emulsifier.

The component (a) has a peak molecular weight of equal to or more than  $2.7 \times 10^5$  and equal to or less than  $2.3 \times 10^6$ . The component (b) is at least one selected from the group consisting of a monoglycerin fatty acid ester and a sucrose fatty acid ester having an HLB of equal to or more than 4 and equal to or less than 16. A free enthalpy of the amylose-lipid complex per dry mass of the composition as measured by differential scanning calorimetry is equal to or more than 0.1 J/g and equal to or less than 20 J/g. A degree of swelling in cold water at 25°C of the starch composition for food is equal to or more than 5.0 and equal to or less than 40, and a soluble fraction amount at 25°C

of the starch composition for food is more than 0% by mass and equal to or less than 20% by mass.

[0010]

In the present embodiment, the composition includes  
5 components (a) and (b), at least a portion of the component (a) and at least a portion of the component (b) form an amylose-lipid complex in the composition, the peak molecular weight of the component (a), the type of component (b) in the composition, and the free enthalpy of the amylose-lipid complex are each in a  
10 specific range, and the degree of swelling in cold water and the soluble fraction amount of the composition are each in a specific range. As a result, when the composition according to the present embodiment is applied to a food, formation of lumps in the food is suitably reduced. Furthermore, by using the  
15 composition according to the present embodiment, a food that is excellent in terms of production yield and texture can be obtained. Specifically, when the composition according to the present embodiment is used, syneresis can be effectively reduced at least either during production or during time passage, and  
20 therefore, a food with a favorable texture can be obtained with an excellent production yield. Furthermore, according to the present embodiment, for example, by applying the composition to a food, it is also possible to obtain a food that can preferably retain moisture and oil at the same time.

25 First, the components included in the composition will be described below.

[0011]

(Component (a))

Component (a) is a starch.

Component (a) is, for example, a starch for food. Regarding the component (a), a compound having a peak molecular weight in  
5 the above-described range is used.

The component (a) is preferably one or more starches selected from the group consisting of tapioca starch (starch derived from cassava), pea starch, potato starch, wheat starch, corn starch, and modified starches thereof, and more preferably  
10 one or two or more starches selected from the group consisting of tapioca starch, crosslinked tapioca starch, pea starch, potato starch, wheat starch, and corn starch.

[0012]

The component (a) may be a modified starch such as the  
15 above-mentioned crosslinked starch; however, from the viewpoint of improving the water absorption rate, it is preferably a starch that has not been subjected to any of an acid-treatment, an oxidization treatment, and an enzymatic treatment.

[0013]

20 The peak molecular weight of the component (a) is equal to or more than  $2.7 \times 10^5$ , preferably equal to or more than  $2.8 \times 10^5$ , more preferably equal to or more than  $2.9 \times 10^5$ , and even more preferably equal to or more than  $4.0 \times 10^5$ , from the viewpoint of improving the water absorption rate.

25 From the viewpoint of reducing stickiness, the peak molecular weight of the component (a) is equal to or less than  $2.3 \times 10^6$ , preferably equal to or less than  $2.0 \times 10^6$ , and more

preferably equal to or less than  $1.6 \times 10^6$ .

[0014]

The content of the component (a) in the composition is preferably equal to or more than 75% by mass, more preferably equal to or more than 80% by mass, even more preferably equal to or more than 85% by mass, still more preferably equal to or more than 90% by mass, even more preferably equal to or more than 92% by mass, and still more preferably equal to or more than 94% by mass, with respect to the total amount of the composition, from the viewpoint of improving the yield and texture of the food.

Furthermore, from the viewpoint of improving the yield and texture of the food, the content of the component (a) in the composition is, for example, equal to or less than 99.9% by mass, preferably equal to or less than 99.8% by mass, more preferably equal to or less than 99.7% by mass, and even more preferably 99.5% by mass, with respect to the total amount of the composition.

[0015]

(Component (b))

Component (b) is an emulsifier and is at least one selected from the group consisting of a monoglycerin fatty acid ester and a sucrose fatty acid ester having an HLB of equal to or more than 4 and equal to or less than 16.

[0016]

Examples of the monoglycerin fatty acid ester include esters of glycerin and fatty acids having equal to or more than 6 and equal to or fewer than 24 carbon atoms, and more specific

examples include glycerin monocaprate ester, glycerin monopalmitate ester, glycerin monostearate ester, and glycerin monobehenate ester.

The number of carbon atoms of the fatty acid in the monoglycerin fatty acid ester is, for example, equal to or more than 6, preferably equal to or more than 10, and more preferably equal to or more than 14, from the viewpoint of improving the yield and texture of the food.

From a similar viewpoint, the number of carbon atoms of the fatty acid in the monoglycerin fatty acid ester is, for example, equal to or less than 24, preferably equal to or less than 22, and more preferably equal to or less than 20.

[0017]

From a similar viewpoint, the fatty acid in the monoglycerin fatty acid ester is preferably a saturated fatty acid or a monovalent unsaturated fatty acid, and more preferably a saturated fatty acid.

[0018]

From a similar viewpoint, the HLB of the monoglycerin fatty acid ester is preferably equal to or more than 0, and more preferably equal to or more than 1.

Furthermore, from the viewpoint of improving the yield of the food, the HLB of the monoglycerin fatty acid ester is preferably equal to or less than 16, more preferably equal to or less than 9, and even more preferably equal to or less than 6.

[0019]

Among the component (b), examples of the sucrose fatty acid

ester include esters of sucrose and fatty acids having equal to or more than 10 and equal to or fewer than 24 carbon atoms, and more specific examples include sucrose stearate ester, sucrose palmitate ester, sucrose myristate ester, sucrose oleate ester, 5 sucrose behenate ester, and sucrose erucate ester.

The number of carbon atoms of the fatty acid in the sucrose fatty acid ester is not limited; however, the number of carbon atoms is, for example, equal to or more than 10, preferably equal to or more than 12, more preferably equal to or more than 10 14, and even more preferably equal to or more than 16.

Although there is no limitation, the number of carbon atoms of the fatty acid in the sucrose fatty acid ester is, for example, equal to or less than 24, preferably equal to or less than 22, more preferably equal to or less than 20, and even more 15 preferably equal to or less than 18.

[0020]

The fatty acid in the sucrose fatty acid ester is preferably a saturated fatty acid or a monovalent unsaturated fatty acid, and more preferably a saturated fatty acid, from the 20 viewpoint of improving the yield of the food.

The sucrose fatty acid ester may include any of mono-, di-, tri-, and polyesters of fatty acids.

[0021]

The HLB of the sucrose fatty acid ester is equal to or more 25 than 4, preferably equal to or more than 6, and more preferably equal to or more than 8, from the viewpoint of improving the yield and texture of the food.

From a similar viewpoint, the HLB of the sucrose fatty acid ester is equal to or less than 16, preferably equal to or less than 14, and more preferably equal to or less than 11.

[0022]

5       The content of the component (b) in the composition is preferably equal to or more than 0.1% by mass, more preferably equal to or more than 0.2% by mass, and even more preferably equal to or more than 0.3% by mass, with respect to the total amount of the composition, from the viewpoint of improving the  
10   yield and texture of the food.

Furthermore, from the viewpoint of lumpiness, the content of the component (b) in the composition is preferably equal to or less than 10% by mass, more preferably equal to or less than 8% by mass, and even more preferably equal to or less than 6% by  
15   mass, with respect to the total amount of the composition.

[0023]

(Amylose-Lipid Complex)

An amylose-lipid complex is specifically formed by at least portions of the components (a) and (b) blended in the  
20   composition.

[0024]

Here, the free enthalpy of the amylose-lipid complex will be explained. The free enthalpy of an amylose-lipid complex is an endothermic peak that occurs when a complex of amylose and a  
25   lipid component in the amylose-lipid complex melts. The free enthalpy is an index that reflects the amount of the amylose-lipid complex formed in the composition, and as this value is

larger, the amount of the amylose-lipid complex formed in the composition is greater. The lipid component may be specifically a lipophilic group (for example, a lipid portion) in the component (b) blended in the composition.

5       The present inventors have newly found that such free enthalpy is effective as an index of the ability of the composition to retain water and oil at the same time and to improve the texture.

[0025]

10       The free enthalpy of the amylose-lipid complex per dry mass of the composition is equal to or more than 0.1 J/g, preferably equal to or more than 0.5 J/g, more preferably equal to or more than 0.6 J/g, even more preferably equal to or more than 0.7 J/g, and still more preferably equal to or more than 0.8 J/g,  
15 from the viewpoints of the reduction of stickiness and the oil retention rate upon water absorption.

