Title: PROCESS FOR PRODUCING TRANSPARENT PASTA BY EXTRUSION

Abstract: The present invention describes an improved process for producing transparent pasta which comprises a) metering starch and water in the weight ratio of 1:0.8 to 1:3 into an extruder which is heated to a temperature of 60 - 95°C and forming a dough-like mixture, wherein the starch in the mixture is gelatinized, b) degassing the dough-like mixture, and c) shaping the dough-like mixture by a die.
Process for producing transparent pasta by extrusion

The present invention is directed to an improved extrusion process for producing transparent pasta and to products obtained by such process.

The conventional processes for producing transparent pasta consist of a plurality of steps (Figure 1): starch and water are processed by heating or gelatinizing the starch to give a dough-like mixture. Thereafter, further starch is added, the mixture is kneaded, extruded into hot water, cooked and subsequently cooled with cold water and dried in order to obtain the end product (US 6,242,032; US 6,110,519; Galvez et al. (1994), J. Food Sci 59/2: 378 and 386; Kim et al.: (1996) Cereal Chem. 73: 302-308).

It is disadvantageous of the previous processes that a plurality of intermediate steps and also standing times are required which significantly increase the labor and time consumption.

Several processes for producing pasta which employ extruders are known from the prior art.

US 5,916,616 deals with a process for producing starch noodles by extrusion, which comprises adding 45-55 parts by weight of hot water to 100 parts by weight of starch obtained from at least one member-selected from the group consisting of potato, sweet potato, tapioca, corn, wheat and a product thereof followed by being mixed to prepare large particles of dough and then extruding the dough under degassing at degrees of vacuum of not less than 650 Torr to produce a dough sheet. Starch noodles thus produced are highly transparent.

EP-A-0267368 discloses quick cooking pasta products which are extruded in a low temperature process by advancing a partially pre-cooked mixture of pasta flour and water prepared in a preconditioner along the length of a screw extruder through a cooking zone, then through a venting zone and a forming zone, and finally through an extrusion die to yield an extruded product.

US 5,989,620 provides with a high temperature extrusion process for the production of legume pasta products. A dough mixture having a moisture content in the range of 15 to
40% is processed in a twin screw extruder or in a single screw extruder at a barrel temperature in the range of 70 to 135°C and extruded through a die to form legume pasta products.

5 The process according to the invention for producing transparent pasta comprises

a) metering starch and water in the weight ratio of 1:0.8 to 1:3 (starch:water) into an extruder which is heated to a temperature of 60 - 95°C and forming a dough-like mixture, wherein the starch in the mixture is gelatinized,

b) degassing the dough-like mixture, and

c) shaping the dough-like mixture by a die.

When shaping the dough like mixture by a die in step c) a dough-strand is obtained as product. The product can be further processed. In one embodiment of the invention, the product is dried after step c) of the process.

15 In the process according to the invention the starch gelatinizes while heating and shearing the dough-like mixture inside the extruder. This has the advantage that no gelatinization step is necessary after extrusion. I.e. a heating or cooking process need not follow the extrusion process, which is in contrast to previous extrusion processes for producing transparent pasta in which gelatinization does not occur.

20 A transparent pasta comprises according to the invention the main components starch and water which are formed into a dough-like mixture. As further components, the pasta can also contain, for example, salt or stabilizers or other common ingredients.

25 Transparent pasta is taken to mean products which are shaped as desired made of starch or starch mixtures and water with or without addition of other ingredients. The transparent pasta is made into a dough, shaped, and may be further processed, e.g. by drying. However, the pasta is not and need not to be subjected to a fermentation or baking process.

30 In the context of the present invention, a pasta is characterized as transparent which possesses a measurable light transmissivity and which can be determined by a transmission measurement.
A basic component which can be used for the process according to the invention is starch. Starch is a nutritionally essential component of the human and animal diet. The structural features of the starch which is contained in foods can affect the functional (eg. water-binding capacity, swelling capacity), nutritional (eg. digestibility, effect of the food on the glycemic index) or structure-determining (eg. cut resistance, texture, stickiness, processability) properties of a very wide range of foods. Food compositions therefore frequently contain a starch having defined structural features which cause the desired properties of the food in question. Also, the properties of foods which contain starch-storage plant tissue (eg. grains, fruits, flowers) can be affected by the starch contained in the plant tissues.

