DESCRIPTION

SOLID PASTE COMPOSITION FOR COOKING AND METHOD FOR PRODUCING SAME

TECHNICAL FIELD

[0001]

The present invention relates to a solid paste composition for heat cooking and a method of producing the composition.

BACKGROUND ART

[0002]

There are a wide variety of solid paste compositions for cooking all over the world, which are made from various raw materials such as cereal flour and starch, by kneading the material with water and salts into a dough, which is then made into various shapes. They are commonly in elongated shapes (e.g., pasta- and noodle-like foods), but some are there are also made into other shapes such as strips, plates, reeds, tubes, dumplings, grains, etc.

[0003]

Such solid paste compositions for cooking, whether in raw or dried form, are eaten after heat cooking. It is known that the texture derived from the composition structure plays an important role in preference. Conventional solid paste compositions for heat cooking are known to have a unique texture due to their protein network structure such as gluten, as explained in Patent Literature 1.

LIST OF CITATIONS

Patent Literature

[0004]

[Patent Literature 1] JP 2017-055672 A

SUMMARY ~~OF INVENTION~~

[0004a]

In one aspect, provided herein is a solid paste composition for heat cooking containing at least pulse as a raw material and satisfying the requirements (1) to (4), (7), and (12) below.

(1) The composition has an insoluble dietary fiber content of 2.0 mass % or more in terms of dry mass basis.

(2) The composition has a starch content of 15 mass % or more in terms of dry mass basis.
(3) The composition has a protein content of 5.5 mass % or more in terms of dry mass basis.
(4) When at least one frozen section A of the composition prepared under [Condition A] below is subjected to CBB (Coomassie Brilliant Blue) staining and observed, at least either (4a) or (4b) is satisfied.
(4a) The ratio of [the number of CBB-stained sites having areas of 200μm^2 or more and degree of roundness of 0.3 or more] to [the number of CBB-stained sites having areas of 30μm^2 or more] is 3% or more.
(4b) The ratio of [the total area of CBB-stained sites having areas of 200μm^2 or more and degrees of roundness of 0.3 or more] to [the total section area of the composition] is 0.3% or more.
[Condition A] The composition is heated in water at 90ºC for 6 minutes and then frozen at -25ºC, and the frozen composition is cut along a certain cut plane A into a section having a thickness of 30 μm, which section is used as a frozen composition section A.
(7) The composition satisfies at least either (7a) or (7b).
(7a) When one mass part of the composition is immersed in 9 mass parts of iodine solution (0.25 mM) at 20°C for 3 minutes and filtered through a 0.20 μm filter, the difference in absorbance (500 nm) of the iodine solution is 0.65 or less.
(7b) When one mass part of the composition is immersed in 9 mass parts of iodine solution (0.25 mM) at 20°C for 3 minutes and filtered through a 0.20 μm filter and the filtrate stained with iodine (final concentration 0.25 mM), the difference in absorbance (500 nm) of the iodine solution is 1.2 or less.
(12) When a 6% suspension of a crushed product of the composition is observed, the number of starch grain structures observed is 300/mm^2 or less.
[0004b]
In another aspect, provided herein is a crushed composition prepared by crushing a composition as described herein.
[0004c]
In another aspect, provide herein is a crushed composition agglomerate prepared by agglomerating a crushed composition as described herein.
[0004d]
In another aspect, provided herein is a process of producing a solid paste composition for heat cooking as described herein, comprising the steps of:
(i) preparing a paste dough composition containing at least pulse as a raw material and having an insoluble dietary fiber content of 1.5 mass % or more in terms of wet basis, a starch content of 5.0 mass % or more in terms of wet basis, a protein content of 3.0 mass % or more in terms of wet basis, and a dry mass basis moisture content of 25 mass % or more;
(ii) kneading the composition prepared in step (i) at a temperature of from 100ºC to 200ºC with a specific mechanical energy (SME) of 350kJ/kg or more; and

(iii) cooling the composition kneaded in step (ii) to a temperature at which a temperature at which the composition does not swell.

PROBLEM TO BE SOLVED BY THE DISCLOSURE

[0005]

However, the composition described in Patent Document 1 is difficult to adjust the fine texture, since its gluten network structure is uniformly formed throughout the

composition. Therefore, it cannot be served for patients with gluten-unreceptive diseases. On the other hand, the conventional starch-based solid paste compositions for heat cooking involves a problem in that when its surface is hardened to enhance its crunchiness, it becomes highly elastic and imparted a rubbery texture.

