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(54) **Title:** A CEREAL YOGURT AND PREPARATION METHOD THEREOF

(57) **Abstract:** This invention relates to a coarse cereal yogurt with unique flavor, wherein various coarse cereal powders are used as raw materials, processed via amylase hydrolysis to form hydrolyzed cereal slurry, and mixed with fresh milk or milk powder, or various coarse cereal powders are mixed with fresh milk or milk powder before amylase hydrolysis, and fermented by lactobacteria. The content of coarse cereal in the final product can be up to 1~40%. This invention belongs to a new type of dairy product, which has unique flavor, contains good proteins from milk, sufficient carbohydrates and many kinds of trace nutrients, and can be used as a good meal replacement food or dessert.



A cereal yogurt and preparation method thereof

Field of the invention

5 The present invention relates to the food production field. Specifically, the present invention relates to a yogurt and preparation method thereof. More specifically, the present invention provides a yogurt added in enzymatically treated cereal. And more specifically, the present invention relates to a yogurt added in enzymatically treated coarse cereal. The present invention also provides a method
10 for preparing the yogurt containing enzymatically hydrolyzed coarse cereal.

Background art

 Yogurt is also called yoghurt, which is a dairy product produced by using
15 cow milk or reconstituted cow milk as main raw materials, processed via sterilization, fermentation, stirring or non-stirring, and adding or without adding other ingredients. The main raw materials of a yogurt could also be goat milk or reconstituted goat milk. The commonly used preparation method is as following: inspection of raw milk, mixing ingredients, homogenization, sterilization,
20 fermentation and final products obtained. Yogurt is rich in nutrients, beside the nutrients from raw milk, and the fermentation of lactobacteria also produces many kinds of vitamins, wherein lactobacteria itself is a probiotic. Since yogurt is a popular food, to satisfy the demands of the public both on health and on taste, the number of kinds of yogurt with addition of various ingredients is increasing.
25 Currently the cereal yogurt in the market or dairy research field is produced by adding granulated cereal directly with relatively small adding amount. However, there is little research on products and processes of preparing yogurt by using coarse grain powder or hydrolyzed coarse grain slurry as raw materials.

30 Coarse grain means the grain other than rice and flour/wheat, which is opposite to fine grain. The common coarse grain in daily lives is as below: cereal: brown rice, maize, millet, red rice, black rice, purple rice, sorghum, barley, oat, buckwheat/bran, and etc.

Beans: soybean, mung bean, red bean, black bean, green soy bean, kidney bean, faba bean, pea, etc. Tubers: sweet potato, Chinese yam, potato, etc.

Wherein, brown rice is the whole grain granule of *Gramineae* plant rice after shells removed, containing peel, aleurone layer and germ. Normally brown rice is a kind of coarse grain opposite to fine white rice. After shell is removed, the brown rice still retains some of the nutrients contained in the tissues of outer layer, and contains more vitamins, minerals and dietary fibers compared with fine white rice. Brown rice has higher nutritional value than white rice.

Black rice is a kind of rice used both for medicine and for food, belongs to glutinous rice, and is a special type obtained from long-term cultivation of *Gramineae* plant rice. Black rice is normally processed in the same way as brown rice processing, and is a special kind of brown rice, with appearance of black, plenty of nutrition, and high edible value. The main nutritional ingredients are counted by weight of dry matter as below: 8.5-12.5% of crude protein, 2.7-3.8% of crude fat, 75-84% of carbohydrates, and 1.7-2% of crude ash. The content of manganese, zinc, copper and other mineral salts in black rice are 1~3 times of the contents in rice, and black rice also contains special components such as vitamin C, chlorophyll, anthocyanin, carotene, and cardiac glycosides of which rice is lack.

As to brown rice and black rice, because of their poor cooking properties and taste, they are seldom used as staple food currently. Normally brown rice and black rice are added into white rice with small amount, and cooked into porridge. Currently, there are a few kinds of processed food available in the market using brown rice or black rice as raw material, and a little research relevant to processing brown rice and/or black rice into fermented dairy products.

The following patents disclose products and methods of the beverage processed from black rice. Chinese patent publication CN101433284A, with the title of "A black rice milk beverage and preparation method thereof", reports the production of black kernalled rice milk by extracting the black kernalled rice subjected to ultrafine grinding. Chinese patent publication CN1136901A, with the title of "Process for producing fermented black rice beverage", reports the production of black rice beverage using saccharified black rice juice

as raw material. Chinese patent publication CN101715821A, with the title of "A yogurt and preparation method thereof", reports a yogurt made from nut, pulp and grain. Chinese patent publication CN101455236A, with title of "A stirred type of cereal yogurt and preparation method thereof", reports a stirred type of cereal yogurt made from raw fresh milk, cereal powder, additive agent for dairy food, lactobacillus strain/functionality probiotics strain, corrective and stabilizing thickening agent. Chinese patent publication CN101715824A, with the title of "A yogurt containing physically denatured starch and preparation method thereof", reports a yogurt made from protein powder, white granulated sugar, physically denatured starch, thickener, food flavorings, fresh milk and lactobacteria. Chinese patent publication CN101579016A, with the title of "A plant-type yogurt and preparation method thereof", reports a plant-type yogurt made from cereal, pulp-type component and yogurt. Chinese patent publication CN101664056A, with the title of "A yogurt and preparation method thereof", report a yogurt made from white granulated sugar, thickener, lactobacteria, mixed sauce of legume and cereal, and fresh milk. Chinese patent publication CN1277806A, with the title of "A milk-type drink and production method thereof", reports a milk drink made from extracted liquid of cereal and natural milk. Chinese patent publication CN101933535A, with the title of "Yogurt containing cereal granule and fruit granule and production method thereof", reports a yogurt containing cereal granule and fruit granule.