The polysaccharide starch is composed of chemically uniform building blocks, the glucose molecules, but is a complex mixture of different molecular forms which have differences with respect to the degree of polymerization and degree of branching, and therefore differ greatly from one another in their physicochemical properties. A distinction is made between amylose starch, an essentially unbranched polymer of alpha-1,4-glycosidically linked glucose units, and amylopectin starch, a branched polymer, in which the branches come about by the occurrence of additional alpha-1,6-glycosidic links. A further essential difference between amylose and amylopectin is the molecular weight. Whereas amylose, depending on the origin of the starch, possesses a molecular weight of 5×10^5 - 10^6 Da, that of amylopectin is between 10^7 and 10^8 Da. The two macromolecules can be differentiated by their molecular weight and their different physicochemical properties, which can be made visible most simply by their different iodine binding properties.

A further basic component which can be used for the inventive process is a starch mixture.

Starch mixtures are taken to mean mixtures which consist of starches of various plant species, eg. when the starch of mung beans is mixed with that of potatoes in order to process it to give pasta. The mixing ratios, the origins (monocotyledonous/dicotyledonous plants) and also the number of origins (of 2, 3 or more plant species) can vary in this case.
The process according to the invention is distinguished by the use of a heated extruder into which starch or a mixture of starches and water are metered. Extruders (DIN 24450: 1987-02) are transport appliances which take in solid to viscous mixtures and express them uniformly from a shaping orifice. Extrusion processes are described, e.g., by: Harper, in: Mercier et al. (editors) "Extrusion cooking" (1989), AACC, p. 5.

The main element of an extruder (Figure 3) is the screw which is housed in a barrel. This screw is driven by a drive (usually an electric motor). A pumpable mixture is produced which is forced through an outlet die.

There are different designs of extruders, e.g. a distinction is made according to the number of transport screws in the barrel between single-screw and multiple screw extruders (also termed single- and multiscrew extruders). There are extruders having one, two or more screws. In the case of the extruders having two screws, a distinction is made between corotating and counterrotating twin-screw extruders. In the corotating twin-screw extruder, the screws rotate in the same direction of rotation, and in the counterrotating one they rotate in the opposite direction of rotation. The transport and pressure buildup are caused in the single-screw and corotating twin-screw extruders by the friction of the mixture rotating with the screw at the stationary barrel wall - also termed friction transport. The mixture which thus remains in rotation is pushed to the outlet die by the helical screw flights. In the counterrotating twin-screw extruder, the principle of forced transport predominates.

As a further embodiment, a corotating extruder is used for the process according to the invention.

The screw is in one embodiment subdivided into three regions having different tasks. In the rear region of the barrel there is what is termed the feed zone in which the material to be extruded is fed ("feeding"), preferably via a hopper, and compacted. This is followed by the compression zone in which the material is further compacted by the reduced flight depth of the screw and the pressure necessary for discharge in the die is thereby built up. Finally, the discharge zone ensures a homogeneous material stream to the die.
In the process according to the invention the extruder is heated to a temperature of 60 to 95°C. The term "temperature" in this connection means the barrel temperature of the extruder. Preferably, the temperature is 75-95°C, particularly preferably 80-95°C, very particularly preferably 85-95°C.

In another embodiment the extruder is heated to a (barrel) temperature of 60-90°C, preferably 75-90°C, more preferably 80-90°C, and most preferably 85-90°C.

The heating is conventionally performed as jacket heating which is operated using electricity, steam, oil or hot water.

In one embodiment, the extruder comprises three zones: feed zone, compression zone and discharge zone, which can be heated differently or at the same temperature. In another embodiment, the extruder can comprise more than three zones, which can be heated differently or at the same temperature. In still other embodiments, the extruder may have only one zone or two zones.