[0006]

Thus, a problem to be addressed by the present ~~invention~~disclosure is to provide a solid paste composition for heat cooking that has elasticity with less rubbery texture, and exhibits a texture that passes smoothly through the teeth when chewed, as well as a method for producing the composition.

MEANS TO SOLVE THE PROBLEM

[0007]

Through intensive efforts in view of these circumstances, the inventors focused on the effects of protein, insoluble dietary fiber, and starch derived from edible plants, to which no attention was given in the conventional art, and found that a solid paste composition for heat cooking that can solve the problem mentioned above can be obtained by adjusting each of these parameters to within a range when producing the paste, and also forming CBB-stained structures with specific shapes inside the composition. In addition, the inventors focused on kneading of the dough composition with strong energy under high-temperature and high-pressure conditions, which are not typically employed in the conventional art by those skilled in the art since such conditions may denature gluten contained in wheat, etc., and found that the solid paste composition for heat cooking mentioned above can be produced according to a simple method by processing edible plant-derived raw materials under specific conditions. Based on these findings, the inventors then proceeded with further research, and have completed the following ~~invention~~disclosures.

[0008]

Specifically, ~~aspect~~examples of the present ~~invention~~disclosure include ~~Aspect~~Examples [1] to [44] below.

[~~Aspect~~Example 1]

A solid paste composition for heat cooking satisfying the requirements (1) to (4) below.

(1) The composition has an insoluble dietary fiber content of 2.0 mass % or more in terms of dry mass basis.

(2) The composition has a starch content of 15 mass % or more in terms of dry mass basis.

(3) The composition has a protein content of 5.5 mass % or more in terms of dry mass basis.

(4) When at least one frozen section A of the composition prepared under [Condition A] below is subjected to CBB (Coomassie Brilliant Blue) staining and observed, at least either (4a) or (4b) is satisfied.

(4a) The ratio of [the number of CBB-stained sites having areas of 200μm^2 or more and degree of roundness of 0.3 or more] to [the number of CBB-stained sites having areas of 30μm^2 or more] is 3% or more.

(4b) The ratio of [the total area of CBB-stained sites having areas of 200μm^2 or more and degrees of roundness of 0.3 or more] to [the total section area of the composition] is 0.3% or more.

[Condition A] The composition is heated in water at 90ºC for 6 minutes and then frozen at -25ºC, and the frozen composition is cut along a certain cut plane A into a section having a thickness of 30 μm, which section is used as a frozen composition section A.

[~~Aspect~~Example 2]

The composition according to ~~Aspect~~Example 1, wherein when the frozen composition section A is subjected to CBB staining and observed, the section further satisfies the at least either (4c) or (4d).

(4c) The area corresponding to the 90th percentile score in the CBB-stained sites having areas of 30μm^2 or more is 3500μm^2 or less.

(4d) The number of CBB-stained sites having longest diameters of 200 μm or more is 40 or less.

[~~Aspect~~Example 3]

The composition according to ~~Aspect~~Example 1 or 2, wherein when the frozen composition section A is subjected to CFW (Calcofluor-white) staining and observed, the section further satisfies the at least either (5a) or (5b).

(5a) The average of the longest diameters of CFW-stained sites is 450 μm or less.

(5b) The average of the ~~aspect~~example ratios of CFW-stained sites is 5.0 or less.

[~~Aspect~~Example 4]

The composition according to any one of ~~Aspect~~Examples 1 to 3, wherein the frozen composition section A is a frozen composition section A1, which is obtained along a cut plane A1 orthogonal to the longitudinal axis of the composition.

[~~Aspect~~Example 5]

The composition according to any one of ~~Aspect~~Examples 1 to 3, wherein the frozen composition section A comprises a frozen composition section A1, which is obtained along a cut plane A1 orthogonal to the longitudinal axis of the composition, and a frozen composition section A2, which is obtained along a cut plane A2 parallel to the longitudinal axis of the composition.

[~~Aspect~~Example 6]

The composition according to any one of ~~Aspect~~Examples 1 to 5, wherein when at least one frozen composition section B prepared under [Condition B] below is measured by the X-ray diffraction method, the average crystallinity at the center of the composition section is

higher than the average crystallinity at the periphery of the composition section.
[Condition B] The composition is frozen at -25°C, and the frozen composition is cut along a certain cut plane B into a section having a thickness of 30 μm, which section is observed as a frozen composition section B.

