CLAIMS

[Claim 1]

A starch-containing solid composition containing pulse and satisfying the requirements (1) to (4) below:

(1) The composition has a starch content of 20 mass % or more in terms of dry mass basis;

(2) The composition satisfies the requirement(s) (a) and/or (b) below:

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

(b) When 14 mass % aqueous slurry of a crushed product of the composition is subjected to measurement with a rapid visco-analyzer with elevating the temperature from 50ºC to 140ºC at a rate of 12.5°C/min, the peak temperature of gelatinization obtained is lower than 120ºC;

(3) The degree of gelatinization of starch in the composition is 50 mass % or more;

(4) The [value α] of the composition defined below is 60% or less, and the [value β] of the composition defined below is 35% or more;

[Value α] When purified starch is obtained by subjecting the composition to isothermal treatment at 90ºC in 40-fold volume of water for 15 minutes and then to [Procedure a] below, and the purified starch obtained is then subjected to measurement under [Condition A] below to determine a molecular weight distribution, the ratio of the area under the curve in an interval with molecular weight logarithms of 5.0 or more but less than 6.5 to the area under the entire curve of the molecular weight distribution is determined to be [value α];

[Value β] The ratio of the area under the curve in an interval with molecular weight logarithms of 6.5 or more but less than 8.0 to the area under the entire curve of the molecular weight distribution is determined to be [value β];

[Procedure a] 2.5% aqueous dispersion of the composition is crushed and treated with proteolytic enzyme, and an ethanol-insoluble and dimethyl sulfoxide-soluble component is obtained as purified starch;

[Condition A] The purified starch is dissolved into 1M aqueous solution of sodium hydroxide at a concentration of 0.10 mass % and allowed to stand at 37ºC for 30 minutes, then combined with an equal volume of water and an equal volume of eluting agent and subjected to filtration with a 5-μm filter, and 5mL of the filtrate is then subjected to gel filtration chromatography to determine a molecular weight distribution in an interval with molecular weight logarithms of 5.0 or more but less than 9.5.

[Claim 2]

The composition according to claim 1, wherein the ratio of the [value β] to the [value α] (β/α) is 0.5 or more.

[Claim 3]

The composition according to claim 1 or 2, wherein the [value γ] of the composition defined below is 30% or less.

[Value γ] The ratio of the area under the curve in an interval with molecular weight logarithms of 8.0 or more but less than 9.5 to the area under the entire curve of the molecular weight distribution is determined to be [value γ].

[Claim 4]

The composition according to any one of claims 1 to 3, wherein the ratio of the [value β] to the [value γ] (β/γ) is 10 or more.

[Claim 5]

The composition according to any one of claims 1 to 4, wherein when the purified starch obtained via the treatment of the [Procedure a] above is subjected to measurement under the [Condition A] above, the logarithm of the mass average molecular weight obtained is 6.0 or more.

[Claim 6]

The composition according to any one of claims 1 to 5, wherein the composition has an amylolytic enzyme activity of 30.0 U/g or less in terms of dry mass basis.

[Claim 7]

The composition according to any one of claims 1 to 6, wherein when the composition is placed into 40-fold volume of water and immediately treated in accordance with the [Procedure a] above, and separated and collected under the [Condition A] above to obtain purified starch, and a sample is prepared from a separated fraction with molecular weight logarithms of 5.0 or more but less than 6.5 by adjusting the pH of the fraction to 7.0 and staining one mass part of the fraction with 9 mass parts of iodine solution (0.25mM), the absorbance of the stained sample at 660 nm is 0.80 or less.

[Claim 8]

The composition according to any one of claims 1 to 7, wherein the composition has a protein content of 3.0 mass % or more in terms of dry mass basis.

[Claim 9]

The composition according to any one of claims 1 to 8, wherein the composition has a PDI (protein dispersibility index) value of less than 55 mass %.

[Claim 10]

The composition according to any one of claims 1 to 9, wherein when the

composition is subjected to the starch and protein digestion treatment under [Procedure b] below followed by ultrasonication, and then to measurement for the particle diameter distribution, the d_{50} and/or d_{90} obtained from the particle diameter distribution is less than 450 μm.
[Procedure b] 6 mass % aqueous 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 11]
The composition according to any one of claims 1 to 10, wherein the composition has an insoluble dietary fiber content of 2.0 mass % or more in terms of dry mass basis.

[Claim 12]
The composition according to any one of claims 1 to 11, wherein the composition has a total oil and fat content of less than 17 mass % in terms of dry mass basis.

[Claim 13]
The composition according to any one of claims 1 to 12, wherein the composition has a dry mass basis moisture content of 60 mass % or less.

[Claim 14]
The composition according to any one of claims 1 to 13, wherein the pulse has a dry mass basis moisture content of less than 15 mass %.

[Claim 15]
The composition according to any one of claims 1 to 14, wherein the pulse is matured pulse.