Furthermore, from the viewpoint of improving the water absorption rate, the free enthalpy of the amylose-lipid complex is equal to or less than 20 J/g, preferably equal to or less  
20 than 15 J/g, more preferably equal to or less than 10 J/g, even more preferably equal to or less than 8 J/g, and still more preferably equal to or less than 5 J/g.

The free enthalpy of the amylose-lipid complex is measured by differential scanning calorimetry. A specific measurement  
25 method will be described later in the section of Examples.

[0026]

(Other Components)

The composition may include components other than the components (a) and (b) or may be a composition that is composed of the components (a) and (b), and at least portions of these components form the amylose-lipid complex.

5        Examples of those other components include insoluble salts such as calcium carbonate and calcium sulfate. By adding an insoluble salt, a bubble structure of the composition is further stabilized, and the production stability can also be improved.

10        When the composition includes an insoluble salt, the content of the insoluble salt in the composition is preferably equal to or more than 0.1% by mass, more preferably equal to or more than 0.2% by mass, and even more preferably equal to or more than 0.5% by mass, with respect to the total amount of the composition, from the viewpoint of improving production  
15        stability.

20        Furthermore, from the viewpoint of improving the yield and texture of the food, the content of the insoluble salt in the composition is preferably equal to or less than 5% by mass, more preferably equal to or less than 3% by mass, and even more preferably equal to or less than 2% by mass, with respect to the total amount of the composition.

[0027]

Next, the physical properties of the composition will be explained.

25        (Degree of Swelling in Cold Water)

The degree of swelling in cold water at 25°C of the composition is equal to or more than 5.0, preferably equal to or

more than 6, more preferably equal to or more than 8, and even more preferably equal to or more than 10, from the viewpoint of improving the water absorption rate.

From a similar viewpoint, the degree of swelling in cold  
5 water at 25°C of the composition is equal to or less than 40, preferably equal to or less than 30, more preferably equal to or less than 20, even more preferably equal to or less than 18, and still more preferably equal to or less than 16.

Here, a method for measuring the degree of swelling in cold  
10 water of the composition will be described later in the section of Examples.

[0028]

(Soluble Fraction Amount)

The soluble fraction amount at 25°C of the composition is  
15 more than 0% by mass, preferably equal to or more than 1% by mass, more preferably equal to or more than 2% by mass, even more preferably equal to or more than 3% by mass, and still more preferably equal to or more than 5% by mass, with respect to the total amount of the composition, from the viewpoint of improving  
20 the yield and texture of the food.

Furthermore, from the viewpoint of reducing stickiness and from the viewpoint of thereby improving the texture, the soluble fraction amount at 25°C of the composition is specifically equal to or less than 20% by mass, preferably equal to or less than  
25 18% by mass, more preferably equal to or less than 16% by mass, even more preferably equal to or less than 14% by mass, and still more preferably equal to or less than 12% by mass, with

respect to the total amount of the composition.

Here, the soluble fraction amount is an index showing a paste-likeness (stickiness) of the composition. A method for measuring the soluble fraction amount will be described later in the section of Examples.

[0029]

(Degree of Pregelatinization)

The degree of pregelatinization of the composition is specifically equal to or more than 35%, preferably equal to or more than 40%, more preferably equal to or more than 45%, even more preferably equal to or more than 50%, and still more preferably equal to or more than 60%, from the viewpoint of moderately increasing the water absorption rate of the food in which the composition is blended.

Furthermore, the degree of pregelatinization of the composition is specifically equal to or less than 100%. From the viewpoint of further reducing the occurrence of lumps when applied to a food and from the viewpoint of reducing stickiness of a food, the degree of pregelatinization of the composition is preferably equal to or less than 95%, more preferably equal to or less than 90%, even more preferably equal to or less than 85%, and still more preferably equal to or less than 80%.

Here, the degree of pregelatinization of the composition is specifically measured by a  $\beta$ -amylase-pullulanase (BAP) method. A more specific measurement method will be described later in the section of Examples.

[0030]

(Shape and Particle Size)

The shape of the composition is, for example, a powdery or granular material. Here, the powdery or granular material includes at least one of a powdery material and a granular material, and may include both a powdery material and a granular material.

The particle size of the composition can be adjusted, for example, based on the form, size, and the like of the food or drink in which the composition is blended. For example, a fraction passing through a sieve with a mesh size of 0.5 mm and remaining on a sieve with a mesh size of 0.15 mm according to the JIS-Z8801-1 standard may be used.

Furthermore, for example, when the composition is used for fillings such as tuna mayonnaise, it is preferable to adjust "the content of the fraction passing through a sieve with a mesh size of 0.25 mm and remaining on a sieve with a mesh size of 0.038 mm according to the JIS-Z8801-1 standard to equal to or more than 60% by mass and equal to or less than 100% by mass". It is also preferable to adjust "the content of the fraction passing through a sieve with a mesh size of 0.25 mm and remaining on a sieve with a mesh size of 0.075 mm to equal to or more than 60% by mass and equal to or less than 100% by mass".

When the composition is used for kneaded foods such as hamburg steaks and soups, it is preferable to adjust "the content of the fraction passing through a sieve with a mesh size of 0.5 mm and remaining on a sieve with a mesh size of 0.075 mm to equal to or more than 60% by mass and equal to or less than

100 % by mass".

[0031]

(Bulk Specific Gravity)

From the viewpoint of increasing the yield of the food, the  
5 bulk specific gravity of the composition measured according to  
JIS K-6720 is, for example, equal to or more than 0.15 g/mL,  
preferably equal to or more than 0.25 g/mL, and more preferably  
equal to or more than 0.30 g/mL, and is, for example, equal to  
or less than 0.8 g/mL, preferably equal to or less than 0.7  
10 g/mL, and more preferably equal to or less than 0.65 g/mL.

[0032]

Here, the bulk specific gravity of the composition is  
measured according to JIS K-6720. A specific measurement method  
will be described later in the section of Examples.

15 [0033]

(Water Absorption Rate)

The water absorption rate at 25°C of the composition is  
preferably equal to or more than 500%, more preferably equal to  
or more than 700%, and even more preferably equal to or more  
20 than 800%, from the viewpoint of improving the yield of the  
food.

The upper limit value of the water absorption rate at 25°C  
of the composition is not limited, and a higher upper limit  
value is more preferable; however, the upper limit value may be,  
25 for example, equal to or less than 2000%, or for example, equal  
to or less than 1500%.

A method for measuring the water absorption rate of the

composition will be described later in the section of Examples.

[0034]

(Oil Retention Rate upon Water Absorption)

The oil retention rate upon water absorption (oil  
5 absorption rate upon water absorption) at 25°C of the  
composition is, for example, equal to or more than 60%,  
preferably equal to or more than 90%, more preferably equal to  
or more than 100%, and even more preferably equal to or more  
than 120%, from the viewpoint of improving the yield of the  
10 food.

The upper limit value of the oil retention rate upon water  
absorption at 25°C of the composition is not limited, and a  
higher upper limit value is more preferable; the upper limit  
value may be, for example, equal to or less than 250%, or for  
15 example, equal to or less than 220%.

[0035]

Here, the oil retention rate upon water absorption is the  
ratio at which oil is retained without being released when  
starch absorbs water. Conventional starches having water  
20 absorption properties (for example, a starch that has been  
subjected to only drum drying pregelatinization treatment) have  
low oil retention rates upon water absorption because when the  
conventional starches absorb water, they release oil, whereas  
the composition of the present embodiment has a high value of  
25 this oil retention rate upon water absorption, that is, the  
composition is excellent for simultaneously retaining both water  
and oil. Furthermore, it is also possible to increase the oil

retention rate upon water absorption by setting the free enthalpy of the amylose-lipid complex per dry mass of starch to a specific range.

A method for measuring the oil retention rate upon water  
5 absorption of the composition will be described later in the section of Examples.

[0036]

(Process for producing Composition)

Next, a process for producing the composition will be  
10 described.

In the present embodiment, the process for producing the composition includes, for example, the following steps.

(Step 1) Obtaining a mixture including components (a) and  
(b)

15 (Step 2) Obtaining the composition according to the present embodiment by subjecting the mixture to a pregelatinization treatment to form an amylose-lipid complex.

[0037]

Here, in order to obtain a composition in which  
20 compositions with the degree of swelling in cold water, the soluble fraction amount, and the free enthalpy of the amylose-lipid complex respectively satisfying specific conditions are each in a specific range, for example, it is important to appropriately select the combination of the components (a) and  
25 (b) and the amount of each component, and to appropriately select the timing for the pregelatinization treatment and the timing for bringing coexistence of the components (a) and (b).