[~~Aspect~~Example 7]

The composition according to any one of ~~Aspect~~Examples 1 to 5, wherein when at least one frozen composition section B prepared under [Condition B] below is subjected to CBB staining and observed, a smooth tissue part with an average thickness of 20 μm or more is found along 30% or more of the perimeter of the composition section on the cut plain B.
[Condition B] The composition is frozen at -25°C, and the frozen composition is cut along a certain cut plane B into a section having a thickness of 30 μm, which section is observed as a frozen composition section B.

[~~Aspect~~Example 8]

The composition according to ~~Aspect~~Example 7, wherein when the frozen composition section B is subjected to CBB staining and observed, the ratio of [the number of CBB-stained sites area 200μm^2 or more and degrees of roundness of 0.3 or more in the smooth tissue part on the cut plane B] to [the number of CBB-stained sites having areas of 30μm^2 or more in the smooth tissue part on the cut plane B] is 3% or more.

[~~Aspect~~Example 9]

The composition according to ~~Aspect~~Example 7 or 8, wherein when the frozen composition section B is measured by the X-ray diffraction method, the average crystallinity in the non-smooth tissue part, which exists inside of the smooth tissue part of the composition, is higher than the average crystallinity in the smooth tissue part.

[~~Aspect~~Example 10]

The composition according to any one of ~~Aspect~~Examples 6 to 9, wherein the frozen composition section B is a frozen composition section B1, which is obtained along a cut plane B1 orthogonal to the longitudinal axis of the composition.

[~~Aspect~~Example 11]

The composition according to any one of ~~Aspect~~Examples 6 to 9, wherein the frozen composition section B comprises a frozen composition section B1, which is obtained along a cut plane B1 orthogonal to the longitudinal axis of the composition, and a frozen composition section B2, which is obtained along a cut plane B2 parallel to the longitudinal axis of the composition.

[~~Aspect~~Example 12]

The composition according to any one of ~~Aspect~~Examples 1 to 11, wherein when a 6% suspension of a crushed product of the composition is observed, the number of starch grain structures observed is 300/mm^2 or less.

[~~Aspect~~Example 13]

The composition according to any one of ~~Aspect~~Examples 1 to 12, further satisfying one or more of (6a) to (6d).

(6a) The content of soluble γ-amino butyric acid in the composition is 25mg % or less.
(6b) The ratio of the soluble γ-amino butyric acid content to the total content of soluble proteinogenic amino acids in the composition is 1.5 mass % or less.
(6c) The content of soluble leucine in the composition is 10mg % or less.
(6d) The ratio of the soluble leucine content to the total content of soluble proteinogenic amino acids in the composition is 1.0 mass % or less.

[~~Aspect~~Example 14]

The composition according to any one of ~~Aspect~~Examples 1 to 13, further satisfying at least either (7a) or (7b).

(7a) When one mass part of the composition is immersed in 9 mass parts of iodine solution (0.25 mM) at 20°C for 3 minutes and filtered through a 0.20 μm filter, the difference in absorbance (500 nm) of the iodine solution is 0.70 or less.
(7b) When one mass part of the composition is immersed in 9 mass parts of iodine solution (0.25 mM) at 20°C for 3 minutes and filtered through a 0.20 μm filter and the filtrate stained with iodine (final concentration 0.25 mM), the difference in absorbance (500 nm) of the iodine solution is 1.2 or less.

[Example~~Aspect~~ 15]

The composition according to any one of ~~Aspect~~Examples 1 to 14, further satisfying at least either (8a) or (8b).

(8a) When one mass part of the composition is treated in 9 mass parts of 1% glucoamylase aqueous solution at 20ºC for 2 hours, the glucose content in the resulting reaction solution is less than 2.40 mass %.
(8b) When one mass part of the composition is treated in 9 mass parts of 1% glucoamylase aqueous solution at 20ºC for 2 hours, the glucose content in the resulting reaction solution is 50% or less of a glucose content in a reaction solution prepared by treating one mass part of a crushed product of the composition in 9 mass parts of 1% glucoamylase aqueous solution at 20ºC for 2 hours.

[~~Aspect~~Example 16]

The composition according to any one of ~~Aspect~~Examples 1 to 15, further satisfying at least either (9a) or (9b).

(9a) When the composition is subjected to [Treatment C] below and then to ultrasonic treatment, the particle size distribution d_{50} of the resulting product is 450 μm or less.
(9b) When the composition is subjected to [Treatment C] below and then to CFW (Calcofluor-white) staining and observed under fluorescence microscope, the average of the longest diameters of CFW-stained sites is 450 μm or less.
[Treatment C] 6 mass % water suspension of the composition is treated with 0.4 volume % of protease and 0.02 mass % of α-amylase at 20ºC for 3 days.

