CLAIMS

[Claim 1]

A swollen composition containing at least pulse and satisfying the requirements (1) to (6) below;

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

(2) The composition has a dry mass basis moisture content of less than 150 mass %;

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

(4) The composition has a dietary fiber content of 3.0 mass % or more in terms of dry mass basis;

(5) When the composition is subjected to [Procedure a] below and the resulting product is subjected to measurement under [Condition A] below to obtain a molecular weight distribution curve in an interval with molecular weight logarithms of 3.5 or more but less than 8.0 (hereinafter referred to as "$MWDC_{3.5\text{-}8.0}$"), the ratio of the area under the curve in an interval with molecular weight logarithms of 3.5 or more but less than 6.5 to the area under the entire curve (hereinafter referred to as "AUC1") is more than 60%;

[Procedure a] The composition is crushed, and an ethanol-insoluble and dimethyl sulfoxide-soluble component is obtained;

[Condition A] The treated product from the [Procedure a] above is dissolved into 1M aqueous solution of sodium hydroxide at a concentration of 0.30 mass % and allowed to stand at 37 ºC for 30 minutes, then combined with an equal volume of water and an equal volume of eluent and subjected to filtration with a 5-μm filter, and 5mL of the filtrate is then subjected to gel filtration chromatography, to thereby obtain a molecular weight distribution;

(6) When the composition is subjected to starch and protein digestion treatment defined in [Procedure b] below followed by ultrasonication, and then subjected to measurement for particle diameter distribution, the particle diameter d_{50} is less than 450μm;

[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 20 ºC for 3 days.

[Claim 2]

The composition according to claim 1, wherein in the molecular weight distribution curve ($MWDC_{3.5\text{-}8.0}$), 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 (hereinafter referred to as "AUC2") is 40% or less.

[Claim 3]

The composition according to claim 1 or 2, wherein in the molecular weight distribution curve ($MWDC_{3.5\text{-}8.0}$), the ratio of the ratio of the area under the curve in an

interval with molecular weight logarithms 3.5 or more but less than 6.5 to the area under the entire curve (AUC1) to 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 (AUC2) (hereinafter referred to as "[AUC2]/[AUC1] ratio") is less than 0.68.

[Claim 4]

The composition according to any one of claims 1 to 3, wherein when the composition is subjected to the [Procedure a] above and the resulting product is subjected to measurement under the [Condition A] above to obtain a molecular weight distribution curve in an interval with molecular weight logarithms of 6.5 or more but less than 9.5 (hereinafter referred to as "$MWDC_{6.5\text{-}9.5}$"), 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 (hereinafter referred to as "AUC3") is 30% or more.

[Claim 5]

The composition according to any one of claims 1 to 4, wherein when the composition is subjected to the [Procedure a] above and the resulting product is subjected to measurement under the [Condition A] above to obtain a molecular weight distribution curve in an interval with molecular weight logarithms of 3.5 or more but less than 6.5 (hereinafter referred to as "$MWDC_{3.5\text{-}6.5}$"), the ratio of the area under the curve in an interval with molecular weight logarithms 3.5 or more but less than 5.0 to the area under the entire curve (hereinafter referred to as "AUC4") is 8% or more.

[Claim 6]

The composition according to any one of claims 1 to 5, wherein when the composition is subjected to the [Procedure a] above and the resulting product is subjected to measurement under the [Condition A] above, the mass average molecular weight logarithm is less than 7.5.

[Claim 7]

The composition according to any one of claims 1 to 6, wherein when the composition is subjected to the [Procedure a] above and the resulting product is subjected to separation under the [Condition A] above, 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 product at 660 nm ($ABS_{5.0\text{-}6.5}$) is 0.10 or more.

[Claim 8]

The composition according to any one of claims 1 to 7, wherein the swollen

composition has a total porosity of more than 1%.

[Claim 9]

The composition according to any one of claims 1 to 8, wherein when the composition is frozen at -25 ºC and cut along a cut plane C into a frozen section C with a thickness of 30μm, and the section C is subjected to calcofluor white (CFW) staining and then observed under fluorescence microscope, the average of the longest diameters of CFW-stained sites is less than 450μm.

