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(72) Inventeurs/Inventors:
KLINGLER, RUDOLF, DE;
BUSCH, KARL-GEORG, DE
(73) Propriétaire/Owner:
BAYER CROPS SCIENCE AG, DE
(74) Agent: GOUDREAU GAGE DUBUC

(54) Titre : NOUILLES CHINOISES A BASE D'AMIDON AUX PROPRIETES PHYSICO-CIMIQUES AMELIOREES
(54) Title: GLASS NOODLE COMPRISING STARCH WITH IMPROVED PHYSICO-CHEMICAL PROPERTIES

(57) **Abrégé/Abstract:**

The present invention relates to a process for producing glass noodles using genetically modified starch, preferably from potatoes, glass noodles produced from genetically modified starch, preferably potato starch, and the use of genetically modified starch for producing glass noodles and demoldable gels.



Abstract

The present invention relates to a process for producing glass noodles using genetically modified starch, preferably from potatoes, glass noodles produced from genetically modified starch, preferably potato starch, and the use of genetically modified starch for producing glass noodles and demoldable gels.

Description

Glass noodle comprising starch with improved physicochemical properties

- 5 The present invention relates to a process for producing glass noodles using genetically modified starch, a glass noodle which has been produced using genetically modified starch, and to the use of genetically modified starch for producing glass noodles and demoldable gels.
- 10 The essential features of the glass noodles of the invention are characterizable by physicochemical properties such as water absorption capacity, transparency, cooking loss and elasticity and thus define the appearance, cooking behavior and the texture (bite firmness, etc.) of the noodle.
- 15 To produce glass noodles, conventionally a paste is first prepared from mung bean starch and water, from which paste by further addition of starch a dough is prepared which can then be extruded, for example through fine nozzles into boiling water. After a short cooking time the noodles are cooled and quenched and then dried.
- 20 The use of mung bean starch alone in the production of noodles leads to a very high quality glass noodle which, when dried, is white, appears transparent after boiling or cooking, has a low water absorption capacity and a high tensile strength and high elasticity.
- 25 Since mung bean starch is produced in a highly complex production process, it is comparatively expensive. There have therefore been many attempts to replace mung bean starch in whole or in part by more inexpensive, occasionally chemically modified starches from wheat, potatoes, tapioca, sago, cassava, corn
- 30 etc. (Kim et al., 1996, Cereal Chem. 73(3), 302-308, Kasemsuwan & Jane, 1995, AACC Annual Meetings, Abstract No. 185, Kasemsuwan et al. 1998, Carbohydrate Polymers 32, 301-312, Chang, 1983, Proceedings of the 6th Int. Congress of Food Sci. And Techn., 1, 111-112, Collado & Corke, 1997, Cereal Chem. 74(2), 182-187).

However, replacing the mung bean starch by more inexpensive starches in the doughmaking is accompanied by various disadvantages which primarily lead to a considerably reduced quality, i.e. reduced elasticity and a higher water absorption capacity (softer consistency) of the noodle.

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The object of the present invention is therefore to provide an alternative production of glass noodles of high quality with good economic efficiency.

10 A further object of the invention is to provide an alternative to the limited availability of mung bean starch, especially for glass noodle production. In addition, the object of the invention is to provide an alternative for the use of possibly chemically modified starches of various origins in the production of glass noodles, in order to reduce production times and production costs.

15 These and other objects are achieved effectively by the present invention, as follows from the description below and the examples set forth.

The present invention provides a process for producing glass noodles, in which starch having an amylose content of at least 25%, a gel strength of
20 about 90-160 g and a phosphate content of at least 0.5 nmol of glucose-6-phosphate/mg of starch is processed in a conventional manner to form a glass noodle.

In an embodiment, at least 30% of the content of the mung bean starch
25 usually used is replaced by the starch specified above.

The present invention further provides a process for producing glass noodles, in which a first starch, a second starch and water are processed to form a glass noodle, wherein the first starch is mung bean starch and wherein the
30 second starch is from tapioca, potatoes, corn and/or wheat, the second starch having an amylose content of at least 25%, a gel strength of about 90-

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160 g and a phosphate content of at least 0.5 nmol of glucose-6-phosphate/mg of starch.

In an embodiment, the amount of the above-mentioned second starch is at least 30% of the total amount of starch of the glass noodles.

The present invention further provides a glass noodle which is obtainable by the above-mentioned process, wherein the glass noodle has an elasticity of at least 1.5 g/cm measured at a diameter from about 0.4 to 0.45 mm of the dried noodle.