[~~Aspect~~Example 17]

The composition according to any one of ~~Aspect~~Examples 1 to 16, comprising at least one edible plant as a raw material and further satisfying at least either (10a) or (10b).

(10a) The ratio of the starch content derived from the edible plant to the total starch content in the composition is 50 mass % or more in terms of dry mass basis.
(10b) The ratio of the protein content derived from the edible plant to the total protein content in the composition is 50 mass % or more in terms of dry mass basis.
[~~Aspect~~Example 18]
The composition according to ~~Aspect~~Example 17, wherein the edible plant is a dried edible plant with a dry mass basis moisture content of less than 25 mass%.
[~~Aspect~~Example 19]
The composition according to ~~Aspect~~Example 17 or 18, wherein the edible plant is a pulse.
[~~Aspect~~Example 20]
The composition according to ~~Aspect~~Example 19, wherein the pulse is one or more species of pulse selected from Pisum, Phaseolus, Cajanus, Vigna, Vicia, Cicer, Glycine and Lens species.
[~~Aspect~~Example 21]
The composition according to ~~Aspect~~Example 19 or 20, wherein the pulse is in the form of pulse flour with a particle size d_{90} of 500 μm or less after subjected to ultrasonic treatment.
[~~Aspect~~Example 22]
The composition according to any one of ~~Aspect~~Examples 19 to 21, wherein the ratio of the starch content derived from pulse to the total starch content in the composition is 50 mass% or more in terms of dry mass basis.
[~~Aspect~~Example 23]
The composition according to any one of ~~Aspect~~Examples 1 to 22, which is not in the form of a swollen product.
[~~Aspect~~Example 24]
The composition according to any one of ~~Aspect~~Examples 1 to 23, which has a total oil and fat content of less than 17 mass % in terms of dry mass basis.
[~~Aspect~~Example 25]
The composition according to any one of ~~Aspect~~Examples 1 to 24, which has a dry mass basis moisture content of 60 mass % or less.
[~~Aspect~~Example 26]
A crushed composition prepared by crushing a composition according to any one of ~~Aspect~~Examples 1 to 25.
[~~Aspect~~Example 27]
A crushed composition agglomerate prepared by agglomerating a crushed composition according to ~~Aspect~~Example 26.
[~~Aspect~~Example 28] A process of producing a solid paste composition for heat cooking according to any one of ~~Aspect~~Examples 1 to 25, comprising the steps of:
(i) preparing a paste dough composition having an insoluble dietary fiber content of 1.5 mass % or more in terms of wet basis, a starch content of 5.0 mass % or more in terms of

wet basis, a protein content of 3.0 mass % or more in terms of wet basis, and a dry mass basis moisture content of 25 mass % or more;

(ii) kneading the composition prepared in step (i) at a temperature of from 100ºC to 200ºC with a specific mechanical energy (SME) of 350kJ/kg or more; and

(iii) cooling the composition kneaded in step (ii) to a temperature at which a temperature at which the composition does not swell.

[~~Aspect~~Example 29]

The process according to ~~Aspect~~Example 28, wherein the paste dough composition in step (i) is prepared at least using pulse.

[~~Aspect~~Example 30]

The process according to ~~Aspect~~Example 29, wherein the ratio of the content of starch derived from pulse to the total starch content in the dough composition prepared in step (i) is 50 mass % or more in terms of dry mass basis.

[~~Aspect~~Example 31]

The process according to ~~Aspect~~Example 29 or 30, wherein the pulse used in step (i) is in the form of pulse flour with a particle size d_{90} of 500 μm or less after subjected to ultrasonic treatment.

[~~Aspect~~Example 32]

The process according to ~~Aspect~~Example 31, wherein the pulse flour used in step (i) satisfies at least either (11a) or (11b).

(11a) When the pulse flour is subjected to [Treatment D] below and then to ultrasonic treatment, the particle size distribution d_{50} of the resulting flour is 450 μm or less.

(11b) When the pulse flour is subjected to [Treatment D] below and then to CFW (Calcofluor-white) staining and observed under fluorescence microscope, the average of the longest diameters of CFW-stained sites of the resulting flour is 450 μm or less.

[Treatment D] 6 mass % water suspension of the pulse flour is treated with 0.4 volume % of protease and 0.02 mass % of α-amylase at 20ºC for 3 days.

[~~Aspect~~Example 33]

The process according to any one of ~~Aspect~~Examples 28 to 32, wherein the kneading in step (ii) is carried out under a pressurized condition of 0.1MPa or more.