At least one of the zones is heated to a temperature which is sufficient to reach starch gelatinization. In an extruder with three or more zones, for example, at least a compression zone may be heated to a temperature which is sufficient to reach starch gelatinization. Other zones, for example a discharge zone, may be heated to a lower temperature.

The dry starting materials can be conventionally fed via a metering system which can comprise, eg., a hopper and a transport device for charging the substances into the extruder.

The process according to the invention, in another embodiment, is further distinguished in that the weight ratio of starch:water is 1:1.1 to 1:3 preferably, the weight ratio starch:water is 1:1.1 - 1:2.5; particularly preferably 1:1.1 - 1:2, and very particularly preferably 1:1.1 - 1:1.5.

Depending on the starch or composition of the starch mixture used, a higher or lower
amount of water may be required in order to maintain the desired processing consistency.

An exemplary embodiment of the present invention is shown in Fig. 2. The process for producing transparent pasta comprises feeding starch and water directly to the extrusion device, and after optional air drying the extruded dough, the product is obtained (Figure 2).

The water can be fed in this process e.g. by gear pump. Otherwise, other devices known to those skilled in the art for liquid metering can be used. In one embodiment of the invention, only one water feeder is used.

A further advantage of the process according to the invention is that it is a continuous process. The starch or the starch mixture is directly charged into the extruder and the water added simultaneously. Thereafter, downstream, the further processing in the extruder follows. The extruder stream passes from the feed orifice to the exit die.

In conventional pasta extrusion processes, water and dough are mixed in advance to give a crumbly mixture (called Premix) and not until after a certain standing time (hydration time) does the further processing in the extruder proceed (US 6,242,032; DE 3447 533, WO 00/54605).

Another advantage of the process according to the invention is that it works at relative low temperatures, e.g. at an extruder barrel temperature of 60 - 95°C.

In another embodiment, the process according to the invention further comprises compacting the starch-water mixture, before degassing, by a reverse feed element. In the process according to the invention, in this case, the degassing proceeds downstream of the reverse feed element, i.e. after the compaction of the dough mixture. Preferably, the degassing proceeds via application of a vacuum at approximately 0.4 bar. Another conceivable variant is, e.g., pressure reduction. After the degassing, the dough mixture exhibits greater homogeneity and fewer air inclusions.

In one embodiment, in the process according to the invention, the extruder used is a
multiple-screw extruder. In a further embodiment, in the process according to the invention, a single-screw extruder is used. The screw of the extruder is composed of transport elements and, optionally, also of reverse feed elements. The screw can contain one or more kneading elements.

In another embodiment of the invention the extruder has a ratio of barrel length to barrel diameter (L/D ratio) of equal or less than 20, preferably equal or less than 18, more preferably equal or less than 15. In still another embodiment, the L/D ratio is in the range of 11 - 20, preferably 11 - 18, more preferably 11 - 15. Such L/D ratios are relatively low which is beneficial for the cost-effectiveness of the process. In one embodiment, only one water feeder is used, as shown in Fig. 3. Extruders used in the prior art often have a larger L/D-ratio than described above.

The extruder stream passes from the feed orifice to the die. The process according to the invention has the advantage, compared with the conventional process, that it is reduced to the metering of starch and also water into the extruder and the subsequent mechanical-thermal treatment. As a result, the production process from metering up to exit from the die on a laboratory scale takes only 15 seconds. Then, the product needs neither be heated nor quenched or cooled.

The shape of the die is not restricted and, for instance, the cross sections of the die and also the pasta produced can be, eg., round, square or oval.

The dough strand is semi-endless and, after it leaves the die, can be rolled up or cut for drying devices.

Drying can be performed in air. As an example, the drying time can be in the range of about 1 - 5 h, preferably about 2 h. Air humidity and external temperature can shorten or prolong the drying operation. Other drying processes known to those skilled in the art can also be used. In one embodiment of the invention, the water content of the glass noodles is in the range of 7-14% after drying,

In a further embodiment, in the process according to the invention the transport rate of the dough mixture through the extruder is 50-1 10g/minute, preferably 60-1 00g/minute,
particularly preferably 70-90g/minute, and very particularly preferably 80g/minute.