[Claim 10]

The composition according to claim 9, wherein the CFW-stained sites are embedded in iodine-stained sites.

[Claim 11]

The composition according to any one of claims 1 to 10, wherein when the composition is frozen at -25 ºC and cut along a cut plane C into a frozen section C with a thickness of 30μm, and the frozen section C is measured under [Condition C] below, at least one of the requirements (c1) to (c3) below is satisfied.

[Condition C] The frozen section of the composition is subjected to imaging mass spectrometry using NANO-PALDI MS (nanoparticle-assisted laser desorption ionization mass spectrometry), using iron oxide nanoparticles coated with γ-aminopropyl triethoxysilane as an ionization assisting agent.

(c1) A product of an average luminance calculated from a signal intensity at m/z 66.88278 (hereinafter referred to as "$AV_{66.88278}$") and an average luminance calculated from a signal intensity at m/z 80.79346 (hereinafter referred to as "$AV_{80.79346}$") ($AV_{66.88278}$ x $AV_{80.79346}$) is 120 or more.

(c2) A standard deviation of luminance in a signal intensity dispersion at m/z 66.88278 (hereinafter referred to as "$SD_{66.88278}$") is 16.0 or more.

(c3) A standard deviation of luminance in a signal intensity dispersion at m/z 80.79346 (hereinafter referred to as "$SD_{80.79346}$") is 4.0 or more.

[Claim 12]

The composition according to any one of claims 1 to 11, wherein when the weighted average perimeter of the pores in the composition is α and the weighted average area of the pores in the composition is β, the ratio α/β is 1.5% or less.

[Claim 13]

The composition according to any one of claims 1 to 12, wherein the composition has a density of less than 1.0 g/cm^3.

[Claim 14]

The composition according to any one of claims 1 to 13, wherein the composition satisfies the requirement (7) below.

(7) The requirement(s) (a) and/or (b) below is satisfied.

(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 measured using rapid visco-analyzer with elevating the temperature from 50 ºC to 140 ºC at a rate of 12.5°C/min, the peak temperature of gelatinization is 95 ºC or lower.

[Claim 15]

The composition according to any one of claims 1 to 14, wherein the composition has a protein content of 3.0 mass % or more in terms of dry mass basis.

[Claim 16]

The composition according to any one of claims 1 to 15, wherein the composition has a total oil and fat content of 2.0 mass % or more in terms of dry mass basis.

[Claim 17]

The composition according to any one of claims 1 to 16, wherein the ratio of the liquid oil and fat content to the total oil and fat content is 20 mass % or more.

[Claim 18]

The composition according to any one of claims 1 to 17, wherein the pulse has a dry mass basis moisture content of less than 15 mass %.

[Claim 19]

The composition according to any one of claims 1 to 18, wherein the pulse is matured pulse.

[Claim 20]

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

[Claim 21]

The composition according to any one of claims 1 to 20, wherein the pulse and/or cereal is in the form of powder with a particle diameter d_{90} of less than 500μm after ultrasonication.

[Claim 22]

The composition according to any one of claims 1 to 21, wherein the total content of pulse is 10 mass % or more in terms of dry mass basis.

[Claim 23]

The composition according to any one of claims 1 to 22, wherein the ratio of the starch content contained in pulse to the total starch content of the composition is 30 mass % or more.

[Claim 24]

The composition according to any one of claims 1 to 23, wherein the ratio of the protein content contained in pulse to the total protein content of the composition is 10 mass % or more.

[Claim 25]

The composition according to any one of claims 1 to 24, further comprising cereal.

[Claim 26]

The composition according to claim 25, wherein the cereal is one or more species of cereal selected from awa (foxtail millet), hie (Japanese millet), kibi (common millet), sorghum, rye, oat, hatomugi (job’s tear), corn, buckwheat, amaranthus, and quinoa.

[Claim 27]

The composition according to any one of claims 1 to 26, wherein the composition has a wheat content of 50 mass % or less in terms of dry mass basis.

[Claim 28]

The composition according to any one of claims 1 to 27, wherein the ratio of the protein content derived from wheat to the total protein content of the composition is 50 mass % or less.