More specifically, by adjusting the quantity ratio between the components (a) and (b) in step 1 and performing a pregelatinization treatment in a state in which the component (a) and the component (b) coexist in step 2, a composition in which the degree of swelling in cold water, the soluble fraction amount, and the free enthalpy of the amylose-lipid complex are in predetermined ranges, can be stably obtained.

Each step will be described more specifically below.

[0038]

10 In step 1, the components (a) and (b) and other appropriate raw material components are blended to obtain a mixture.

In step 1, the blending amount of the component (a) is preferably equal to or more than 75% by mass, more preferably equal to or more than 80% by mass, even more preferably equal to or more than 85% by mass, still more preferably equal to or more than 90% by mass, and even more preferably equal to or more than 95% by mass, with respect to the total composition of the raw material components blended in the mixture, from the viewpoint of improving the yield and texture of the food.

20 Furthermore, from the viewpoint of improving the yield and texture of the food, the blending amount of the component (a) is preferably equal to or less than 99.8% by mass, more preferably equal to or less than 99.0% by mass, and even more preferably equal to or less than 98.5% by mass, with respect to the total composition.

[0039]

In step 1, the blending amount of the component (b) is

preferably equal to or more than 0.1 parts by mass, more preferably equal to or more than 0.2 parts by mass, even more preferably equal to or more than 0.5 parts by mass, and still more preferably equal to or more than 1.5 parts by mass, with  
5 respect to 100 parts by mass of the component (a), from the viewpoint of improving the yield and texture of the food.

From the viewpoint of lumpiness, the blending amount of the component (b) is preferably equal to or less than 10 parts by mass, more preferably equal to or less than 5 parts by mass, and  
10 even more preferably equal to or less than 3 parts by mass, with respect to 100 parts by mass of the component (a).

[0040]

In step 2, a composition is obtained by subjecting the mixture to a pregelatinization treatment to form an amylose-  
15 lipid complex.

For the pregelatinization treatment, a general method that is used for heating and gelatinization of starch can be used. As the method for the pregelatinization treatment, specifically, methods of using machines such as a drum dryer, a jet cooker, an  
20 extruder, and a spray dryer are known; however, in the present embodiment, from the viewpoint of more reliably obtaining a composition in which the degree of swelling in cold water and the free enthalpy of the amylose-lipid complex are respectively in the above-mentioned ranges, heating and gelatinization using  
25 an extruder or a drum dryer is preferred, and an extruder treatment is more preferred.

[0041]

Furthermore, step 2 preferably includes heating and pressurizing the mixture with an extruder to granulate the mixture. As a result, a composition in which the degree of swelling in cold water and the soluble fraction amount of the composition and the free enthalpy of the amylose-lipid complex respectively satisfy specific conditions can be obtained as a granulated material.

In the case of performing an extruder treatment, usually, water is added to the raw material to adjust the water content to about 10% to 50% by mass, and then the mixture is heated and caused to swell under the conditions of, for example, a barrel temperature of 30°C to 200°C, an outlet temperature of 80°C to 180°C, a speed of screw rotation of 100 to 1,000 rpm, and a heat treatment time of 5 to 60 seconds.

Optimal conditions for each condition in the extruder treatment are as follows.

The water content is preferably 12% to 40% by mass, more preferably 15% to 30% by mass, and even more preferably 17% to 27% by mass.

The barrel temperature is preferably 30°C to 190°C, more preferably 30°C to 180°C, and even more preferably 30°C to 170°C.

The outlet temperature is preferably 90°C to 170°C, more preferably 100°C to 165°C, and even more preferably 110°C to 160°C.

The speed of screw rotation is preferably 120 to 1,000 rpm, more preferably 140 to 1,000 rpm, and even more preferably 150

to 1,000 rpm.

The heat treatment time is preferably 7 to 50 seconds, and more preferably 10 to 45 seconds.

Furthermore, when the composition is obtained as a  
5 granulated material in step 2, the obtained granulated material is pulverized, sieved, and appropriately adjusted in size as necessary, and thereby a granular material, a powdery material, or a mixture thereof, each having a desired size as the composition, can be obtained.

10 [0042]

The composition obtained in the present embodiment can be suitably used as a food quality improver as it is or in combination with other components.

In the composition of the present embodiment, since the  
15 formation of lumps is suitably reduced when used in a food, for example, the texture of the food can be preferably improved. Furthermore, the production yield of a food can be improved.

By using the composition of the present embodiment, for example, the retention of water in a food can be enhanced, and  
20 specifically, it is also possible to decrease syneresis or to prevent concomitant migration of water to other food materials.

[0043]

Examples of the food to which the composition according to the present embodiment is applied include paste foods, marinated  
25 foods, soups, and whipped cream.

The food to which the composition is applied may be provided as a food itself, or may be provided as a part of a

food, for example, as a filling for stuffed bread or as a decoration for baked confectionery.

[0044]

Specific examples of the paste foods include livestock meat  
5 paste foods such as hamburg steaks, meatballs, nuggets, sausages, gyoza dumplings, shaomai dumplings, and baozi; meat-like paste foods in which the meat of livestock meat paste products has been replaced with vegetable proteins; and fish paste foods such as fish balls and fish sausages.

10 Other specific examples of the paste foods include paste foods derived from vegetable materials, such as wasabi paste, mustard paste, plum paste, and sesame paste. The paste foods derived from vegetable materials may be paste tube products filled in tube containers.

15 Specific examples of the marinated foods include salads such as potato salad and tuna salad; and fillings such as canned tuna tossed with mayonnaise (tuna mayonnaise).

Specific examples of the soups include potage soup, cream soup, and minestrone.

20 [0045]

By applying the composition obtained by the present embodiment to a food, the production yield of the food can be improved, and product quality such as the texture can be made preferable. Furthermore, in the present embodiment, a process  
25 for producing a food includes adding the composition according to the present embodiment to the food.

[0046]

The present invention includes the following aspects.

1. A starch composition for food, including the following components (a) and (b):

(a) a starch; and

5 (b) an emulsifier,

in which at least a portion of the component (a) and at least a portion of the component (b) form an amylose-lipid complex in the starch composition for food,

the component (a) has a peak molecular weight of equal to  
10 or more than  $2.7 \times 10^5$  and equal to or less than  $2.3 \times 10^6$ ,

the component (b) is at least one selected from the group consisting of a monoglycerin fatty acid ester and a sucrose fatty acid ester having an HLB of equal to or more than 4 and equal to or less than 16,

15 a free enthalpy of the amylose-lipid complex per dry mass of the composition as measured by differential scanning calorimetry is equal to or more than 0.5 J/g and equal to or less than 20 J/g,

a degree of swelling in cold water at 25°C of the starch  
20 composition for food is equal to or more than 5.0 and equal to or less than 40, and

a soluble fraction amount at 25°C of the starch composition for food is more than 0% by mass and equal to or less than 20% by mass.

25 2. The starch composition for food according to 1., in which the component (a) is a starch that has not been subjected to any of an acid-treatment, an oxidization treatment, and an

enzymatic treatment.

3. The starch composition for food according to 1. or 2.,  
in which the component (a) is one or two or more starches  
selected from the group consisting of tapioca starch,  
5 crosslinked tapioca starch, pea starch, potato starch, wheat  
starch, and corn starch.

4. A process for producing the starch composition for food  
according to any one of 1. to 3., the process comprising:

obtaining a mixture including the components (a) and (b);

10 and

obtaining the starch composition for food by subjecting the  
mixture to a pregelatinization treatment to form the amylose-  
lipid complex.

5. The process according to 4., in which in the obtaining a  
15 mixture, a blending amount of the component (b) is equal to or  
more than 0.1 parts by mass and 10 parts by mass with respect to  
100 parts by mass of the component (a).

6. The process according to 4. or 5., in which in the  
obtaining a mixture, a blending amount of the component (a) is  
20 equal to or more than 75% by mass and equal to or less than  
99.8% by mass with respect to a total composition.

7. The process according to any one of 4. to 6., in which  
the obtaining the starch composition for food includes heating  
and pressurizing the mixture with an extruder to granulate the  
25 mixture.

Examples

[0047]

Examples of the present invention are shown below; however, the gist of the present invention is not intended to be limited to these.

[0048]

5       The following materials were mainly used as raw materials.  
(Starch)

Crosslinked tapioca starch: ACTOBODY TP-2, manufactured by J-Oil Mills, Inc., peak molecular weight  $9.10 \times 10^5$

10       Potato starch: BP-200, manufactured by J-Oil Mills, Inc.,  
peak molecular weight  $1.85 \times 10^6$

High-amylose corn starch: High-amylose corn starch HS-7, manufactured by J-Oil Mills, Inc., peak molecular weight  $2.73 \times 10^5$

15       Pea starch: Puris Pea, manufactured by Puris Proteins, LLC,  
peak molecular weight  $2.97 \times 10^5$

Raw tapioca starch: Narive Tapioca Starch, manufactured by SIAM STARCH Co., Ltd., peak molecular weight  $1.29 \times 10^6$

Wheat starch: WS-525, manufactured by Chiba Flour Milling Co., Ltd.

