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¹ INSTANT RICE PORRIDGE AND PROCESS FOR ITS PRODUCTION

This invention relates to an instant rice porridge.

BACKGROUND OF THE INVENTION

Rice porridge which is a very popular dish among Asian communities is conventionally prepared in the home by overcooking rice grains in an excess quantity of water until the grains of rice start to loose their individual identity but still retain some texture. In the end product which comprises a gelatinised starch matrix the rice grains have a core which gives some resistance to bite and a considerably softened outer layer, the combination giving the product mouth feel and a degree of body or chewability.

Preparation of rice porridge in the home is a time consuming operation since cooking to the right degree of softening of the rice grains takes a long time and must be continually overseen to ensure that the product is not undercooked, when the centre of the grains is too hard, or overcooked, when the entire product becomes a liquid mush.

Various attempts have been made to produce an instant rice porridge in the form of a dry product that can be hydrated with hot, particularly boiling water. Such products have hitherto been generally unsuccessful, in some cases because they take too long to hydrate and in others because the texture or mouth feel or other organoleptic properties are not like those of freshly made rice porridge.

In one proposed method, rice is cooked to a normal extent in hot water. The rice grains are then air dried and flaked on a flaking machine. This flaked rice is then puffed before packaging. The product has a hard brittle texture which means that it easily breaks into small pieces. It also tends to have a low specific gravity and a hard surface skin so that when water is added, the product floats and takes a considerable time (10 minutes and more) to hydrate and sink. The granular form of the rice tends to remain after hydration even though the product is puffed and it is virtually impossible to obtain a traditional slurry-like consistency desirable in a rice porridge even with very vigorous stirring. There is little surface starch to produce a gelatinous matrix.

An alternative form of puffed product is produced in a manner similar to that used for manufacturing prawn crackers by producing extruded granules of rice from a mixture of ground rice and water without allowing any puffing at the die exit and

subsequently puffing the product with the application of heat. This product is very similar to the breakfast cereal known as " Rice Crispies ". It is of extremely low specific gravity and floats on the hydrating water. When it is finally hydrated and thoroughly mixed with the hydrating water, there is very little texture in the product.

In a further attempt to make instant rice porridge, rice powder and water is passed through a heated extruder to form pellets or particles of cooked rice. These pellets are then ground to a fine powder either with or without a further water reduction step. This cooked rice powder mixes virtually instantly with hot water to produce a gruel-like product with little or no texture and none of the other desirable organoleptic properties of a rice porridge.

JP 60 192557 A discloses a process of making of dried gruel by cooking a specific ratio mixture of polished and unpolished rice in an extruder. JP 59 021361 A discloses a process of making of instant mushy food in which rice is cooked, then fed to an extruder for kneading and moulding, and then expanded using hot air.

SUMMARY OF THE INVENTION

According to a first aspect of the invention, an instant rice porridge product comprises puffed generally rice grain sized, discrete pieces of rice having a more dense compacted central region, a less dense intermediate region of closed cells surrounding the central region, and a surface region of generally open cells, the surface region of said pieces consisting of substantially fully gelatinised starch and the central region consisting of partially gelatinised starch.

According to a second aspect of the invention, a method for making the above instant rice porridge product comprises passing rice, optionally mixed with a minor amount of water, through a cooking extruder and a die, allowing the product to puff on exit from the die and cutting off substantially rice grain size pieces of the puffed product, the extrusion conditions being such that the product exiting the die has a substantially fully gelatinised surface region and a partially gelatinised central region, and passing the puffed product pieces through a flaker to make the centre of the pieces compacted and more dense. In the flaker, which preferably comprises a pair of nip rolls, the cells in the interior of the particles are collapsed or reduced in size and the still moist rice coheres to form a compacted core while the outer cells are ruptured to form an open cell surface structure. Closed cells may remain between the open cell surface layer and the core.

The open cell surface structure allows easier penetration of hydrating water and the denser core provides mouth feel and bite texture.

In addition the flattened particles have a higher packing density which provides a further advantage that the pack size for a given weight of product can be reduced.

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The rice that is fed to the extruder may be whole grain rice or it may be ground prior to use. In a grinding step, the rice may be ground to a fine powder or merely reduced to pieces having a size adapted to the extrusion apparatus used.

The water content of the rice fed to the extruder will normally be between 3 and 35% by weight, for example, about 28% by weight.

The addition of water may or may not be necessary depending on the original water content of the rice grains and the extrusion conditions. There must be enough water present to allow the rice to cook in the extruder to provide the fully gelatinised and partially gelatinised portions.

Generally the maximum amount of water that is needed to be added is 40% of the weight of the rice, that is to say for every 5 units by weight of rice, 2 units by weight of water is the maximum addition.