[Claim 29]

The composition according to any one of claims 1 to 28, wherein the composition is substantially free of gluten.

[Claim 30]

The composition according to any one of claims 1 to 29, wherein the composition contains dietary fiber-localized part of edible plant.

[Claim 31]

The composition according to claim 30, wherein the dietary fiber-localized part contains seed skin of pulse.

[Claim 32]

The composition according to any one of claims 1 to 31, wherein the total content of edible part of pulse and/or cereal and dietary fiber-localized part of edible plant is 10 mass % or more in terms of dry mass basis.

[Claim 33]

The composition according to any one of claims 1 to 32, wherein the composition contains both edible part of pulse and dietary fiber-localized part of pulse.

[Claim 34]

The composition according to any one of claims 30 to 33, wherein the dietary fiber-localized part of edible plant includes dietary fiber-localized part of psyllium.

[Claim 35]

The composition according to any one of claims 30 to 34, wherein the dietary fiber-localized part of edible plant includes dietary fiber-localized part having undergone enzyme treatment.

[Claim 36]

The composition according to claim 35, wherein the enzyme treatment is xylanase and/or pectinase treatment.

[Claim 37]

The composition according to any one of claims 30 to 36, wherein the composition is a non-fermented swollen composition or a fermented swollen composition.

[Claim 38]

A method for producing a composition according to any one of claims 1 to 28, comprising the steps of:

(i) preparing a dough composition containing at least pulse and having

(1) a starch content of 8.0 mass % or more in terms of wet mass basis,

(2) a dry mass basis moisture content of more than 40 mass %,

(3) a dietary fiber content of 2.0 mass % or more in terms of wet mass basis,

(4) a starch digestion enzyme activity of 0.2 U/g or more in terms of dry mass basis, and

(5) according to a particle diameter distribution obtained by subjecting the dough composition to the starch and protein digestion treatment defined in the [Procedure b] above followed by ultrasonication, a particle diameter d_{50} of less than 450μm; and
(ii) swelling the dough composition from step (i) via heating treatment, wherein the AUC1 value of the composition increases by 5% or more and the dry mass basis moisture content of the composition increases by 5 mass % or more during the heating treatment.

[Claim 39]

The method according to claim 38, wherein the dough composition at step (i) further satisfies the requirement (6-1) below.

(6-1) The requirement(s) (c-1) and/or (d-1) is satisfied.

(c-1) When 6% suspension of a crushed product of the dough composition is observed, the number of starch grain structures is 40/mm^2 or more.

(d-1) When 14 mass % aqueous slurry of a crushed product of the dough composition is subjected to measurement using rapid visco-analyzer with elevating the temperature from 50 ºC to 140 ºC at a rate of 12.5°C/min, the peak temperature of gelatinization is higher than 95 ºC.

[Claim 40]

The method according to claim 38 or 39, wherein the dough composition at step (i) further satisfies the requirement (6-2) below.

(6-2) The requirement(s) (c-2) and/or (d-2) is satisfied.

(c-2) When 6% suspension of a crushed product of the composition is observed, the number of starch grain structures decreases by 10/mm^2 or more during step (ii).

(d-2) When 14 mass % aqueous slurry of a crushed product of the composition is subjected to measurement using rapid visco-analyzer with elevating the temperature from 50 ºC to 140 ºC at a rate of 12.5°C/min, the peak temperature of gelatinization decreases by 5% or more during step (ii).

[Claim 41]

The method according to any one of claims 38 to 40, wherein the pulse has undergone warming treatment in such a manner that the decrement difference of the peak temperature of gelatinization before and after the warming treatment is 50 ºC or lower.

[Claim 42]

The method according to any one of claims 38 to 41, wherein the pulse used in the dough composition at step (i) is in the form of powder with a particle diameter d_{90} of less than 500μm after ultrasonication.

[Claim 43]

The method according to any one of claims 38 to 42, wherein 30% or more of the starch digestion enzyme activity of the dough composition at step (i) is derived from pulse.

[Claim 44]

The method according to any one of claims 38 to 43, wherein the dough composition at step (i) further comprises cereal.