The present invention further provides a glass noodle which is obtainable by the above-mentioned process, wherein the glass noodle has a water absorption capacity of a maximum of 550% at a diameter from about 0.4 to 0.45 mm of the dried noodle.

The present invention further provides a use of a starch as described above for producing glass noodles.

The present invention further provides a use of the above-mentioned first starch and second starch for producing glass noodles.

The present invention further provides a process for producing a demoldable gel, which comprises boiling a roughly 2-15% strength suspension of a starch defined above and cooling it to a temperature below 30°C.

The present invention further provides a process for producing a demoldable gel, which comprises boiling a roughly 2-15% strength suspension of the above-mentioned first starch and second starch and cooling it to a temperature below 30°C.

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The present invention further provides a use of a starch as defined above to form a demoldable gel by cooling a roughly 2-15% strength boiled suspension of the starch to a temperature below 30°C.

- 5 The present invention further provides a use of the above-mentioned first starch and second starch to form a demoldable gel by cooling a roughly 2-15% strength boiled suspension of said starch to a temperature below 30°C.

10 The present invention further provides a process for producing glass noodles, in which a first starch, a second starch, and water are processed to form a glass noodle, wherein the first starch is mung bean starch and wherein the second starch is from genetically modified plants having an amylose content of at least 25%, a gel strength of about 90-160 g and a phosphate content of at least 0.5 nmol of glucose-6-phosphate/mg of starch.

15

Modern methods of biotechnology make available a multiplicity of transgenic, starch-producing plants, in particular corn, potato, wheat or rice, from which starch, that is to say within the meaning of the present invention "genetically modified starch" can be isolated, which starch sometimes has considerably
20 modified physicochemical properties, for example a change in the amylose/amylopectin ratio, the chain length distribution of the amylopectin, the degree of phosphorylation and the mineral content (Ca^{2+} +, Mg^{2+} , etc.) or the lipid content etc.

- 25 Owing to the modified properties of said genetically modified starches some completely novel and also highly surprising possibilities for use are created given the extremely wide use of starches in industry and in the food sector.

It has not been found that, surprisingly, starches from genetically
30 modified plants (GMS), preferably from tapioca, corn, wheat and/or potatoes, in particular from wheat and/or potatoes and very particularly from potatoes, having an amylose content of greater than 25%, preferably > 30, in particular > 33% (amylose content determined by the method of Hovenkamp-Hermelink et al., 1988, Potato Research 31: 241-246) and
35 a gel strength of about 90-160 g, preferably 100-160 g, in particular

110-160 g (gel strength determined in accordance with Example 3 B) are outstandingly suitable for producing glass noodles or demoldable gels.

5 The present invention therefore relates to a process for producing glass noodles in which starch, especially starch from tapioca, potatoes, corn and/or wheat, preferably potatoes and/or wheat, in particular potatoes, having an amylose content of at least 25%, preferably >30%, in particular >33% and a gel strength of about 90-160 g, preferably 100-160 g, in particular 110-160 g, is processed in a conventional manner to give a glass
10 noodle, in which preferably at least 30%, particularly preferably about 30-90%, in particular about 35-80% and very particularly preferably about 40-65%, of the mung bean starch usually used is replaced by said starch.

15 In the process of the invention for producing glass noodles preference is furthermore given to starches from tapioca, potatoes, corn and/or wheat which have a phosphate content of at least 0.5 nmol, preferably 1 nmol and in particular 1.5 nmol of glucose-6-phosphate (G6P)/mg of starch (determined by the enzymatic method described in Example 8 b of the international patent application WO 97/11188 A1).

20 The invention finally further relates to a glass noodle which features an elasticity of at least 1.5 g/cm, preferably at least 1.7 g/cm and/or a water absorption capacity of a maximum of 550%, preferably a maximum of 530%, in particular a maximum of 500%, at a diameter from about 0.4 to
25 0.45 mm of the dried noodle, obtainable by the process according to the invention for producing glass noodles, in which starch, especially starch from tapioca, potatoes, corn and/or wheat, preferably potatoes and/or wheat, in particular potatoes, having an amylose content of at least 25%, preferably >30%, in particular >33%, and a gel strength of about 90-160 g,
30 preferably 100-160 g, in particular 110-160 g, is processed in a conventional manner to give a glass noodle, in which preferably at least 30%, in particular about 30-90%, particularly preferably about 35-80% and very particularly preferably about 40-65%, of the mung bean starch usually used is replaced by said starch and said starch in a further preferred
35 embodiment has a phosphate content of at least 0.5 nmol, preferably 1 nmol, and in particular 1.5 nmol of G6P/mg of starch.