[Claim 16]
The composition according to any one of claims 1 to 15, wherein the pulse is one or more species of pulse selected from Pisum, Phaseolus, Cajanus, Vigna, Vicia, Cicer, Glycine and Lens species.

[Claim 17]
The composition according to any one of claims 1 to 16, wherein the pulse is in the form of powder with a particle diameter d_{90} of less than 500μm after ultrasonication.

[Claim 18]
The composition according to any one of claims 1 to 17, wherein the pulse content is 50 mass % or more in terms of dry mass basis.

[Claim 19]

The composition according to any one of claims 1 to 18, wherein the ratio of the starch contained in pulse to the total starch content of the composition is 30 mass % or more.

[Claim 20]

The composition according to any one of claims 1 to 19, wherein the ratio of the protein contained in pulse to the total protein content of the composition is 10 mass % or more.

[Claim 21]

The composition according to any one of claims 1 to 20, which is a non-swollen product.

[Claim 22]

A crushed composition prepared by crushing the composition according to any one of claims 1 to 21.

[Claim 23]

A crushed composition agglomerate prepared by agglomerating the crushed composition according to claim 22.

[Claim 24]

A method for producing a starch-containing solid composition according to any one of claims 1 to 21, comprising the steps of:

(i) preparing a composition having a starch content of 10.0 mass % or more in terms of wet mass basis and a dry mass basis moisture content of more than 40 mass % ; and

(ii) kneading the composition prepared at step (i) at a temperature of between 100ºC and 190ºC under conditions with an SME value of 400 kJ/kg or more until the requirements (1) to (4) below are satisfied:

(1) The composition satisfies the requirement(s) (a) and/or (b) below.

(a) The number of starch grain structures of the composition is 300/mm^2 or less.

(b) When 14 mass % aqueous slurry of a crushed product of the composition is subjected to measurement with a rapid visco-analyzer with elevating the temperature from 50ºC to 140ºC at a rate of 12.5°C/min, the peak temperature of gelatinization is less than 120 ºC;

(2) The degree of gelatinization of the composition is 50 mass % or more;

(3) The [value α] of the composition is 60% or less;

(4) The [value β] of the composition is 35% or more.

[Claim 25]

The method according to claim 24, further comprising the step of:

(iii) cooling the kneaded composition from step (ii) to less than 100 ºC.

[Claim 26]

The method according to claim 24 or 25, further comprising the step of:

(iv) adjusting the dry mass basis moisture content of the composition to less than 25 mass %.

[Claim 27]

The method according to claim 26, wherein the time required after the temperature of the composition drops below 80°C until the dry mass basis moisture content of the composition decreases to less than 25 mass % on a dry weight basis after step (ii) is 10 minutes or more.

[Claim 28]

The method according to any one of claims 24 to 27, wherein the time required for the dry mass basis moisture content of the composition to become less than 25 mass % is adjusted by applying water addition treatment to the composition at step (iii) or thereafter.

[Claim 29]

The method according to any one of claims 24 to 28, further comprising a step after step (ii) through which the degree of gelatinization decreases by 1 mass % or more.

[Claim 30]

The method according to any one of claims 24 to 29, further comprising, at least after step (ii), the step of:

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

[Claim 31]

The method according to claim 30, further comprising, after step (v), the step of:

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

[Claim 32]

The method according to any one of claims 24 to 31, wherein step (ii) is carried out using an extruder.

[Claim 33]

The method according to claim 32, wherein preparing the composition at step (i) comprises, before feeding raw materials to the extruder, adding water to the raw materials.

[Claim 34]

The method according to claim 32 or 33, wherein preparing the composition at step (i) comprises, after feeding raw materials to the extruder, adding water to the raw materials in the extruder.

[Claim 35]

The method according to claim 34, wherein at step (i), the raw materials in the extruder are not exposed to temperatures of 90 °C or more when the dry mass basis moisture content is less than 25 mass %.

[Claim 36]

The method according to any one of claims 32 to 35, wherein more than 50 mass % of the total water content to be added at steps (i) and (ii) during production is mixed with other raw materials before the internal temperature of the extruder rises to 90°C or more.

[Claim 37]

The method according to any one of claims 32 to 36, wherein the composition after step (iii) is placed on a mesh conveyor having a loading surface which is partially or completely ventilated.

[Claim 38]

The method according to claim 37, further comprising adding water to the composition before or after being placed on the mesh conveyor.

[Claim 39]

The method according to claim 37 or 38, further comprising lowering the composition temperature by blowing air from the top and/or from the bottom of the mesh conveyor against the composition.

[Claim 40]

The method according to claim 39, wherein the degree of gelatinization decreases by 1 mass % during the air blowing.

[Claim 41]

The method according to any one of claims 32 to 40, wherein the flight screw length of the extruder is 95% or less of the total screw length of the extruder.