20       Corn starch: Corn Starch Y, manufactured by J-Oil Mills, Inc., peak molecular weight  $5.40 \times 10^5$

Waxy Corn Starch: Waxy Corn Starch Y, manufactured by J-Oil Mills, Inc., peak molecular weight  $2.42 \times 10^6$

[0049]

25       (Emulsifier)

Sucrose fatty acid ester 1: RYOTO Sugar Ester S-370, constituent fatty acids C18 series, HLB 3, manufactured by

Mitsubishi-Chemical Foods Corporation

Sucrose fatty acid ester 2: RYOTO Sugar Ester S-570,  
constituent fatty acids C18 series, HLB 5, manufactured by  
Mitsubishi-Chemical Foods Corporation

5        Sucrose fatty acid ester 3: RYOTO Sugar Ester S-770,  
constituent fatty acids C18 series, HLB 7, manufactured by  
Mitsubishi-Chemical Foods Corporation

      Sucrose fatty acid ester 4: RYOTO Sugar Ester S-970,  
constituent fatty acids C18 series, HLB 9, manufactured by  
10 Mitsubishi-Chemical Foods Corporation

      Sucrose fatty acid ester 5: RYOTO Sugar Ester S-1170,  
constituent fatty acids C18 series, HLB 11, manufactured by  
Mitsubishi-Chemical Foods Corporation

      Sucrose fatty acid ester 6: RYOTO Sugar Ester S-1670,  
15 constituent fatty acids C18 series, HLB 16, manufactured by  
Mitsubishi-Chemical Foods Corporation

      Sucrose fatty acid ester 7: RYOTO Sugar Ester P-1670,  
constituent fatty acids C16 series, HLB 16, manufactured by  
Mitsubishi-Chemical Foods Corporation

20        Monoglycerin fatty acid ester 1: EMULGY MS, constituent  
fatty acids C16 (40%), C18 (60%), manufactured by Riken Vitamin  
Co., Ltd.

      Monoglycerin fatty acid ester 2: POEM P(V)S, constituent  
fatty acids C16 (60%), C18 (40%), manufactured by Riken Vitamin  
25 Co., Ltd.

[0050]

(Others)

Calcium carbonate: COLLOCALSO EX, manufactured by Shiraishi Calcium Kaisha, Ltd.

Tuna flakes: Light Tuna Super Non-Oil, manufactured by Inaba Foods Co., Ltd.

5        Mayonnaise: PURE SELECT Mayonnaise, manufactured by Ajinomoto Food Manufacturing Co., Ltd.

Thickener 1: Succinoglycan, manufactured by DSP Gokyo Food & Chemical Co., Ltd.

10       Sweet corn: Sweet corn, manufactured by Natural Kitchen Co., Ltd.

Creaming powder: KN-30, manufactured by J-Oil Mills, Inc.

Lactose: Lactose, manufactured by Bubble Star Co., Ltd.

Onion powder: Onion powder, manufactured by GABAN Co., Ltd.

15       Concentrated whey: FONDOLAC SL, manufactured by Meggle Japan Co., Ltd.

Chicken extract: CPR, manufactured by Riken Vitamin Co., Ltd.

"Ajinomoto": "AJINOMOTO" (registered trademark),  
manufactured by Ajinomoto Co., Inc.

20       [0051]

(Examples 1 to 20 and Comparative Examples 1 to 5)

In the present examples, raw materials were mixed according to the components and mix proportions shown in Table 1 to Table 4, and compositions were prepared by the following method.

25       That is, in each example, raw material components were mixed in a bag until the mixture became sufficiently uniform, and a mixture was obtained. The mixture was subjected to a

pressurization and heating treatment by using a twin-screw extruder (manufactured by Kohwakougyou, Inc., KEI-45). The treatment conditions are as follows.

Raw material supply: Quantities shown in each table

5 Water addition: Quantity shown in each table

Barrel temperature: 30°C, 60°C, 90°C, and 130°C from the raw material inlet port toward the outlet port

Outlet temperature: 130°C to 150°C

Speed of screw rotation: Quantity shown in each table

10 [0052]

A heated and gelatinized material obtained by an extruder treatment in this manner was dried at 110°C to adjust the water content to about 10% by mass.

Next, the dried heated and gelatinized material was  
15 pulverized with a desktop cutter pulverizer and then was sieved with sieves of the JIS-Z8801-1 standard, and a fraction passing through a 0.5-mm sieve and remaining on a 0.15-mm sieve was used as the composition of each example.

For the measurement of the degree of pregelatinization and  
20 free enthalpy, the composition of each example was pulverized with a desktop cutter pulverizer and then sieved with sieves of the JIS-Z8801-1 standard, and a fraction passing through a 0.15-mm sieve was subjected to measurement.

[0053]

25 (Method for Measuring Peak Molecular Weight of Component (a))

Measurement of the peak molecular weight was carried out by

using an HPLC unit manufactured by Tosoh Corporation (pump DP-8020, RI detector RS-8021, degassing apparatus SD-8022).

(1) A sample was pulverized, and a fraction passing through a sieve with a mesh size of 0.15 mm was collected with sieves of the JIS-Z8801-1 standard. This collected fraction was suspended in a mobile phase to a concentration of 1 mg/mL, and the suspension was heated at 100°C for 3 minutes to completely dissolve. Filtration was performed by using a 0.45- $\mu$ m filtration filter (manufactured by ADVANTEC MFS, Inc., DISMIC-25HP PTFE 0.45  $\mu$ m), and the filtrate was used as an analysis sample.

(2) The molecular weight was measured under the following analysis conditions.

Column: Two units of TSKgel  $\alpha$ -M (7.8 mm $\phi$ , 30 cm)  
(manufactured by Tosoh Corporation)  
Flow rate: 0.5 mL/min  
Mobile phase: 90% (v/v) dimethyl sulfoxide solution containing 5 mM NaNO<sub>3</sub>  
Column temperature: 40°C  
Quantity of analysis: 0.2 mL

(3) Detector data was collected using software (MULTISTATION GPC-8020 model II data collection ver5.70, manufactured by Tosoh Corporation), and the molecular weight peak was calculated.

For the calibration curve, pullulans having known molecular weights (Shodex Standard P-82, manufactured by Showa Denko K.K.) were used.

[0054]

(Method for Measuring Degree of Pregelatinization)

Measurement of the degree of pregelatinization of the starch in a granular material was carried out by a  $\beta$ -amylase-pullulanase (BAP) method.

1. The composition was pulverized in advance, and particles having the particle size adjusted to a mesh size of equal to or less than 0.15 mm were used as a measurement sample.

2. According to the method described in "A new method for measuring degree of gelatinization and degree of aging of starch using  $\beta$ -amylase-pullulanase (BAP) system", Denpun Kagaku (Starch Science), Vol. 28, No. 4, pp. 235-240 (1981), the degree of pregelatinization of the starch in the granular material was measured.

15 [0055]

(Method for Measuring Free Enthalpy)

Using DSC 7000-X (manufactured by Hitachi, Ltd.), 2 mg of the composition and 9.5 mg of water were introduced into an Al simple sealed pan (methochrome treatment) and sealed. This was left to stand at room temperature (25°C, hereinafter the same) for equal to or more than 3 hours, and water was absorbed.

A blank cell was used as a reference. The temperature was raised from 10°C to 140°C at a rate of 3 °C/min (measurement point: every 0.5 seconds).

25 In the obtained DSC chart, the amount of heat measured from the endothermic peak area having a peak top in the following temperature range was defined as the free enthalpy of an

amylose-lipid complex per dry mass of the composition  
(hereinafter, also simply referred to as "free enthalpy").

- Composition including sucrose fatty acid ester: 80°C to 100°C

5       · Composition including monoglycerin fatty acid ester:  
115°C to 125°C

- Other compositions: 80°C to 100°C or 115°C to 125°C  
[0056]

(Method for Measuring Degree of Swelling in Cold Water,  
10 Soluble Fraction Amount, and Water Absorption Rate)

1. 1 g (A) of a sample was weighed into a 50-mL Falcon  
tube, and the mass was designated as A.