[~~Aspect~~Example 34]

The process according to any one of ~~Aspect~~Examples 28 to 33, wherein the kneading in step (ii) is carried out until the soluble γ-amino butyric acid content in the composition decreases to 50 mass % or less of the soluble γ-amino butyric acid content in the composition before step (ii).

[~~Aspect~~Example 35]

The process according to any one of ~~Aspect~~Examples 28 to 34, wherein the kneading in step (ii) is carried out until the soluble leucine content in the composition decreases to 50 mass % or less of the soluble leucine content in the composition before step (ii).

[~~Aspect~~Example 36]

The process according to any one of ~~Aspect~~Examples 28 to 35, wherein the kneading in step (ii) is carried out for a period of from 0.1 to 60 minutes.

[~~Aspect~~Example 37]

The process according to any one of ~~Aspect~~Examples 28 to 36, wherein the composition in step (iii) is cooled to 95ºC or less.

[~~Aspect~~Example 38]

The process according to any one of ~~Aspect~~Examples 28 to 37, wherein the kneading in step (ii) and/or the cooling in step (iii) are/is carried out using an extruder.

[~~Aspect~~Example 39]

The process according to ~~Aspect~~Example 38, wherein the extruder is a uniaxial extruder or a biaxial extruder.

[~~Aspect~~Example 40]

The process according to any one of ~~Aspect~~Examples 28 to 39, wherein the ratio of the length of a flight screw part to the total length of a barrel of the extruder is 95% or less.

[~~Aspect~~Example 41]

The process according to any one of ~~Aspect~~Examples 28 to 40, further comprising, after step (iii):

(iv) maintaining the composition after the cooling in step (iii) at a temperature at which the composition does not swell in an atmosphere with a dry mass basis moisture content of 25 mass % or more for 0.02 hours or more.

[~~Aspect~~Example 42]

The process according to any one of ~~Aspect~~Examples 28 to 41, further comprising, after step (iii):

(v) crushing the composition to produce a crushed composition.

[~~Aspect~~Example 43]

The process according to ~~Aspect~~Example 42, further comprising, after step (v):

(vi) agglomerating the crushed composition to prepare a crushed composition agglomerate.

[~~Aspect~~Example 44]

A solid paste composition for heat cooking produced by a process of according to any one of ~~Aspect~~Examples 28 to 43.

EFFECT OF THE ~~INVENTION~~DISCLOSURE

[0009]

The present disclosure~~invention~~ provides a solid paste composition for heat cooking that has elasticity with less rubbery texture, and exhibits a texture that passes smoothly through the teeth when chewed, as well as a method for producing the composition.

CLAIMS

[Claim 1]

A solid paste composition for heat cooking containing at least pulse as a raw material and satisfying the requirements (1) to (4), (7), and (12) below.

(1) The composition has an insoluble dietary fiber content of 2.0 mass % or more in terms of dry mass basis.

(2) The composition has a starch content of 15 mass % or more in terms of dry mass basis.

(3) The composition has a protein content of 5.5 mass % or more in terms of dry mass basis.

(4) When at least one frozen section A of the composition prepared under [Condition A] below is subjected to CBB (Coomassie Brilliant Blue) staining and observed, at least either (4a) or (4b) is satisfied.

(4a) The ratio of [the number of CBB-stained sites having areas of 200μm^2 or more and degree of roundness of 0.3 or more] to [the number of CBB-stained sites having areas of 30μm^2 or more] is 3% or more.

(4b) The ratio of [the total area of CBB-stained sites having areas of 200μm^2 or more and degrees of roundness of 0.3 or more] to [the total section area of the composition] is 0.3% or more.

[Condition A] The composition is heated in water at 90ºC for 6 minutes and then frozen at -25ºC, and the frozen composition is cut along a certain cut plane A into a section having a thickness of 30 μm, which section is used as a frozen composition section A.

(7) The composition satisfies at least either (7a) or (7b).

(7a) When one mass part of the composition is immersed in 9 mass parts of iodine solution (0.25 mM) at 20°C for 3 minutes and filtered through a 0.20 μm filter, the difference in absorbance (500 nm) of the iodine solution is 0.65 or less.

(7b) When one mass part of the composition is immersed in 9 mass parts of iodine solution (0.25 mM) at 20°C for 3 minutes and filtered through a 0.20 μm filter and the filtrate stained with iodine (final concentration 0.25 mM), the difference in absorbance (500 nm) of the iodine solution is 1.2 or less.