[Claim 42]

The method according to any one of claims 24 to 41, wherein the requirement (c) or (d) is satisfied at step (ii):

(c) When 6% suspension of a crushed product of the composition is observed, the number of starch grain structures decreases by more than 5% during step (ii);

(d) When 14 mass % aqueous slurry of a crushed product of the composition is subjected to measurement with a rapid visco-analyzer with elevating the temperature from 50ºC to 140ºC at a rate of 12.5°C/min, the peak temperature of gelatinization decreases by 1 ºC or higher during step (ii).

[Claim 43]

The method according to any one of claims 24 to 42, wherein when a the particle diameter distribution is determined by subjecting the composition from step (i) to starch and protein digestion treatment followed by ultrasonication, the d_{50} and/or d_{90} obtained from the particle diameter distribution is less than 450 μm.

[Claim 44]

The method according to any one of claims 24 to 43, wherein the ratio of the content of starch in the form of heat-treated pulse to the total starch content of the composition at step (i) is 30 mass % or more.

[Claim 45]

The method according to any one of claims 24 to 44, wherein the amylolytic enzyme activity (U/g) decreases by 20% or more through step (ii).

[Claim 46]

The method according to any one of claims 24 to 45, wherein when the composition from step (i) is placed into 40-fold volume of water and immediately treated in accordance with the [Procedure a] above, and separated and collected under the [Condition A] above to obtain purified starch, and a sample is prepared from a separated fraction with molecular weight logarithms of 5.0 or more but less than 6.5 by adjusting the pH of the fraction to 7.0 and staining one mass part of the fraction with 9 mass parts of iodine solution (0.25mM), the absorbance of the stained sample at 660 nm is 0.80 or less.

[Claim 47]

The method according to any one of claims 24 to 46, wherein when the composition from step (i) is placed into 40-fold volume of water and immediately treated in accordance with the [Procedure a] above, and separated and collected under the [Condition A] above to obtain purified starch, and a first sample and a second sample are prepared from a first separated fraction with molecular weight logarithms of 5.0 or more but less than 6.5 and a

second separated fraction with molecular weight logarithms of 6.5 or more but less than 8.0, respectively, by adjusting the pH of each fraction to 7.0 and staining each fraction with 9 mass parts of iodine solution (0.25mM), the ratio of the absorbance (660nm) of the stained second sample to the absorbance (660nm) of the stained first sample is 0.003 or more.

[Claim 48]

The method according to any one of claims 24 to 47, wherein the composition from step (i) has a PDI value of less than 90 mass %.

[Claim 49]

A starch-containing solid composition containing pulse and satisfying the requirements (1) to (4) below:

(1) The composition has a starch content of 20 mass % or more in terms of dry mass basis;

(2) The composition satisfies the requirement(s) (a) and/or (b) below:

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

(b) When 14 mass % aqueous slurry of a crushed product of the composition is subjected to measurement with a rapid visco-analyzer with elevating the temperature from 50ºC to 140ºC at a rate of 12.5°C/min, the peak temperature of gelatinization obtained is lower than 120ºC;

(3) The degree of gelatinization of starch in the composition is 50 mass % or more;

(4) The [value α] of the composition defined below is 60% or less, the ratio of the [value β] of the composition defined below to the [value α] (β/α) is 0.5 or more, and the [value γ] is 30% or less;

[Value α] When purified starch is obtained by subjecting the composition to isothermal treatment at 90ºC in 40-fold volume of water for 15 minutes and then to [Procedure a] below, and the purified starch obtained is then subjected to measurement under [Condition A] below to determine a molecular weight distribution, the ratio of the area under the curve in an interval with molecular weight logarithms of 5.0 or more but less than 6.5 to the area under the entire curve of the molecular weight distribution is determined to be [value α];

[Value β] The ratio of the area under the curve in an interval with molecular weight logarithms of 6.5 or more but less than 8.0 to the area under the entire curve of the molecular weight distribution is determined to be [value β];

[Value γ] The ratio of the area under the curve in an interval with molecular weight logarithms of 8.0 or more but less than 9.5 to the area under the entire curve of the molecular weight distribution is determined to be [value γ];

[Procedure a] 2.5% aqueous dispersion of the composition is crushed and treated with

proteolytic enzyme, and an ethanol-insoluble and dimethyl sulfoxide-soluble component is obtained as purified starch;
[Condition A] The purified starch is dissolved into 1M aqueous solution of sodium hydroxide at a concentration of 0.10 mass % and allowed to stand at 37ºC for 30 minutes, then combined with an equal volume of water and an equal volume of eluting agent and subjected to filtration with a 5-μm filter, and 5mL of the filtrate is then subjected to gel filtration chromatography to determine a molecular weight distribution in an interval with molecular weight logarithms of 5.0 or more but less than 9.5.