2. Water was added to the tube graduation of 50 mL while  
vortexing the mixture.

15       3. A sediment was dispersed by inverting and mixing five  
times, and then the dispersion was vortexed for 10 seconds and  
left to stand at room temperature for 30 minutes.

4. Centrifugation was performed at 4000 rpm for 30 minutes  
to separate the dispersion into a sediment layer and a  
20 supernatant layer.

(Centrifuge: manufactured by Hitachi Koki Co., Ltd.,  
Hitachi desktop centrifuge CT6E type; rotor: T4SS type swing  
rotor; adaptor: 50TC×2S adaptor)

5. The supernatant was removed with a pipette, the mass of  
25 the sediment layer was measured, and this was designated as B.

6. The mass obtained when the sediment layer was dried to  
solid (105°C, 24 hours) was measured, and this was designated as

C.

7. The degree of swelling in cold water, the soluble fraction amount, and the water absorption rate of the composition were determined based on the following equations.

5 Degree of swelling in cold water =  $B/C$

Soluble fraction (%) =  $(A - C) / A \times 100$

Water absorption rate (%) =  $(B - A) / A \times 100$

[0057]

(Method for Measuring Bulk Specific Gravity)

10 The composition obtained in each example was sieved to obtain a fraction passing through a 0.5-mm sieve and remaining on a 0.25-mm sieve. 80 g of this fraction was weighed, and the bulk specific gravity was measured according to the JIS K-6720 standard using a bulk specific gravity meter (manufactured by  
15 Kuramochi Kagaku Kikai Seisakusho Co., Ltd.).

[0058]

(Method for Measuring Oil Retention Rate upon Water Absorption)

The oil retention rate upon water absorption of the  
20 composition ("water absorption rate upon water absorption (a double amount of water added)" in Table 1 to Table 4) was determined by the following procedure.

1. 4 g of rapeseed oil (manufactured by J-Oil Mills, Inc.) was added to 1 g of the composition, and the mixture was  
25 thoroughly mixed in a plastic cup.

2. 2 g of water was added thereto, and the mixture was mixed until a dough became uniform.

3. A cercle having a diameter of 32 mm was placed on a flat plate, and the dough was put therein to be even.

4. The cercle was removed, and the flat plate was tilted to about 30 degrees.

5. The flat plate was left to stand still for 10 minutes.

6. Dripped oil was thoroughly wiped off, the water-absorbed and oil-absorbed dough was collected, and the mass was measured (this amount was designated as (A)). The oil retention rate upon water absorption was calculated by the following equation.

Oil retention rate upon water absorption (% by mass) =  $((A - 1 - 2) / 1) / (1 - \text{water content \%}) \times 100$

[0059]

(Lumpiness)

Lumpiness was evaluated by the following procedure.

1. 28.5 g of water was added all at once to 1.5 g of the composition.

2. The mixture was immediately mixed with a spoon for 10 seconds, and the lumpiness was evaluated according to the following criteria.

o: No lumps are formed

Δ: One to two lumps are formed

×: Three or more lumps are formed

[illegible]

[0061]

[Table 2]

Table 2

|                                                |                                                                          | Example 9 | Comparative Example 3 | Example 10 | Example 11   | Example 12 | Example 13   | Example 14 | Comparative Example 4 | Comparative Example 5 |
|------------------------------------------------|--------------------------------------------------------------------------|-----------|-----------------------|------------|--------------|------------|--------------|------------|-----------------------|-----------------------|
| Emulsifier                                     | HLB                                                                      | 11        | none                  | 11         | 16           | 11         | 11           | 11         | 11                    | 11                    |
|                                                | Fatty acid (stearic acid: S, palmitic acid: P)                           | S         |                       | S          | S            | S          | S            | S          | S                     | S                     |
| Mix proportion of raw material (parts by mass) | Crosslinked tapioca starch                                               |           |                       |            |              |            |              |            |                       |                       |
|                                                | Potato starch                                                            | 97        | 99                    |            |              |            |              |            |                       |                       |
|                                                | Pea starch                                                               |           |                       | 97         | 97           |            |              |            |                       |                       |
|                                                | Raw tapioca starch                                                       |           |                       |            |              | 97         |              |            |                       |                       |
|                                                | Wheat starch                                                             |           |                       |            |              |            | 97           |            |                       |                       |
|                                                | Corn starch                                                              |           |                       |            |              |            |              | 97         |                       |                       |
|                                                | High-amylose corn starch                                                 |           |                       |            |              |            |              |            | 97                    |                       |
|                                                | Waxy corn starch                                                         |           |                       |            |              |            |              |            |                       | 97                    |
|                                                | Calcium carbonate                                                        | 1         | 1                     | 1          | 1            | 1          | 1            | 1          | 1                     | 1                     |
|                                                | (b) Sucrose fatty acid ester 5                                           | 2         |                       | 2          |              | 2          | 2            | 2          | 2                     | 2                     |
|                                                | (b) Sucrose fatty acid ester 6                                           |           |                       |            | 2            |            |              |            |                       |                       |
| Production conditions                          | g of added water/per 100 g of starch/min                                 | 17.3      |                       | 23.5       | 23.5         | 23.5       | 23.5         | 23.5       | 23.5                  | 23.5                  |
|                                                | Feed amount g/min                                                        | 416.0     |                       | 306.0      | 306.0        | 306.0      | 306.0        | 306.0      | 306.0                 | 306.0                 |
|                                                | Speed of screw rotation rpm                                              | 230       |                       | 230        | 230          | 230        | 230          | 230        | 230                   | 230                   |
| Physical properties                            | Water absorption rate                                                    | 1889.3%   | 525.2%                | 762.5%     | 736.2%       | 1371.0%    | 1052.8%      | 1126.4%    | 343.3%                | 146.4%                |
|                                                | Oil absorption rate upon water absorption (double amount of water added) | 98%       | 55%                   | 202%       | 153%         | 93%        | 175%         | 188%       | 138%                  | 21%                   |
|                                                | Degree of pregelatinization                                              | 73%       | 87%                   | 76%        | Not measured | 80%        | Not measured | 61%        | 1%                    | 98%                   |
|                                                | Free enthalpy (J/g)                                                      | 1.39      | 0                     | 1.30       | Not measured | 1.15       | Not measured | 0.85       | 0.29                  | 0.10                  |
|                                                | Bulk specific gravity                                                    | 0.61      | 0.65                  | 0.4342     | 0.35         | 0.65       | 0.64         | 0.64       | 0.53                  | 0.59                  |
|                                                | Degree of swelling in cold water                                         | 23.2      | 16.3                  | 10.1       | 9.6          | 17.3       | 13.4         | 13.1       | 4.7                   | 10.5                  |
|                                                | Soluble fraction amount                                                  | 13.6%     | 61.3%                 | 13.8%      | 11.6%        | 14.2%      | 12.8%        | 5.6%       | 5.1%                  | 75.7%                 |
|                                                | Lumpiness                                                                | ○         | ×                     | ○          | ○            | ○          | ○            | ○          | ○                     | ×                     |

[0062]

[Table 3]

Table 3

|                                                               |                                                                                | Example<br>15       | Example<br>16 | Example<br>17       | Example<br>18       |
|---------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------|---------------|---------------------|---------------------|
| Emulsifier                                                    | HLB                                                                            | 4-5                 | 4-5           | 4-5                 | 4-5                 |
|                                                               | Fatty acid (stearic acid: S,<br>palmitic acid: P)                              | P:S =<br>4:6        | P:S =<br>6:4  | P:S =<br>6:4        | P:S =<br>6:4        |
| Mix<br>proportion<br>of raw<br>material<br>(parts by<br>mass) | Crosslinked tapioca starch                                                     | 100                 | 97            |                     |                     |
|                                                               | Potato starch                                                                  |                     |               | 100                 |                     |
|                                                               | Pea starch                                                                     |                     |               |                     | 97                  |
|                                                               | Calcium carbonate                                                              |                     | 1             |                     | 1                   |
|                                                               | (b) Monoglycerin fatty acid<br>ester 1                                         | 2                   |               |                     |                     |
|                                                               | (b) Monoglycerin fatty acid<br>ester 2                                         |                     | 2             | 2                   | 2                   |
| Production<br>conditions                                      | g of added water/per 100 g of<br>starch/min                                    | 18.0                | 18.0          | 17.3                | 23.5                |
|                                                               | Feed amount g/min                                                              | 400.0               | 400.0         | 416.0               | 306.0               |
|                                                               | Speed of screw rotation rpm                                                    | 245                 | 245           | 230                 | 230                 |
| Physical<br>properties                                        | Water absorption rate                                                          | 746%                | 644.3%        | 677.2%              | 577.7%              |
|                                                               | Oil absorption rate upon water<br>absorption (double amount of<br>water added) | 233%                | 227%          | 217%                | 191%                |
|                                                               | Degree of pregelatinization                                                    | Not<br>measure<br>d | 41%           | 37%                 | 65%                 |
|                                                               | Free enthalpy (J/g)                                                            | Not<br>measure<br>d | 2.64          | 3.28                | 8.21                |
|                                                               | Bulk specific gravity                                                          | 0.41                | 0.53          | Not<br>measure<br>d | 0.50                |
|                                                               | Degree of swelling in cold water                                               | 9.7                 | 7.9           | 8.7                 | 6.0                 |
|                                                               | Soluble fraction amount                                                        | 1.0%                | 2.7%          | 5.4%                | Not<br>measure<br>d |
|                                                               | Lumpiness                                                                      | ○                   | ○             | ○                   | ○                   |