(12) When a 6% suspension of a crushed product of the composition is observed, the number of starch grain structures observed is 300/mm^2 or less.

[Claim 2]

The composition according to claim 1, wherein when the frozen composition section A is subjected to CBB staining and observed, the section further satisfies the at least either (4c) or (4d):

(4c) The area corresponding to the 90th percentile score in the CBB-stained sites having areas of 30μm^2 or more is 3500μm^2 or less.

(4d) The number of CBB-stained sites having longest diameters of 200 μm or more is 40 or less.

[Claim 3]

The composition according to claim 1 or 2, wherein when the frozen composition section A is subjected to CFW (Calcofluor-white) staining and observed, the section further satisfies the at least either (5a) or (5b):

(5a) The average of the longest diameters of CFW-stained sites is 450 μm or less.

(5b) The average of the aspect ratios of CFW-stained sites is 5.0 or less.

[Claim 4]

The composition according to any one of claims 1 to 3, wherein the frozen composition section A is a frozen composition section A1, which is obtained along a cut plane A1 orthogonal to the longitudinal axis of the composition, or ~~.~~

~~[Claim 5]~~

~~The composition according to any one of claims 1 to 3,~~ wherein the frozen composition section A comprises a frozen composition section A1, which is obtained along a cut plane A1 orthogonal to the longitudinal axis of the composition, and a frozen composition section A2, which is obtained along a cut plane A2 parallel to the longitudinal axis of the composition.

[Claim 5~~6~~]

The composition according to any one of claims 1 to ~~5~~4, wherein when at least one frozen composition section B prepared under [Condition B] below is measured by the X-ray diffraction method, the average crystallinity at the center of the composition section is higher than the average crystallinity at the periphery of the composition section, or ~~.~~

~~[Condition B] The composition is frozen at -25°C, and the frozen composition is cut along a certain cut plane B into a section having a thickness of 30 μm, which section is observed as a frozen composition section B.~~

~~[Claim 7]~~

~~The composition according to any one of claims 1 to 5,~~ wherein when at least one frozen composition section B prepared under [Condition B] below is subjected to CBB staining and observed, a smooth tissue part with an average thickness of 20 μm or more is found along 30% or more of the perimeter of the composition section on the cut plain B.

[Condition B] The composition is frozen at -25°C, and the frozen composition is cut along a certain cut plane B into a section having a thickness of 30 μm, which section is observed as a frozen composition section B.

[Claim 6~~8~~]

The composition according to claim 5~~7~~, wherein when the frozen composition section B is subjected to CBB staining and observed, the ratio of [the number of CBB-stained sites area 200μm^2 or more and degrees of roundness of 0.3 or more in the smooth tissue part on the cut plane B] to [the number of CBB-stained sites having areas of 30μm^2 or more in the smooth tissue part on the cut plane B] is 3% or more.

[Claim 7~~9~~]

The composition according to claim 5~~7~~ or 6~~8~~, wherein when the frozen composition section B is measured by the X-ray diffraction method, the average crystallinity in the non-smooth tissue part, which exists inside of the smooth tissue part of the composition, is higher than the average crystallinity in the smooth tissue part.

[Claim 8~~10~~]

The composition according to any one of claims 5~~6~~ to 7~~9~~, wherein the frozen composition section B is a frozen composition section B1, which is obtained along a cut plane B1 orthogonal to the longitudinal axis of the composition, or ~~.~~

~~[Claim 11]~~

~~The composition according to any one of claims 6 to 9,~~ wherein the frozen composition section B comprises a frozen composition section B1, which is obtained along a cut plane B1 orthogonal to the longitudinal axis of the composition, and a frozen composition section B2, which is obtained along a cut plane B2 parallel to the longitudinal axis of the composition.

~~[Claim 12]~~

~~The composition according to any one of claims 1 to 11, wherein when a 6% suspension of a crushed product of the composition is observed, the number of starch grain structures observed is 300/mm^2 or less.~~

[Claim ~~13~~9]

The composition according to any one of claims 1 to ~~12~~8, further satisfying one or more of (6a) to (6d).

(6a) The content of soluble γ-amino butyric acid in the composition is 25mg % or less.

(6b) The ratio of the soluble γ-amino butyric acid content to the total content of soluble proteinogenic amino acids in the composition is 1.5 mass % or less.

(6c) The content of soluble leucine in the composition is 10~~mg~~ mass % or less.

(6d) The ratio of the soluble leucine content to the total content of soluble proteinogenic amino acids in the composition is 1.0 mass % or less.