In the process according to the invention the starch used can be a plant starch.

A person skilled in the art differentiates starch-storage plants such as, eg., cereals, potatoes, rice, corn, peas or beans, from plants whose main storage material is, eg., oil (e.g. rape). Starch-storage plants predominantly store the starch in grains, tubers, or the legume seeds.

The starch is isolated and purified in a manner known to those skilled in the art. Methods of starch extraction and purification are described, eg., in: Tegge, G. (2004): Starke und Starkederivate [Starch and starch derivatives] (Hamburg, Behr’s Verlag).

In the process according to the invention, preferably, the starch or a starch mixture used is selected and extracted from, eg., mung bean, pea, rice, potato or sweet potato.

By means of the selection of these plants or their starches or starch mixtures, particularly transparent pasta may be produced.

Particularly transparent pasta according to the invention is also termed "glass noodles".

In a one embodiment of the present invention, the pasta produced by the process according to the invention is thereby a glass noodle.

Glass noodles are fine, virtually transparent noodles which are conventionally produced from mung bean starch and water. Since mung bean starch is relatively expensive, starch from carrots, wheat, peas, rice or (sweet) potatoes is also used (either "pure" or in a mixture with mung bean starch). So, preferable starches which are used in the process to produce glass noodles are selected from mung bean starch, carrot starch, wheat starch, pea starch, rice starch, (sweet) potato starch, or mixtures thereof.

Glass noodles are stored and sold dried and must be softened or swollen in water before they are used in various dishes.

In one embodiment of the present invention, mixtures of various starches may also be
used. In these mixtures, fractions of the mung bean starch are replaced by other plant starches which likewise gelatinize to be glassy. These can be, eg., starches from pea, potato, rice, corn, wheat or sweet potatoes. In a further embodiment, in the process according to the invention, at least 30% of the mung bean starch which is conventionally required may be replaced, preferably 30-90% mung bean starch may be replaced by 10-70% other plant starches, particularly preferably about 35-80% by 20-65%, in particular about 40-65% by 35 - 60%, without significant loss of quality of the glass noodles occurring.

WO 00/54605 describes the advantages of such mixtures, namely that production is made significantly cheaper, but the noodles have the same glassiness, taste and processing quality as glass noodles from pure mung bean starch.

The present invention is also directed to a transparent pasta produced by the process according to the invention which has an elasticity of 0.3 to 2.0 g/mm³.

Elasticity is taken to mean the extensibility of a dough product (after cooking or heating) without the product tearing (up to the tearing limit). It is defined as tensile strength/linear strain of the cooked noodle.

Elasticity is defined as described hereinafter in the methods section. In a preferred embodiment, the elasticity is 0.4 to 1.8 g/mm³, particularly preferably 0.6 to 1.6 g/mm³, very particularly preferably 0.8 to 1.4 g/mm³ and very extremely preferably 0.8 to 2.0 g/mm³.

The pasta produced by the process according to the invention can be a noodle. Noodles are taken to mean by those skilled in the art pasta shaped as desired which is cooked before consumption. A cooking or baking process is not employed in the production.

In a further embodiment, the pasta produced by the process according to the invention is a glass noodle produced from the components water and starch, wherein the starch has a phosphate content of at least 0.4 µmol of PO₄/₀ of starch and an amylose content of 20-70%.
In still another embodiment of the invention, the starch used for the process according to the invention has a phosphate content of at least 0.4 µmol of PO₄/g of starch and also an amylose content of 20-70%. Preferably, the amylose content is 20 - 50%.

A particularly suitable starch for the process according to the invention has proven to be potato starch T51, the elasticity of which is comparable to that of a glass noodle made of mung bean starch. A significantly higher elasticity is exhibited by glass noodles from potato starch T264. Not only T51 but also T264 have a high amylose content which has a beneficial effect on the elasticity of the product processed therefrom.