[0063]

[Table 4]

Table 4

|                                                               |                                                                                | Example<br>19 | Example<br>20 |
|---------------------------------------------------------------|--------------------------------------------------------------------------------|---------------|---------------|
| Emulsifier                                                    | HLB                                                                            | 11            | 11            |
|                                                               | Fatty acid (stearic acid: S,<br>palmitic acid: P)                              | S             | S             |
| Mix<br>proportion<br>of raw<br>material<br>(parts by<br>mass) | Potato starch                                                                  | 98            | 94            |
|                                                               | (b) Sucrose fatty acid ester 5                                                 | 1             | 4             |
|                                                               | Calcium carbonate                                                              | 1             | 1             |
| Production<br>conditions                                      | g of added water/per 100 g of<br>starch/min                                    | 17.3          | 17.3          |
|                                                               | Feed amount g/min                                                              | 416.0         | 416.0         |
|                                                               | Speed of screw rotation rpm                                                    | 230           | 230           |
| Physical<br>properties                                        | Water absorption rate                                                          | 1270.4%       | 867.9%        |
|                                                               | Oil absorption rate upon water<br>absorption (double amount of water<br>added) | 78%           | 177%          |
|                                                               | Degree of pregelatinization                                                    | 75%           | 71%           |
|                                                               | Free enthalpy (J/g)                                                            | 0.71          | 1.83          |
|                                                               | Bulk specific gravity                                                          | 0.56          | 0.73          |
|                                                               | Degree of swelling in cold water                                               | 16.5          | 9.86          |
|                                                               | Soluble fraction amount                                                        | 15.9%         | 1.6%          |
|                                                               | Lumpiness                                                                      | ○             | △             |

[0064]

From Table 1 to Table 4, each of the compositions obtained  
 5 in the Examples had an excellent balance of the water absorption  
 rate, the oil absorption rate upon water absorption, and the  
 lump reduction.

[0065]

(Examples 21 to 28 and Comparative Examples 6 to 12)

10 In the present examples, the composition was applied to  
 canned tuna tossed with mayonnaise (tuna mayonnaise). The  
 composition used in each example and the evaluation results are  
 shown in Table 5 to Table 7.

[0066]

15 (Mix proportions of tuna mayonnaise)

Raw material                      Mix proportion (% by mass)

[ 0067 ]

10            1. Onions were cut into 5 mm squares and boiled in hot  
water for 2 minutes.

3. The onion pieces equivalent to 85% of the mass of 2.  
15 were squeezed and drained.

5. The materials of 3. and 4., mayonnaise, and the seasoning were thoroughly mixed.

20            6. Each composition was added to the material of 5. at the  
ratio of addition described in each table with respect to the  
weight of the tuna mayonnaise, and the mixture was thoroughly  
mixed to obtain tuna mayonnaise.

[ 0068 ]

22.5 g of the tuna mayonnaise was sandwiched between sandwich breads, and then the resultant was wrapped with a

plastic film to obtain a tuna mayonnaise sandwich.

[0069]

(Method for Measuring Amount of Syneresis)

The tuna mayonnaise was placed in a plastic cup with a lid  
 5 and stored overnight under refrigeration, subsequently the  
 container containing the tuna mayonnaise was tilted and left to  
 stand for 2 hours, and the water collected by syneresis was  
 measured to obtain the amount of syneresis (g).

[0070]

10 (Proportion of Migration of Water from Filling to Bread)

1. The tuna mayonnaise sandwich was stored overnight under  
 refrigeration.

2. The tuna mayonnaise was removed from the tuna mayonnaise  
 sandwich, and the proportion of migration of water from the  
 15 filling to the bread was measured from " $((\text{weight of bread after}$   
 $\text{overnight storage}) - (\text{weight of bread before making sandwich})) /$   
 $(\text{weight of bread before making sandwich}))$ ".

[0071]

(Sensory Evaluation)

20 The tuna mayonnaise was placed in a plastic cup with a lid  
 and stored overnight under refrigeration, and then sensory  
 evaluation was performed.

In the examples described in Table 5, the texture was  
 evaluated by one panelist, and a sample with preferable  
 25 juiciness, paste-likeness, and low roughness was regarded as  
 acceptable.

In the examples described in the evaluations in Table 6,

three panelists graded according to the following criteria, and the average score was used for evaluation. Examples with a score for paste-likeness of equal to or higher than 4.0 and a score for roughness of equal to or higher than 3.0 were regarded  
 5 as acceptable.

In the examples described in Table 7, the tuna mayonnaise sandwiches were stored overnight under refrigeration, the tuna mayonnaise was taken out, one panelist evaluated the texture, and samples with preferable juiciness, powder-likeness, and low  
 10 roughness were regarded as acceptable.

[0072]

<Paste-likeness>

5: Natural texture without paste-likeness

4: Barely paste-like

15 3: Slightly paste-like

2: Paste-like

1: Considerably paste-like

[0073]

<Roughness>

20 5: Not feeling roughness at all

4: Slightly feeling roughness

3: Mildly feeling roughness

2: Feeling roughness

1: Considerably feeling roughness

25

[0074]

[Table 5]

Table 5

|                     | Comparative Example 6                                                  | Example 21                                  | Example 22                                     |
|---------------------|------------------------------------------------------------------------|---------------------------------------------|------------------------------------------------|
| Composition         | -                                                                      | Example 5                                   | Example 17                                     |
| Amount of addition  | 0.0%                                                                   | 1.0%                                        | 1.0%                                           |
| Amount of syneresis | 2.61 g/50 g                                                            | 0.18 g/50 g                                 | 0.26 g/50 g                                    |
| Texture             | Lacking in brittleness and juiciness, Low paste-likeness and roughness | Juicy, no paste-likeness, and Low roughness | Juicy, no paste-likeness, and Slight roughness |

[0075]

[Table 6]

Table 6

|                     | Comparative Example 7 | Comparative Example 8 | Comparative Example 9 | Comparative Example 10 | Comparative Example 11 | Example 23 | Example 24  | Example 25  |
|---------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|------------|-------------|-------------|
| Composition         | -                     | Comparative Example 1 | Comparative Example 2 | Comparative Example 5  | Comparative Example 4  | Example 5  | Example 10  | Example 9   |
| Amount of addition  | 0.0%                  | 1.3%                  | 1.3%                  | 1.3%                   | 1.3%                   | 1.3%       | 1.3%        | 1.3%        |
| Amount of syneresis | 3.66/50 g             | 0.02/50 g             | 0.67/50 g             | 0.72/50 g              | 1.62/50 g              | 0.29/50 g  | 0.21 g/50 g | 0.06 g/50 g |
| Paste-likeness      | 5.0                   | 1.0                   | 4.0                   | 3.0                    | 4.0                    | 4.2        | 4.5         | 4.5         |
| Roughness           | 5.0                   | 4.0                   | 1.0                   | 3.0                    | 1.0                    | 3.8        | 3.5         | 4.0         |

5

[0076]

[Table 7]

Table 7

|                                                                | Comparative Example 12           | Example 26                      | Example 27                      | Example 28                              |
|----------------------------------------------------------------|----------------------------------|---------------------------------|---------------------------------|-----------------------------------------|
| Composition                                                    | -                                | Example 10                      | Example 5                       | Example 6                               |
| Amount of addition                                             | 0.0%                             | 1.3%                            | 1.3%                            | 1.3%                                    |
| Proportion of migration of water from tuna mayonnaise to bread | 19.0%                            | 11.3%                           | 12.0%                           | 10.7%                                   |
| Texture of tuna mayonnaise                                     | Low juiciness<br>Dry and brittle | o Juicy,<br>Low powder-likeness | o Juicy,<br>Low powder-likeness | © Juicy,<br>Not feeling powder-likeness |

[0077]

(Examples 29 and 30 and Comparative Examples 13 to 15)

In the present examples, the composition was applied to  
 10 hamburger steaks. The type of the composition blended in each  
 example and the evaluation results are shown in Table 8.