~~[Claim 14]~~

~~The composition according to any one of claims 1 to 13, further satisfying at least either (7a) or (7b).~~

~~(7a) When one mass part of the composition is immersed in 9 mass parts of iodine solution (0.25 mM) at 20°C for 3 minutes and filtered through a 0.20 μm filter, the difference in absorbance (500 nm) of the iodine solution is 0.70 or less.~~

~~(7b) When one mass part of the composition is immersed in 9 mass parts of iodine solution (0.25 mM) at 20°C for 3 minutes and filtered through a 0.20 μm filter and the filtrate stained with iodine (final concentration 0.25 mM), the difference in absorbance (500 nm) of the iodine solution is 1.2 or less.~~

[Claim ~~15~~10]

The composition according to any one of claims 1 to ~~14~~9, further satisfying at least either (8a) or (8b).

(8a) When one mass part of the composition is treated in 9 mass parts of 1% glucoamylase aqueous solution at 20ºC for 2 hours, the glucose content in the resulting reaction solution is less than 2.40 mass %.

(8b) When one mass part of the composition is treated in 9 mass parts of 1% glucoamylase aqueous solution at 20ºC for 2 hours, the glucose content in the resulting reaction solution is 50% or less of a glucose content in a reaction solution prepared by treating one mass part of a crushed product of the composition in 9 mass parts of 1% glucoamylase aqueous solution at 20ºC for 2 hours.

[Claim ~~16~~11]

The composition according to any one of claims 1 to ~~15~~10, further satisfying at least either (9a) or (9b).

(9a) When the composition is subjected to [Treatment C] below and then to ultrasonic treatment, the particle size distribution d_{50} of the resulting product is 450 μm or less.

(9b) When the composition is subjected to [Treatment C] below and then to CFW (Calcofluor-white) staining and observed under fluorescence microscope, the average of the longest diameters of CFW-stained sites is 450 μm or less.

[Treatment C] 6 mass % water suspension of the composition is treated with 0.4 volume % of protease and 0.02 mass % of α-amylase at 20ºC for 3 days.

[Claim ~~17~~12]

The composition according to any one of claims 1 to ~~16~~11, ~~comprising at least one edible plant as a raw material and~~ further satisfying at least either (10a) or (10b).

(10a) The ratio of the starch content derived from the pulse ~~edible plant~~ to the total starch content in the composition is 50 mass % or more in terms of dry mass basis.

(10b) The ratio of the protein content derived from the pulse ~~edible plant~~ to the total

protein content in the composition is 50 mass % or more in terms of dry mass basis.

[Claim ~~18~~13]

The composition according to claim ~~17~~12, wherein the pulse ~~edible plant~~ is a dried pulse ~~edible plant~~ with a dry mass basis moisture content of less than 25 mass%.

~~[Claim 19]~~

~~The composition according to claim 17 or 18, wherein the edible plant is a pulse.~~

[Claim ~~20~~14]

The composition according to ~~claim 19~~any one of claims 1 to 13, wherein the pulse is one or more species of pulse selected from Pisum, Phaseolus, Cajanus, Vigna, Vicia, Cicer, Glycine and Lens species, and/or ~~.~~

~~[Claim 21]~~

~~The composition according to claim 19 or 20,~~ wherein the pulse is in the form of pulse flour with a particle size d_{90} of 500 μm or less after subjected to ultrasonic treatment, and/or ~~.~~

~~[Claim 22]~~

~~The composition according to any one of claims 19 to 21,~~ wherein the ratio of the starch content derived from pulse to the total starch content in the composition is 50 mass% or more in terms of dry mass basis.

[Claim ~~23~~15]

The composition according to any one of claims 1 to ~~22~~14, which is not in the form of a swollen product, and/or ~~.~~

~~[Claim 24]~~

~~The composition according to any one of claims 1 to 23,~~ which has a total oil and fat content of less than 17 mass % in terms of dry mass basis, and/or ~~.~~

~~[Claim 25]~~

~~The composition according to any one of claims 1 to 24,~~ which has a dry mass basis moisture content of 60 mass % or less.

[Claim ~~26~~16]

A crushed composition prepared by crushing a composition according to any one of claims 1 to ~~25~~15.

[Claim ~~27~~17]

A crushed composition agglomerate prepared by agglomerating a crushed composition according to claim ~~26~~16.