The present invention is hereinafter illustrated by working examples which are not to be construed as limiting the scope of the invention.
Material and Methods

1. Origin and analysis of the starches used

Use was made of commercially available starches or starch origins from Bayer BioScience GmbH. As a reference, use was made of a glass noodle commercial product (Lungkouw Glasnudeln, Asia Euro Import-Export GmbH).

- Smooth-skinned pea: native smooth-skinned pea starch, manufacturer: Cosucra (Fonsenoy, Belgium)
- MBS/KS: mung bean starch/potato starch 1:1
- Hylon®VII: commercial product corn starch, manufacturer: National Starch
- T 51: potato starch, described in WO 97/11188
- T264: potato starch, described in WO 2004/056999


The starch was isolated and obtained as described in Tegge, G (2004, 3rd edition): Starke und Starkederivate [Starch and starch derivatives]; Behr’s Verlag Hamburg.

2. Extrusion process

For production of the glass noodles, use was made of a corotating twin-screw laboratory extruder (PRISM TSE 16 TC from Thermo Prism, Staffordshire/UK). The screw diameter is D = 16 mm, the screw length 15 D = 240 mm.

The barrel of the processing part of the extruder was cooled in the region of the metering using tap water (approximately 17°C) and the following two barrel sections heated to 80°C, the die zone (hole matrix 0.1 mm) to 85°C.

The screws were configured as follows (viewed from the feed on):

6 ½ x D transport elements
2 x D/4 kneading elements
1 x D/2 reverse feed element
1 x D/2 transport element
6 x D transport elements
1 V x D pressurizing element

In the barrel, a vacuum valve for degassing the starch mixture was built in at the height of the reverse feed element.

The starch or the starch mixture was transported into the extruder at a volumetric flow rate of 0.6 kg/h using a precision metering instrument type GLD (metering tool size 0) from Gericke GmbH (Rielasingen / Germany). The water was added using a gear pump (model Reglo-Z from Ismatec (Wertheim-Mondfeld/Germany) via a pipe which was installed 35 mm after the feed orifice for the starch metering, at a volumetric flow rate of 0.53 l/h.

The process sequence in the extruder comprises metering starch having the equilibrium water content into the extruder and transporting it into the processing part by means of a screw or a screw pair, immediately thereafter mixing it with water and during the transport heating and/or gelatinizing and plasticizing it, shearing the plastic mass, degassing it and also compacting it and thereafter shaping it as a plastic-elastic mixture in the matrix (hole matrix 0.1 mm).

The noodle strand continuously discharged from the die was wound up onto a perspex roll (0.150 mm) or else suspended in strands each of approximately 500 mm in length over a metal bar fastened to a stand for drying at room temperature.

3. Study of glass noodle properties

The quality of the glass noodles was characterized by determination of the tensile force, extensibility and also elasticity (ratio of tensile force/extension), water absorption and also the boiling loss. The diameter of the noodles was measured using a caliper.

For measurement of tensile force and extensibility, 4 individual noodle strands having a
length of approximately 40 cm were used and were cooked for 1 min in 600 ml of boiling tap water. After they were cooked, the glass noodles were first poured over a household sieve (800 µm mesh width), then quenched with 100 ml of water (9°C), subsequently to prevent drying - placed on a metal sieve (500 µm mesh width) through which flowed cold steam or mist which had been generated by ultrasound.

Tensile force and extensibility were measured using a TA-XT2 Texture Analyzer (Stable Micro Systems Ltd, Godalming/Surrey, UK). For this, individual glass noodles (diameter of 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 holder (corresponding to the "Tensile Rig A/SPR") of the TA-XT2 Texture Analyzer, in such a manner that the intermediate space was 50 mm. The noodles were then extended at 1 mm/s until they tore, and a force-length diagram was plotted. From the value of the tensile force (maximum force required for tearing a noodle strand), based on the cross-sectional area (in g/mm²) and the value of elongation at tearing (in mm), the ratio (force/elongation in g/mm³) was calculated as a measure of the elasticity and/or structure. A large figure characterizes a short structure, a small figure rather a "long" structure.