The amount of water in the rice contributes to control of the temperature of extrusion. There must be enough free water in the product leaving the extruder to cause the necessary degree of puffing and allow coherence of the core on flaking but there

should not be so much that considerable drying of the extruded product is necessary. Some drying of the product will normally be necessary to reduce the water activity of the product to a level commensurate with a desired shelf life.

Drying under the wrong conditions can produce a skin around the pieces of product which hinders the hydration process and prevents a smooth transition between the water gelatinised phase and the grain phase of the porridge. This should be avoided in the product of the invention.

Temperature control of the product in and on exit from the extruder is essential. The temperature in the extruder is dependent on the temperature of the extruder barrel, the speed of the extruder screw, the gap between the extruder screw and the barrel and the amount of water in the material. The higher the amount of water in the product, the lower the temperature rise in the extruder. The higher the speed of the extruder, the greater the temperature of the product, and the smaller the extruder gap, the greater the temperature of the product. The size of the space between the end of the screw and the die which is the primary space in which cooking of the product occurs can be varied to alter the residence time of the product in the cooking space to ensure that the product is cooked in the extruder to the desired extent.

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The temperature of the product on exit from the extruder coupled with the pressure drop determines how much the product is puffed. The pressure drop can be adjusted by altering the pressure within the extruder by changing the speed of the screw.

Any form of cooking extruder may be used in the production of the product of the invention. The extruder may be a single or multi screw extruder and may have a grooved or smooth barrel.

The residence time of the rice in the extruder is preferably in the range to 4 - 7 seconds and the preferred length of the passage through the extruder is about 15cm but this will depend to a large extent on the exact nature of the extruder used. The skilled extruder operator will know from an inspection of the product whether the extrusion conditions are correct and how to adjust them, if they need changing. A subsequent flaking operation allows a greater degree of flexibility during extrusion.

DESCRIPTION OF THE DRAWING

The single figure of the drawings shows one form of screw extruder for use in the process of the invention.

Referring now to the drawing, a screw extruder machine for use in the process comprises a barrel (1) with shallow grooves (2) and a piston (3) in the form of a screw (4) located within the said barrel (1). The barrel (1) is connected to a die (5) by a suitable connecting mechanism (6). The rotation of the piston (3) results in a forward movement of the rice grain-water mixture. During passage through the extruder the mixture is heated to cook the mixture and the movement of the screw (7) forces the cooked mixture through the orifices (8) within the die (5). The difference in the pressure inside and outside the extruder leads to a rapid expansion of the water in the mixture which acquires a cellular structure. This product is then cut off with a high speed rotary blade (not shown) to produce a product of generally rice grain size.

This product may then be flaked by passage through a roller machine (not shown).

The end product can be packed with or without undergoing a drying process depending on the required shelf-life of the product. The shelf-life of the product can be greatly enhanced if it is dried to around 4% to 6% moisture content prior to packaging.

The characteristics of the product can be changed by monitoring such parameters as the barrel (1) temperature, the speed of the piston (3), the moisture content of the rice grain-water mixture prior to extrusion, temperature of the die (5), the distance between the wall and the grooves (2) within the barrel (1), the distance between the piston head (7) and the die (5), and the length and the diameter of the extruder machine. While some of the extruder characteristics can be varied within fixed limits, the other parameters can be monitored and adjusted individually or in combination during production to obtain desired characteristics of the end product.

The product is characterised by being oval in shape, flattened in nature with a white to creamy colour. It has a surface with slightly plastic characteristic and an open cell structure. When analysed, the internal structure revealed large empty cavities surrounding a compressed and coherent core in which the bubble structure is much reduced. The surface comprises a layer of fully

gelatinised starch giving a slightly translucent glassy appearance to the product. The core comprises partially gelatinised starch. The cream colour of the product is attributed this partially gelatinised starch within the structure. The mixture of fully and partially gelatinised starch imparts to the product a partial barrier to water that prevents instant hydration. This barrier is broken down on addition of hot water to the product.

The structural composition enables full hydration to occur as the partially gelatinised starch undergoes complete gelatinisation giving the mixture a traditional rice porridge appearance, texture and taste. The rate of hydration may be adjusted by adjusting the degree of puffing of the product and the degree of compaction in the flaking operation. A hydration period of between about 3 and 5 minutes is desirable.

The product can be formed into a more complete meal by adding other materials together or separately packed. These include various flavours (such as chicken, mushroom, abalone, etc) colour, protein (such as soya powder, whole bean, etc) vegetables (mushroom, carrot, corn, peas, onion etc), fruit (such as plum, apricot, apple etc), meat (such as chicken, beef, lamb etc) and fish. These can be added in either fresh or processed form and may be added before or after extrusion or in separate packages in a packaged product.