The invention also relates to the use of a starch, especially a starch from tapioca, potatoes, corn and/or wheat, preferably potatoes and/or wheat, in

particular potatoes, having an amylose content of at least 25%, preferably > 30%, in particular >33%, and a gel strength of about 90-160 g, preferably 100-160 g, in particular 110-160 g, and a phosphate content of at least 0.5 nmol, preferably 1 nmol, and in particular 1.5 nmol of G6P/mg of starch in a
5 process for producing glass noodles or demoldable gels.

Inasmuch as the use of said starches relates to the production of demoldable gels, for their production, preferably, an about 2-15% strength boiled suspension of said starch is cooled to a temperature of 0-30°C, preferably room temperature (i.e. about 15-25°C). The present invention
10 also relates to a process for producing demoldable gels in which a starch, especially a starch from tapioca, potatoes, corn and/or wheat, preferably potatoes and/or wheat, in particular potatoes, having an amylose content of at least 25%, preferably > 30%, in particular >33% and a gel strength of
15 about 90-160 g, preferably 100-160 g, in particular 110-160 g, and a phosphate content of at least 0.5 nmol, preferably 1 nmol, and in particular 1.5 nmol of G6P/mg of starch, in an about 2-15% strength suspension, preferably 3-12% strength, in particular 4-10% strength suspension, is boiled and cooled to a temperature of about 0-30, preferably about 15-
20 25°C.

The term „genetically modified starches“ (GMSs) for the purposes of the present invention means starches from genetically modified plants, preferably from tapioca, corn, wheat and/or potatoes, in particular from
25 wheat and/or potatoes, especially from potatoes, which have been modified by biotechnological methods, preferably with respect to their side-chain distribution (e.g. their amylose content), their phosphate content and/or their gel formation properties, which can be characterized, for example, by means of the ratio of final viscosity to peak viscosity in an RVA profile (cf.
30 Example 3 A) or their gel strength (cf. Example 3 B). GMSs are disclosed, for example, by the patent applications or patents hereinafter, the listing hereinafter not being complete:

WO 90/12876 A1, WO 91/19806 A1, WO 92/11375 A1, WO 92/11376 A1, WO 92/11382 A1, WO 92/14827 A1, WO 94/09144 A1, WO 94/11520 A1,
35 WO 95/04826 A1, WO 95/07355 A1, WO 95/26407 A1, WO 95/34660 A1, WO 95/35026 A1, WO 96/15248 A1, WO 96/19581 A1, WO 96/27674 A1, WO 96/34968 A1, WO 97/04112 A1, WO 97/04113 A1, WO 97/11188 A1, WO 97/16554 A1, WO 97/20040 A1, WO 97/22703 A1, WO 97/45545 A1, WO 98/11181 A1, WO 98/11228 A1, WO 98/15621 A1, WO 98/37213 A1,

WO 98/37214 A1, and CA 2,061,443, DE 19820607.0, DE 19820608.9, DE 19836097.5, DE 19836098.3, DE 19836099.1, EP 0 521 621, EP 0 703 314, EP 0 737 777, EP 0 779 363 or US 5,300,145. WO 97/11188 A1 extensively describes
5 the GMSs used in the examples hereinafter.

In the production of glass noodles, the use according to the invention of GMSs in the process of the invention allows at least 30% of the conventionally required mung bean starch to be replaced, preferably about 30-90%, particularly preferably
10 about 35-80%, in particular about 40-65% without any significant loss in quality of the glass noodles occurring.

A further preferred embodiment of the inventive process additionally comprises the process steps

- 15 a) producing a paste using mung bean starch and
b) producing a noodle dough using said GMSs.

For the purposes of the present invention, „glass noodle" means any noodle which has an elasticity (tensile strength/elongation) of at least 1.5 g/cm, preferably at
20 least 1.7 g/cm, and/or a water absorption capacity of a maximum of 550% (w/w), preferably a maximum of 530%, particularly preferably a maximum of 500%, measured at a noodle diameter of about 0.4-0.45 mm.

The term "glass noodle", however, is not restricted to noodles of diameter about
25 0.4-0.45mm, but relates to any noodle of the same composition.