4. Water absorption and boiling loss

The water absorption and boiling loss were determined by cooking 5 g of glass noodles in 300 ml (1 l glass beaker) of boiling distilled water for 1 min, then pouring them over a sieve having 0.5 mm mesh width, draining for 1 min, and subsequently weighing them.

\[
\text{Water absorption} = \frac{(\text{Weight noodles cooked} - \text{Weight noodles uncooked}) \times 100}{\text{Weight noodles uncooked}}
\]

All of the cooking water which was poured out and drained off was evaporated overnight or to constant weight in a crystallization dish (500 ml) at 105°C.

\[
\text{Boiling loss} = \frac{\text{Weight dry residue} \times 100}{\text{Weight noodles uncooked}}
\]

The water absorption expresses the difference in weight between cooked noodles and
air-dry noodles, the boiling loss corresponds to the fraction of the noodles which became soluble on boiling and which was determined as drying residue of the cooking water. The soluble mass was related to the weight of the air-dry noodles.

5

Examples

Example 1: Characterization of the starches used

Tab 1: Listing of the phosphate and amylose contents of the starches used

<table>
<thead>
<tr>
<th>Starch</th>
<th>Phosphate content [μmolPO4/g of starch]</th>
<th>Amylose [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>1.5</td>
<td>26.6</td>
</tr>
<tr>
<td>Mung bean</td>
<td>1.5</td>
<td>28.1</td>
</tr>
<tr>
<td>Smooth-skinned pea</td>
<td>0.5</td>
<td>27.9</td>
</tr>
<tr>
<td>Potato</td>
<td>11.2</td>
<td>20.3</td>
</tr>
<tr>
<td>MBS/KS</td>
<td>5.3</td>
<td>27.8</td>
</tr>
<tr>
<td>Hylon VII</td>
<td>1.4</td>
<td>44.0</td>
</tr>
<tr>
<td>T 51</td>
<td>5.7</td>
<td>28.3</td>
</tr>
<tr>
<td>T 264</td>
<td>47.1</td>
<td>42.0</td>
</tr>
</tbody>
</table>
Example 2: Characterization of glass noodle extruder products

Table 2: Comparison of diameter, tensile force, extension and elasticity of noodles from different starches

<table>
<thead>
<tr>
<th>STARCH</th>
<th>Ø (mm±s)</th>
<th>TENSILE FORCE (g ± s)</th>
<th>Specific FORCE (g/mm²)</th>
<th>EXTENSION (mm)</th>
<th>ELASTICITY²) g/mm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>0.75±0.05</td>
<td>13.8± 2.8</td>
<td>31.2± 4.7</td>
<td>57.2±10.6</td>
<td>0.56±0.13</td>
</tr>
<tr>
<td>Mung bean</td>
<td>0.75±0.02</td>
<td>16.6± 2.7</td>
<td>36.8± 7.0</td>
<td>114.0±21.0</td>
<td>0.32±0.02</td>
</tr>
<tr>
<td>Smooth-skinned pea</td>
<td>0.76±0.02</td>
<td>13.8± 1.7</td>
<td>30.5± 4.0</td>
<td>62.7± 8.4</td>
<td>0.49±0.05</td>
</tr>
<tr>
<td>Potato</td>
<td>0.75±0.08</td>
<td>Not measurable³)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MBS/KS</td>
<td>0.76±0.05</td>
<td>7.3± 1.4</td>
<td>133.4± 2.3</td>
<td>≥135</td>
<td>0.12±0.03³)</td>
</tr>
<tr>
<td>Hylon VII</td>
<td>0.51±0.01</td>
<td>Not measurable⁴)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T 51</td>
<td>0.77±0.03</td>
<td>15.3± 3.8</td>
<td>33.3±10.7</td>
<td>107.8±14.9</td>
<td>0.31±0.07</td>
</tr>
<tr>
<td>T 264</td>
<td>0.72±0.02</td>
<td>48.7± 2.7</td>
<td>119.8±13.7</td>
<td>65.6± 9.2</td>
<td>1.86±0.24</td>
</tr>
</tbody>
</table>