[Claim ~~28~~18]

A process of producing a solid paste composition for heat cooking according to any one of claims 1 to ~~25~~15, comprising the steps of:

(i) preparing a paste dough composition containing at least pulse as a raw material and having an insoluble dietary fiber content of 1.5 mass % or more in terms of wet basis, a starch content of 5.0 mass % or more in terms of wet basis, a protein content of 3.0 mass % or more in terms of wet basis, and a dry mass basis moisture content of 25 mass % or more;

(ii) kneading the composition prepared in step (i) at a temperature of from 100ºC to 200ºC with a specific mechanical energy (SME) of 350kJ/kg or more; and

(iii) cooling the composition kneaded in step (ii) to a temperature at which a temperature at which the composition does not swell.

[Claim 19]

The process according to claim 18, wherein the paste dough composition in step (i) has a dry mass basis moisture content of 40 mass % or more, and/or

~~[Claim 29]~~

~~The process according to claim 28, wherein the paste dough composition in step (i) is prepared at least using pulse.~~

~~[Claim 30]~~

~~The process according to claim 29,~~ wherein the ratio of the content of starch derived from pulse to the total starch content in the dough composition prepared in step (i) is 50 mass % or more in terms of dry mass basis, and/or ~~.~~

~~[Claim 31]~~

~~The process according to claim 29 or 30,~~ wherein the pulse used in step (i) is in the form of pulse flour with a particle size d_{90} of 500 μm or less after subjected to ultrasonic treatment.

[Claim ~~32~~20]

The process according to ~~claim 31~~claim 18 or 19, wherein the pulse ~~flour~~ used in step (i) is pulse flour which satisfies at least either (11a) or (11b).

(11a) When the pulse flour is subjected to [Treatment D] below and then to ultrasonic treatment, the particle size distribution d_{50} of the resulting flour is 450 μm or less.

(11b) When the pulse flour is subjected to [Treatment D] below and then to CFW (Calcofluor-white) staining and observed under fluorescence microscope, the average of the longest diameters of CFW-stained sites of the resulting flour is 450 μm or less. [Treatment D] 6 mass % water suspension of the pulse flour is treated with 0.4 volume % of protease and 0.02 mass % of α-amylase at 20ºC for 3 days.

[Claim ~~33~~21]

The process according to any one of claims ~~28~~ 18 to ~~32~~20, wherein the kneading in step (ii) is carried out under a pressurized condition of 0.1MPa or more, and/or ~~.~~

~~[Claim 34]~~

~~The process according to any one of claims 28 to 33, wherein the kneading in step (ii) is carried out~~ until the soluble γ-amino butyric acid content in the composition decreases to 50 mass % or less of the soluble γ-amino butyric acid content in the composition before step (ii), and/or ~~.~~

~~[Claim 35]~~

~~The process according to any one of claims 28 to 34, wherein the kneading in step (ii) is carried out~~ until the soluble leucine content in the composition decreases to 50 mass % or less of the soluble leucine content in the composition before step (ii), and/or ~~.~~

~~[Claim 36]~~

~~The process according to any one of claims 28 to 35, wherein the kneading in step (ii) is carried out~~ for a period of from 0.1 to 60 minutes.

[Claim ~~37~~22]

The process according to any one of claims ~~28~~ 18 to ~~36~~21, wherein the composition in step (iii) is cooled to 95ºC or less, and/or, ~~.~~

~~[Claim 38]~~

~~The process according to any one of claims 28 to 37, wherein~~ the kneading in step (ii) and/or the cooling in step (iii) are/is carried out using an extruder.

[Claim ~~39~~23]

The process according to claim ~~38~~22, wherein the extruder is a uniaxial extruder or a biaxial extruder, and/or ~~.~~

~~[Claim 40]~~

~~The process according to any one of claims 28 to 39,~~ wherein the ratio of the length of a flight screw part to the total length of a barrel of the extruder is 95% or less.

[Claim ~~41~~24]

The process according to any one of claims ~~28~~ 18 to ~~40~~23, further comprising, after step (iii):

(iv) maintaining the composition after the cooling in step (iii) at a temperature at which the composition does not swell in an atmosphere with a dry mass basis moisture content of 25 mass % or more for 0.02 hours or more, and/or ~~.~~

~~[Claim 42]~~

~~The process according to any one of claims 28 to 41, further comprising, after step (iii):~~

(v) crushing the composition to produce a crushed composition.

[Claim ~~43~~25]

The process according to claim ~~42~~24, further comprising, after step (v):

(vi) agglomerating the crushed composition to prepare a crushed composition agglomerate.

~~[Claim 44]~~

~~A solid paste composition for heat cooking produced by a process of according to any one of claims 28 to 43.~~