[0078]

(Mix proportions of hamburger steak)

|    | Raw material                      | Mix proportion      |
|----|-----------------------------------|---------------------|
|    | (1) Beef (80% lean)               | 33.0% by mass       |
|    | (1) Chicken meat (chicken breast) | 18.0% by mass       |
|    | (1) Pork                          | 5.0% by mass        |
| 5  | (1) Salt                          | 0.60% by mass       |
|    | (1) Pork fat                      | 4.0% by mass        |
|    | (2) Onion (raw)                   | 23.5% by mass       |
|    | (2) Egg white                     | 8.0% by mass        |
|    | (2) Cornstarch Y                  | 0.60% by mass       |
| 10 | (2) Sugar                         | 0.10% by mass       |
|    | (2) Pepper                        | 0.10% by mass       |
|    | (2) "AJINOMOTO"                   | 0.10% by mass       |
|    | (3) Water                         | 2.5% by mass        |
|    | (4) Bread crumbs                  | 2.0% by mass        |
| 15 | <u>(4) Composition</u>            | <u>2.5% by mass</u> |
|    | Total                             | 100.00% by mass     |

[0079]

(Process for Producing Hamburg Steak)

1. All the materials of (1) in the above-described "Mix  
 20 proportions of hamburg steak" were put in a bowl and mixed by  
 hand.

2. The mixture was mixed for 3 minutes in a Kenmix mixer  
 (manufactured by Aicoasha Manufacturing Co., Ltd.) at an  
 intensity of 2.

25 3. The materials of (2) were added thereto and mixed by  
 hand, and the mixture was mixed for 1 minute in a Kenmix mixer  
 (manufactured by Aicoasha Manufacturing Co., Ltd.) at an

intensity of 2.

4. The material of (3) was put therein, and the mixture was thoroughly mixed by hand.

5. The materials of (4) that had been mixed in advance were added thereto, and the mixture was thoroughly mixed by hand so as not to form lumps.

6. 120 g was weighed and formed.

7. The formed patty was baked on both sides on a hot plate at 200°C for 1 minute on each side.

10 8. A mesh was placed on an iron plate of a convection oven, the dough after baking in the above-described procedure 7. was placed on top of the mesh and baked at 200°C for 9 minutes to obtain a hamburger steak.

9. The weight after baking was measured, and the ratio of weight after baking / weight before baking (the procedure 6.) was designated as baking yield. A yield of equal to or more than 75% was regarded as acceptable.

10. The obtained hamburger steak was stored at -20°C for one week.

20 [0080]

(Sensory Evaluation)

Three frozen-stored hamburger steaks were placed side by side on a plate, wrapped, and heated in a microwave oven at 700 W for 3 minutes. Three panelists graded the juiciness, toughness, paste-likeness, and the feeling of meat grains of the heat-thawed hamburger steaks according to the following criteria, and the average score was used for evaluation. Examples that

received a score of equal to or higher than 3 for all of the items were regarded as acceptable.

[0081]

(Juiciness)

5 5: Considerably juicy

4: Juicy

3: Slightly juicy

2: Slightly dry

1: Dry

10 (Toughness)

5: Considerably strong meat-like toughness

4: Strong meat-like toughness

3: Having meat-like toughness

2: Tender

15 1: Considerably tender

(Paste-likeness)

4: No paste-like feeling

3: Almost no paste-like feeling

2: Paste-like

20 1: Considerably paste-like

(Feeling of Meat Grains)

5: Considerably feeling the feeling of meat grains

4: Feeling the feeling of meat grains

3: Slightly feeling the feeling of meat grains

25 2: Slightly low feeling of meat grains

1: Low feeling of meat grains

[0082]

[Table 8]

Table 8

|             |                           | Comparative<br>Example 13 | Comparative<br>Example 14 | Comparative<br>Example 15 | Example 29 | Example 30 |
|-------------|---------------------------|---------------------------|---------------------------|---------------------------|------------|------------|
| Composition |                           | Comparative<br>Example 5  | Comparative<br>Example 1  | Comparative<br>Example 2  | Example 5  | Example 17 |
| Yield       |                           | 72.3%                     | 73.9%                     | 76.8%                     | 76.4%      | 75.6%      |
| Texture     | Juiciness                 | 3.0                       | 2.7                       | 1.3                       | 4.0        | 3.2        |
|             | Toughness                 | 2.0                       | 2.3                       | 3.7                       | 3.8        | 3.5        |
|             | Paste-likeness            | 2.2                       | 1.5                       | 3.3                       | 3.0        | 3.0        |
|             | Feeling of meat<br>grains | 2.3                       | 1.7                       | 2.7                       | 3.0        | 3.7        |

[0083]

(Examples 31 and 32 and Comparative Example 16)

- 5 In the present examples, the composition was applied to a soup. The type of the composition blended in each example and the evaluation results are shown in Table 9.

[0084]

(Mix Proportions of Powdered Soup)

| 10 | Raw material                 | Mix proportion |
|----|------------------------------|----------------|
|    | Sweet corn                   | 29% by mass    |
|    | Potato starch                | 16% by mass    |
|    | Composition or potato starch | 6% by mass     |
|    | Sugar                        | 22% by mass    |
| 15 | Creaming powder              | 18% by mass    |
|    | Salt                         | 3% by mass     |
|    | Lactose                      | 2% by mass     |
|    | Whole milk powder            | 1% by mass     |
|    | Onion powder                 | 0.5% by mass   |
| 20 | Concentrated whey            | 0.2% by mass   |
|    | Chicken extract              | 0.6% by mass   |
|    | White pepper                 | 0.1% by mass   |

|             |              |
|-------------|--------------|
| "AJINOMOTO" | 1.6% by mass |
|-------------|--------------|

|       |              |
|-------|--------------|
| Total | 100% by mass |
|-------|--------------|

[0085]

(Process for Producing Powdered Soup)

5        1. The raw materials were mixed so as to achieve the  
blending proportions of the above-described "Mix Proportions of  
Powdered Soup".

2. The mixture was granulated and dried under the following  
conditions using a fluidized bed granulator (manufactured by  
10 Powrex Corporation, FD-MP-01D/PLS).

Binder: 80 mL of 10% dextrin (SUNDEX 100 solution), with  
respect to 400 g of powder

Supply air volume: 0.6 m<sup>3</sup>/min target

Supply air temperature: 70°C

15 Exhaust air temperature: about 30°C

Rotor rotation: 120 rpm

Atomized spray air: 90 g/min

Atomized flow rate: 10 g/min

Granulation time: about 10 min + 5 min for drying after  
20 granulation

Powder sweeping conditions: 0.3 s/interval of 1.0 s

[0086]

(Method for Preparing Soup)

To 17.6 g of the powdered soup, 150 g of hot water whose  
25 temperature was adjusted in a pot set to 98°C was added, and the  
mixture was immediately stirred 15 times (at a speed of one  
rotation per second) with a spoon.

[0087]

(Lump Weight)

The obtained soup was passed through a sieve with a mesh size of 1 mm, and the weight of lumps remaining on the sieve was  
5 designated as lump weight.

[0088]

(Sensory Evaluation)

Two panelists graded a thickness and fibrousness of the obtained soup according to the following criteria and evaluated  
10 the properties by discussion. A score of equal to or higher than 2 was regarded as acceptable.

[0089]

(Thickness)

3: There is a preferable moderate thickness

15 2: Slightly lacking in thickness

1: Lacking in thickness

(Fibrousness)

3: Feeling the fibrousness

2: Slightly feeling the fibrousness

20 1: Not feeling the fibrousness

[0090]

[Table 9]

Table 9

|               |             | Comparative<br>Example 16 | Example 31   | Example 32   |
|---------------|-------------|---------------------------|--------------|--------------|
| Particle size |             | -                         | 250 to 75 μm | 250 to 75 μm |
| Composition   |             |                           | Example 9    | Example 17   |
| Lump weight   |             | 8.34 g                    | 1.88 g       | 1.04 g       |
| Texture       | Thickness   | 3                         | 3            | 2            |
|               | Fibrousness | 2                         | 2            | 3            |

[0091]

(Examples 33 and 34 and Comparative Examples 17 to 20)

In the present examples, the compositions were applied to whipped cream. The type of the composition blended in each example and the evaluation results are shown in Table 10.