For the purposes of the present invention, „elasticity" is defined as the tensile strength/elongation of the cooked noodle and is determined by tensile tests using a texture analyzer (Texture Analyser TA-XT2, Stable Micro Systems, UK). For this
30 purpose, individual glass noodles (diameter 0.4 - 0.45 mm) after boiling (100 s at 100°C) and cooling (60 s at 20°C) were wound round an upper and lower round holder of the instrument, so that the intermediate space was 50 mm. The noodles were then extended at 1 mm/s up to break point and a stress-strain diagram was recorded. From the maximum required force to break a noodle and the elongation
35 of the noodle at the time point of break, the ratio force/distance in g/cm was calculated as a measure of the elasticity.

The „cooking loss“ was reported as dry residue of the cooking water based on the initial noodle dough mass, and the „transparency“ was determined by optical evaluation.

5

„Water absorption capacity“ for the purposes of the description is defined as the amount of water in g which was taken up by the noodle during the cooking process (100 s at 100°C), based on the initial noodle dough mass.

10 Description of the Figures:

Fig. 1: represents a diagrammatic RVA temperature profile (viscosity vs. time [min]) with the viscometric parameters T= gelatinization temperature, temperature at the time point when gelatinization begins; Max signifies the maximum viscosity (peak viscosity); Min designates the minimum viscosity; Fin designates the final viscosity; Set is the difference (Δ) of Min and Fin (setback).

The examples hereinafter are intended to explain and illustrate the subject matter of the invention. The examples are therefore in no case to be understood as restricting the present invention.

Examples:

25 Example 1: Glass noodle production

To prepare the noodle dough, initially a starch paste consisting of 49 parts of water and 6 parts of starch (control: mung bean starch) was produced at 90°C for 15 min. Then, by successive addition of 55 parts of other starch, a dough was prepared and kneaded for 15 min at 40°C to give a homogeneous composition. The homogeneous noodle dough was extruded into boiling water through fine nozzles of 1.5 mm in diameter and after a cooking time of 100 s the noodles were quenched for 60 s in cold water at 20°C.

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After subsequent air drying, noodles having a diameter of 0.4 to 0.45 mm were obtained.

Example 2: Physicochemical characterization of the glass noodles

Noodles which were produced according to Example 1 and had various starch compositions were analyzed for their various properties.

5 The mung bean starch (MB) was replaced by the starches listed hereinafter in such a manner that to prepare the paste, only mung bean starch was used and to prepare the dough differing amounts of alternative starches were used.

Table 1: Characterization of the glass noodles

10

Ex. No.	Starch composition	Water absorption capacity (%)	Elasticity (g/cm)	Cooking loss (%)
1	MB (100 %)	432	2.15	6.1
2	MB : PO (50:50)	529	1.35	6.8
3	MB : PO (25:75)	576	0.99	6.8
4	MB : GMS 1 (50:50)	492	1.72	6.4
5	MB : GMS 1 (25:75)	529	1.56	6.8
6	MB : GMS 2 (50:50)	491	1.72	7.2
7	MB : GMS 3 (50:50)	498	1.52	5.5
8	MB : GMS 4 (50:50)	487	1.70	6.5
9	MB : GMS 5 (50:50)	531	1.65	5.8
10	PAL (100)	454	1.92	5.7
11	PAL : GMS 1 (50:50)	510	1.21	7.0

The abbreviations used in Table 1 have the following meanings:

MB = native mung bean starch, importer: Asia Mekong, Hamburg, FRG

- PO = conventional native potato starch, Emsland-Stärken, Emlichheim, FRG
- 5
GMS 1 = genetically modified potato starch having an amylose content of about 37%, obtainable according to Example No. 10 of international patent application WO 97/11188 A1
- GMS 2 = genetically modified potato starch having an amylose content of about 33.8%, obtainable according to Example No. 10 of international patent application WO 97/11188 A1
- 10
GMS 3 = genetically modified potato starch having an amylose content of about 27.5%, obtainable according to Example No. 6 of international patent application WO 97/11188 A1
- GMS 4 = genetically modified potato starch having an amylose content of about 31.7%, obtainable according to Example No. 6 of international patent application WO 97/11188 A1
- 15
GMS 5 = genetically modified potato starch having an amylose content of about 31.9%, obtainable according to Example No. 7 of international patent application WO 97/11188 A1
- PAL = native green pea starch, manufacturer, Cosucra, Fonsenoy, Belgium

20

Example 3: Characterization of the starch properties

3 A) Viscosity

25 The gelatinization properties or viscosity properties of starch samples can be recorded using a Rapid Visco Analyzer, Newport Scientific Pty Ltd, Investment Support Group, Warriewood NSW 2102, Australia.