* Means of n = 7 individual values

1) calculated from force based on the cross-sectional area
2) specific force / extension (mean)
3) not measurable, stuck, disintegrated on boiling, in part too firm
4) nonelastic, broke on exit from the extrusion and on boiling
5) force at maximum extension length (135 mm)

The glass noodles which were produced under constant extrusion conditions varied within wide limits with respect to extension behavior. Measured by the numerical value of the elasticity of the commercial product as reference product, the noodles produced by means of extrusion from T51, smooth-skinned pea resp. MUNG BEAN were the most similar to the latter. At a greater diameter of the noodles, the elasticity value was correspondingly higher. The use of mung bean starch and pea starch gave less stable, particularly readily extensible products, those made of conventional potato starch tore rapidly when measuring the tensile force. The mixture of mung bean starch and potato starch gave glass noodles having high extensibility (≥135), and the noodles did not break on extension.
Example 3: Water absorption and boiling loss

Table 3: Comparison of water absorption and boiling loss (in %) of noodles made of different starches

<table>
<thead>
<tr>
<th>STARCH / Product</th>
<th>WATER ABSORPTION(^1) (%)</th>
<th>BOILING LOSS(^2) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference (^1)</td>
<td>145</td>
<td>0.8</td>
</tr>
<tr>
<td>Mung bean</td>
<td>183</td>
<td>0.8</td>
</tr>
<tr>
<td>Smooth-skinned pea</td>
<td>178</td>
<td>1.7</td>
</tr>
<tr>
<td>Potato</td>
<td>Not</td>
<td>measurable</td>
</tr>
<tr>
<td>MBS/KS(^5)</td>
<td>169</td>
<td>4.4</td>
</tr>
<tr>
<td>Hylon VII</td>
<td>Not</td>
<td>measurable</td>
</tr>
<tr>
<td>T 51</td>
<td>180</td>
<td>3.0</td>
</tr>
<tr>
<td>T 264</td>
<td>292</td>
<td>3.7</td>
</tr>
</tbody>
</table>

\(^1\) Water absorption after 1 min in boiling water
\(^2\) Boiling loss after 1 min in boiling water

The water absorption expresses the weight difference between the cooked noodles and the equilibrium water content (10-14%) of the air-dry noodles, the boiling loss corresponds to the fraction of the noodles which became soluble on boiling which was determined as drying residue of the cooking water. The soluble mass was related to the weight of the air-dry noodles.
Patent claims

1. A process for producing transparent pasta, which comprises
   a) metering starch and water in the weight ratio of 1:0.8 to 1:3 (starch:water) into an extruder which is heated to a temperature of 60 - 95°C and forming a dough-like mixture, wherein the starch in the mixture is gelatinized,
   b) degassing the dough-like mixture, and
   c) shaping the dough-like mixture by a die.

2. The process as claimed in claim 1, wherein the product obtained after step c) is dried.

3. The process as claimed in claim 1 or 2, wherein the dough, before the degassing, is passed via a reverse feed element.

4. The process as claimed in one of claims 1 to 3, wherein the extruder is a single-screw extruder.

5. The process as claimed in one of the preceding claims, wherein the extruder has a ratio of barrel length to barrel diameter (L/D-ratio) of equal or less than 20.

6. The process as claimed in one in one of the preceding claims, wherein the starch used is a plant starch.

7. The process as claimed in claim 6, wherein the starch used is obtained from mung bean, pea, potato, rice or a mixture thereof.

8. A transparent pasta produced by a process as claimed in one of claims 1 to 7, wherein it has an elasticity of 0.3 to 2.0 g/mm³.

9. The pasta as claimed in claim 8, wherein the transparent pasta is a noodle.

10. The pasta as claimed in claim 9, wherein the transparent pasta is a glass noodle.
11. A glass noodle comprising the components water and a starch having a phosphate content of at least 0.4 µmol of PO₄⁴⁻ g of starch and an amylose content of 20-70%, obtainable by a process as claimed in one of claims 1 to 7.
Figure 1: Conventional process for pasta production

Figure 2: Process according to the invention for producing pasta
Figure 3: Diagrammatic structure of an extruder