5 [0092]

(Mix Proportions of Whipped Cream)

|    | <u>Raw material</u>          | <u>Mix proportion</u> |
|----|------------------------------|-----------------------|
|    | White sugar                  | 10% by mass           |
|    | Fresh cream                  | 80% by mass           |
| 10 | <u>Water + composition*2</u> | <u>10% by mass</u>    |
|    | Total                        | 100% by mass          |

[0093]

\*2 The amount of water was adjusted such that the composition had the blending proportion described in Table 10

15 [0094]

(Process for Producing Whipped Cream)

1. Water and the composition were mixed to prepare "water + composition" in the above-described "Mix Proportions of Whipped Cream".

20 At this time, in Examples 33 and 34 in Table 10, a predetermined amount of water was added to the composition, and the mixture was stirred with a spoon and prepared.

In Comparative Examples 17 to 20, since lumps were easily formed, the mixtures were sufficiently stirred with a Homomixer  
25 so as not to form lumps.

2. All the materials were combined, and the mixture was whipped (after 1 minute at speed 1, 3 minutes or more at speed 2

\*3) with a hand mixer in an ice bath to obtain a whipped cream of each example.

\*3 The overrun (weight after whipping / weight before whipping) of each test plot was adjusted to be about 1.8 to 2.1.

5 In Comparative Example 18 in Table 10, it was difficult only for the thickener 1 (succinoglycan) to foam, and the overrun was about 1.4.

[0095]

(Amount of Syneresis)

10 The amount of syneresis during storage under refrigeration of the obtained whipped cream was measured by the following method.

7 g of whipped cream was squeezed out into an area with a radius of 2.2 cm from the center of two stacked sheets of filter  
15 paper and was stored under refrigeration for 18 hours.

After storage, the whipped cream was removed, and the "weight of the filter paper after storage - weight of the filter paper before storage" was measured as the amount of syneresis.

[0096]

20 (Sensory Evaluation)

Two panelists graded the melt-in-the-mouth property and the brittleness and roughness of the obtained whipped cream after storage for 18 hours under refrigeration (4°C), according to the following criteria and evaluated the properties by discussion.  
25 Samples with a score of equal to or higher than 3 for both the melt-in-the-mouth property and the dryness and roughness were regarded as acceptable.

[0097]

(Melt-in-the-Mouth Property)

3: The melt-in-the-mouth property is good

2: The melt-in-the-mouth property is slightly poor, and

5 there is a leftover in the mouth

1: The melt-in-the-mouth property is poor, and there is a  
leftover in the mouth

(Dryness and Roughness)

3: Not feeling dryness and roughness

10 2: Slightly feeling dryness and roughness

1: Feeling dryness and roughness

[0098]

[Table 10]

Table 10

|                          |                                | Comparative<br>Example 17 | Comparative<br>Example 18 | Comparative<br>Example 19 | Comparative<br>Example 20 | Example<br>33 | Example<br>34 |
|--------------------------|--------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------|---------------|
| Composition or thickener |                                | -                         | Thickener 1               | Comparative<br>Example 1  | Comparative<br>Example 2  | Example 9     | Example 6     |
| Amount of addition       |                                | 0.00%                     | 0.05%                     | 0.50%                     | 0.50%                     | 0.50%         | 0.50%         |
| Amount of syneresis      |                                | 1.21 g                    | 0.60 g                    | 0.67 g                    | 0.95 g                    | 0.75 g        | 0.77 g        |
| Texture                  | Melt-in-the-<br>mouth Property | 2                         | 1                         | 1                         | 1                         | 3             | 3             |
|                          | Dryness and<br>roughness       | 1                         | 3                         | 3                         | 1                         | 3             | 3             |

[0099]

15 (Examples 35 and 36)

In the present examples, the compositions were prepared according to the methods of Example 1, except that the components and the raw materials described in Table 11 were mixed, and Poly twin BCTG62 manufactured by Bühler Group was used as a twin-screw extruder for the heating and pressurization treatment. Measurement and evaluation were carried out for the obtained compositions according to the methods of Example 1. The results are also shown together in Table 11.

[0100]

[Table 11]

Table 11

|                                                               |                                                                                | Example<br>35   | Example<br>36   |
|---------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------|-----------------|
| Emulsifier                                                    | HLB                                                                            | 11              | 11              |
|                                                               | Fatty acid (stearic acid: S,<br>palmitic acid: P)                              | S               | S               |
| Mix<br>proportion<br>of raw<br>material<br>(parts by<br>mass) | Crosslinked tapioca starch                                                     |                 |                 |
|                                                               | Potato starch                                                                  | 97.8            | 97.7            |
|                                                               | High-amylose corn starch                                                       |                 |                 |
|                                                               | Calcium carbonate                                                              | 1               | 1               |
|                                                               | Sucrose fatty acid ester 1                                                     |                 |                 |
|                                                               | (b) Sucrose fatty acid ester 2                                                 |                 |                 |
|                                                               | (b) Sucrose fatty acid ester 3                                                 |                 |                 |
|                                                               | (b) Sucrose fatty acid ester 4                                                 |                 |                 |
|                                                               | (b) Sucrose fatty acid ester 5                                                 | 1.2             | 1.3             |
|                                                               | (b) Sucrose fatty acid ester 6                                                 |                 |                 |
|                                                               | (b) Sucrose fatty acid ester 7                                                 |                 |                 |
| Production<br>conditions                                      | g of added water/per 100 g of<br>starch/min                                    | 9.0             | 9.0             |
|                                                               | Feed amount g/min                                                              | 11666.0         | 11666.0         |
|                                                               | Speed of screw rotation rpm                                                    | 750             | 750             |
| Physical<br>properties                                        | Water absorption rate                                                          | 1104.2%         | 1158.7%         |
|                                                               | Oil absorption rate upon water<br>absorption (double amount of water<br>added) | 118%            | 74%             |
|                                                               | Degree of pregelatinization                                                    | 100%            | 90%             |
|                                                               | Free enthalpy (J/g)                                                            | 0.10            | 0.30            |
|                                                               | Bulk specific gravity                                                          | Not<br>measured | Not<br>measured |
|                                                               | Degree of swelling in cold water                                               | 15.2            | 15.9            |
|                                                               | Soluble fraction amount                                                        | 20%             | 20%             |
|                                                               | Lumpiness                                                                      | ○               | ○               |

[0101]

This patent application claims priority on the basis of

5 Japanese Patent Application No. 2021-061388, filed on March 31,  
2021, the disclosure of which is incorporated herein in its  
entirety by reference.

## CLAIMS

[Claim 1] A starch composition for food, comprising the following components (a) and (b):

- 5       (a) a starch; and  
      (b) an emulsifier,

wherein at least a portion of the component (a) and at least a portion of the component (b) form an amylose-lipid complex in the starch composition for food,

- 10       the component (a) has a peak molecular weight of equal to or more than  $2.7 \times 10^5$  and equal to or less than  $2.3 \times 10^6$ ,

- the component (b) is at least one selected from the group consisting of a monoglycerin fatty acid ester and a sucrose fatty acid ester having an HLB of equal to or more than 4 and  
15 equal to or less than 16,

a free enthalpy of the amylose-lipid complex per dry mass of the composition as measured by differential scanning calorimetry is equal to or more than 0.1 J/g and equal to or less than 20 J/g,

- 20       a degree of swelling in cold water at 25°C of the starch composition for food is equal to or more than 5.0 and equal to or less than 40, and

- a soluble fraction amount at 25°C of the starch composition for food is more than 0% by mass and equal to or less than 20%  
25 by mass.

[Claim 2] The starch composition for food according to claim 1,

wherein the component (a) is a starch that has not been subjected to any of an acid-treatment, an oxidization treatment, and an enzymatic treatment.

- 5 [Claim 3] The starch composition for food according to claim 1 or 2, wherein the component (a) is one or two or more starches selected from the group consisting of tapioca starch, crosslinked tapioca starch, pea starch, potato starch, wheat starch, and corn starch.

10

[Claim 4] A process for producing the starch composition for food according to any one of claims 1 to 3, the process comprising:

obtaining a mixture including the components (a) and (b);

15 and

obtaining the starch composition for food by subjecting the mixture to a pregelatinization treatment to form the amylose-lipid complex.

- 20 [Claim 5] The process according to claim 4, wherein in the obtaining a mixture, a blending amount of the component (b) is equal to or more than 0.1 parts by mass and equal to or less than 10 parts by mass with respect to 100 parts by mass of the component (a).

25

[Claim 6] The process according to claim 4 or 5, wherein in the obtaining a mixture, a blending amount of the component (a) is

equal to or more than 75% by mass and equal to or less than 99.8% by mass with respect to a total composition.

[Claim 7] The process according to any one of claims 4 to 6,  
5 wherein the obtaining the starch composition for food includes heating and pressurizing the mixture with an extruder to granulate the mixture.