Similarly, the health benefits of the product can be enhanced by adding, for example, vitamins, minerals, protein, herbs and traditional plants and plant extracts such as parsley, lotus seed, barley, ginseng, ginger, germ, mint and so on.

EXAMPLE

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The following example illustrates the invention.

50 kilograms of rice having a moisture content of 15% to 16% by weight were ground. The ground rice was intimately mixed with 7% to 10% of water and passed to a screw extruder of a type suitable for food processing and as generally shown in the drawing.

The extruder had an internal barrel diameter of 76 millimeters and a barrel length of 200 millimeters. The interior of the barrel was formed with a rectangular section helical groove of pitch 12 millimeters, depth 7 millimeters and width 6 millimeters at the entry of end of the barrel and which decreased in depth along the length of the barrel to zero depth at the exit end.

The extruder barrel terminated in a die plate having a plurality of rectangular openings of dimensions 7 x 1.5 millimeters. A rotatory knife was set to cut off the material exiting the die plate in 7 millimeter lengths. The extruder screw had a diameter of 74 millimeters providing a clearance with in the barrel of 2 millimeters. The pitch of the screw was 12.7 millimeters with the thread having a width of 4 millimeters and depth of 7 millimeters.

The rice/water mixture was fed to the extruder at a rate of 0.25 kilograms/minute. The screw speed was set at 400 revs/minute and the external barrel temperature set at 100°C.

When steady state conditions had been reached the material exiting the extruder comprised generally ellipsoidal pieces of puffed rice of general size approximately that of rice grains.

During passage through the extruder with a residence time of 6 seconds the rice particles coagulated as the starch gelatinised. The outside of the coagulum cooked to the greatest extent such that the starch became fully gelatinised on exit from the die. On the inside the starch remained only partially gelatinised. The inside of the pieces leaving the extruder remained more moist and cooler than the outside and hence was not puffed to the same extent as the outside.

The product from the extruder was then passed to a flaker comprising a pair of contra rotating nip rolls. In the nip the surface cells became ruptured and the moist centre of the pieces became compacted and more dense.

The product from the flaker was then passed through a hot air tunnel and dried to a moisture content of less than 4% by weight to improve storage capability and shelf life of the product. The product was then packaged in hermetically sealed foil packets.

The product when covered with boiling water floated for a short period but then hydrated and on stirring sank. A fully acceptable rice porridge could be produced within three minutes.

Further experiments were carried out with the same rice/water mixture using the same extruder but varying the screw speed between 300 and 450 revs /minute, the barrel temperature between 80°C and 120°C and the residence time between 4 and 7 seconds. Satisfactory products which hydrated within above 3 minutes were obtained.

CLAIMS

1. A method of making an instant rice porridge product, which comprises passing rice through a cooking extruder and a die, allowing the product to puff on exit from the die and cutting off substantially rice grain size pieces of the puffed product, the extrusion conditions being such that the product exiting the die has a substantially fully gelatinised surface region and a partially gelatinised central region, and passing the puffed product pieces through a flaker to make the centre of the pieces compacted and more dense.
2. A method according to claim 1, wherein the flaker consists of a pair of nip rolls.
3. A method according to claim 1 or claim 2, wherein the rice fed to the extruder is whole rice.
4. A method according to claim 1 or claim 2, wherein the rice fed to the extruder is ground rice.
5. A method according to any one claims 1 to 4, wherein the rice is fed to the extruder mixed with water in an amount of up to 40% of the weight of the rice.

6. An instant rice porridge product made according to the method of any one of claims 1 to 5, the product comprising puffed generally rice grain sized, discrete pieces of rice having a more dense compacted central region, a less dense intermediate region of closed cells surrounding the central region, and a surface region of generally open cells, the surface region of said pieces consisting of substantially fully gelatinised starch and the central region consisting of partially gelatinised starch.

7. A product according to claim 6, wherein said pieces are generally lenticular in shape.

8. A product according to claim 6 or claim 7, wherein said pieces comprise rice particles bonded together by a starch matrix.

9. A product according to any one of claims 6 to 8, which can be hydrated within 3 to 5 minutes to form rice porridge.

10. A pack of instant rice porridge product comprising a first hermetically sealed package containing a quantity of the product of a process according to any one of claims 1 to 5 or the product according to any one of claims 6 to 9, and at least one further sealed package containing a quantity of at least one additive selected from flavouring ingredients and foodstuffs, the first and further packages being packed in a cup member of a size to contain the contents of the packages and a quantity of water sufficient to hydrate said contents and to produce a slurry product of the consistency of a conventional rice porridge.