[Claim 45]

The method according to any one of claims 38 to 44, wherein the AUC3 value of the dough composition at step (i) is 30% or more.

[Claim 46]

The method according to any one of claims 38 to 45, wherein the AUC2 value of the composition decreases by 5% or more through the heating treatment of step (ii).

[Claim 47]

The method according to any one of claims 38 to 46, wherein the [AUC2]/[AUC1] ratio decreases by 10% or more through the heating treatment of step (ii).

[Claim 48]

The method according to any one of claims 38 to 47, wherein the total porosity increases by 1% or more through the heating treatment of step (ii).

[Claim 49]

The method according to any one of claims 38 to 48, wherein the absorbance at 660 nm ($ABS_{5.0\text{-}6.5}$) increases by 0.03 or more through the heating treatment of step (ii).

[Claim 50]

The method according to any one of claims 38 to 49, wherein at least one of the requirements (c1) to (c3) below is satisfied through the heating treatment of step (ii).

(c1) The product $AV_{66.88278}$ x $AV_{80.79346}$ increases by 30% or more.

(c2) The standard deviation $SD_{66.88278}$ increases by 5% or more.

(c3) The standard deviation $SD_{80.79346}$ increases by 5% or more.

[Claim 51]

The method according to any one of claims 38 to 50, wherein the dough composition prepared at step (i) comprises dietary fiber-localized part of edible plant.

[Claim 52]

The method according to claim 51, wherein the content of the dietary fiber-localized part of edible plant in the dough composition prepared at step (i) is 0.1 mass % or more in terms of wet mass basis.

[Claim 53]

The method according to claim 51 or 52, wherein the dietary fiber-localized part of edible plant comprises seed skin of pulse.

[Claim 54]

The method according to any one of claims 51 to 53, wherein the dough composition at step (i) comprises both edible part of pulse and dietary fiber-localized part of pulse.

[Claim 55]

The method according to any one of claims 51 to 54, wherein the dietary fiber-localized part of edible plant comprises seed skin of psyllium.

[Claim 56]

The method according to any one of claims 51 to 55, further including subjecting the dietary fiber-localized part of edible plant to enzyme treatment.

[Claim 57]

The method according to claim 56, wherein the enzyme treatment is xylanase and/or pectinase treatment.

[Claim 58]

The method according to claim 56 or 57, further including carrying out the enzyme treatment at step (i) and/or step (ii).

[Claim 59]

The method according to claim 58, wherein step (ii) includes:

(ii-a) yeast-fermenting the dough composition from step (i); and

(ii-b) baking the yeast-fermented composition from step (ii-a).

[Claim 60]

The method according to any one of claims 38 to 59, wherein step (ii) includes:

(ii-1a) kneading the dough composition from step (i) under pressurized conditions with heating at a temperature of more than 100 ºC l; and

(ii-1b) subjecting the kneaded composition from step (ii-1a) to normal pressure at a temperature of more than 100 ºC.

[Claim 61]

The method according to any one of claims 38 to 59, wherein step (ii) includes:
(ii-2a) mixing the dough composition from step (i) with air bubbles and/or expansion agent; and
(ii-2b) heating the mixed composition from step (ii-2a) at a certain temperature.

[Claim 62]

The compsition according to any one of claims 1 to 37, wherein the total starch content of pulse-derived starch to the total starch content of the composition is 30 mass % or more.

[Claim 63]

A dough composition for use in the production method according to any one of claims 38 to 61, which comprises at least pulse and satisfies the requirements (1) to (5) below;
(1) The starch content of the composition is 8.0 mass% or more in terms of wet mass basis;
(2) The moisture content of the composition is more than 40 mass% in terms of dry mass basis;
(3) The dietary fiber content of the composition is 2.0 mass% or more in terms of wet mass basis;
(4) The starch digestion enzyme activity of the composition is 0.2 U/g or more in terms of dry mass basis;
(5) When the composition is subjected to starch and protein digestion treatment defined in [Procedure b] below followed by ultrasonication, and then subjected to measurement for particle diameter distribution, the particle diameter d_{50} is less than 450μm.