30 For a Rapid Visco Analyzer (RVA) measurement, a suspension of 2 g of starch in 25 ml of water is subjected to the following heating program: suspend for 60 s at 50°C, heat from 50°C to 95°C at 12°C/min, hold at a constant temperature for 2.5 min, cool to 50°C at 12°C/min and then keep constant for 2 min. The RVA temperature profile gives the viscometric parameters of the starches studied for the maximum (Max) and final viscosity (Fin), the gelatinization temperature (T), the minimum viscosity (Min) occurring after the maximum viscosity and the difference between
35 minimum and final viscosity (Setback, Set) (cf. Fig. 1).

The quotient of final viscosity and peak viscosity of native potato starch from potatoes of the cultivar Désirée, which was determined in this manner, is about 0.4.

5 3 B) Gel strength

To determine gel strength using a Texture Analyzer, 2 g of starch is gelatinized in 25 ml of water (cf. measurement using RVA) and then kept sealed air-tight for 24 h at 25°C. The samples were fixed under the probe (round piston) of a Texture Analyzer TA-XT2 (Stable Micro Systems) and

10 the gel strength was determined using the following parameter settings:

Test speed	0.5 mm
Depth of penetration:	7 mm
Contact surface (of the piston)	113 mm ²
Pressure/contact surface	2 g

Patent claims:

1. A process for producing glass noodles, in which a first starch, a second starch, and water are processed to form a glass noodle, wherein the first starch is mung bean starch and wherein the second starch is from genetically modified plants having an amylose content of at least 25%, a gel strength of about 90-160 g and a phosphate content of at least 0.5 nmol of glucose-6-phosphate/mg of starch.
2. The process of claim 1, wherein the second starch is from (a) a genetically modified tapioca plant, (b) a genetically modified potato plant, (c) a genetically modified corn plant, (d) a genetically modified wheat plant, or (e) any combination of (a) to (d).
3. The process as claimed in claim 1 or 2, wherein the amount of the second starch is at least 30% of the total amount of starch of the glass noodles.
4. A glass noodle which is obtainable by a process as claimed in any one of claims 1 to 3, wherein the glass noodle has an elasticity of at least 1.5 g/cm measured at a diameter of about 0.4 to 0.45 mm of the dried noodle.
5. A glass noodle obtainable by a process as claimed in any one of claims 1 to 3, wherein the glass noodle has a water absorption capacity of a maximum of 550% (w/w) at a diameter of about 0.4 to 0.45 mm of the dried noodle.
6. Use of a first starch and second starch for producing glass noodles, wherein the first starch is mung bean starch and wherein the second starch is from genetically modified plants having an amylose content of

at least 25%, a gel strength of about 90-160 g and a phosphate content of at least 0.5 nmol of glucose-6-phosphate/mg of starch.

7. The use of claim 6, wherein the second starch is from (a) a genetically modified tapioca plant, (b) a genetically modified potato plant, (c) a genetically modified corn plant, (d) a genetically modified wheat plant, or (e) any combination of (a) to (d).
8. A process for producing a demoldable gel, which comprises boiling a roughly 2-15% strength suspension of a first starch and second starch and cooling it to a temperature below 30°C, wherein the first starch is mung bean starch and wherein the second starch is from genetically modified plants having an amylose content of at least 25%, a gel strength of about 90-160 g and a phosphate content of at least 0.5 nmol of glucose-6-phosphate/mg of starch.
9. The process of claim 8, wherein the second starch is from (a) a genetically modified tapioca plant, (b) a genetically modified potato plant, (c) a genetically modified corn plant, (d) a genetically modified wheat plant, or (e) any combination of (a) to (d)
10. Use of a first starch and second starch to form a demoldable gel by cooling a roughly 2-15% strength boiled suspension of said starch to a temperature below 30°C, wherein the first starch is mung bean starch and wherein the second starch is from genetically modified plants having an amylose content of at least 25%, a gel strength of about 90-160 g and a phosphate content of at least 0.5 nmol of glucose-6-phosphate/mg of starch.
11. The use of claim 10, wherein the second starch is from (a) a genetically modified tapioca plant, (b) a genetically modified potato plant, (c) a

genetically modified corn plant, (d) a genetically modified wheat plant, or (e) any combination of (a) to (d).

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RVA - Profile