The following scientific papers report production methods and products processed from black rice. "Research and preparation of black rice yogurt" (Hongxia Zhao et al., China Brewing, P105-107, Issue 14, 2008) reports the preparation of black rice yogurt from the juice of liquefied and saccharified black rice. "Research and preparation of buffalo milk black rice yogurt" (Baiyun Yang et al., Food Science, P67-68, Issue 7, Volume 21, 2000) reports after soaking and pulping (wherein the ratio of black rice and water is 1:7) black rice, adding in high-temperature α -amylase, stirring and heating to 95~97°C, enzymatically hydrolyzing under constant temperature for 30~60mins, filtrating to make black rice slurry, and preparing yogurt with the slurry and buffalo milk. "Bifidobacterium bifidum drinks of black rice" (Jianbo Jia et al., Guangzhou Food Science and Technology, P41-43, Issue 2, Volume 12, 1996) reports the preparation of yogurt from grinding slurry of black rice. "Research and preparation of black rice frozen yogurt" (Qingchun Li et al., Food Industry, P23-24, Issue 1, 2001) reports the process method of yogurt via fermentation of mixture of

black rice grinding slurry and milk. "Preparation of fermentative rice milk from germinated brown rice" (Hui Yuan et al., Journal of the Chinese Cereals and Oils Association, P14-17, Issue 7, Volume 24, 2009) reports a process for preparing fermentative yogurt by using germinated brown rice as raw material and adding in milk for fermentation after grinding and gelatinization.

Yogurt is more and more popular as a favorite meal companion or dessert. However, to meet the diversified demands on health, nutrition and taste of the public, there is still market for new yogurt products and preparation method thereof. The present invention provides a yogurt with high cereal content for supplying more energy to the consumers.

Summary of the invention

Firstly, the present invention provides a yogurt containing high content of carbohydrates.

Carbohydrates refer to the compounds saccharides. Carbohydrates are the most widely distributed, naturally occurring organic compounds on earth. They are mainly composed of carbon, hydrogen and oxygen. Glucose, sucrose, starch, cellulose, and etc. all belong to carbohydrates. Traditional yogurt is made from the milk fermented by lactobacteria, wherein the major nutrients are protein and vitamin, and the carbohydrates content is relatively low. Yogurt containing cereal granule belongs to prior art, however, the adding amount of cereal is low and the utilization rate of carbohydrates in cereal is low.

The present invention uses amylase acting on cereal, and adds treated cereal into the yogurt to make a yogurt containing high content of cereal.

The inventor treats the cereal with amylase separately, and adds the treated cereal into the raw material for yogurt preparation or into the prepared yogurt, to make the yogurt containing high content of cereal of the present invention.

The inventor adds cereal into the raw material for yogurt preparation, and then adds amylase into the cereal-containing material to effect to make the yogurt containing high content of cereal of the present invention.

5 Amylase can hydrolyze the starch in the cereal. The nutrient 2 formed from cereal hydrolysis can provide new nutrient for traditional yogurt, and thereby provides a new type of yogurt for the present invention. The new type yogurt of the present invention is a composite nutritional yogurt, and comprises: nutrient 1 from traditional yogurt, and raw material ingredient 2 from cereal hydrolysis.

10 In the present invention, nutrient 1 from traditional yogurt is a general concept of the nutrients contained in the dairy products, which is produced by using cow milk or goat milk or reconstituted milk thereof as raw materials, processed via sterilization, fermentation, stirring or non-stirring, and adding or without adding other ingredients.

15 In the present invention, raw material ingredient 2 from cereal hydrolysis is a general concept of the nutrients formed by the acting of amylase on the cereal.

20 The yogurt in the present invention is a type of composite nutritional yogurt, comprising: nutrient 1 from traditional yogurt, and raw material ingredient 2 from cereal hydrolysis.

25 Nutrient 1 from traditional yogurt can mainly provide protein and vitamin for the consumers; and raw material ingredient 2 from cereal hydrolysis can mainly provide carbohydrates for the consumers. Therefore, the yogurt is a type of composite nutritional yogurt.

30 The yogurt in the present invention can be called as high starch content yogurt, high cereal content yogurt, high-carbohydrate content yogurt, high energy yogurt, composite nutritional yogurt or composite substance yogurt. All the above terms reflect the features of the yogurt in the present invention.

Other components, such as fruit granule or gel pieces, can also be added into the yogurt in the present invention. The above components can be understandable by one skilled in the art, and optionally added in according to the actual demands.

5 Preferably, the high-carbohydrate content yogurt in the present invention is produced by using coarse cereal and amylase which can act on the starch in the coarse cereal, to introduce relatively higher amount of carbohydrate into the yogurt. Coarse cereal provides more nutrients, especially the nutrients which can not be provided by daily fine grain.

10 In one of the preferable example of the present invention, middle-temperature amylase or low-temperature amylase is adopted for starch treatment.

15 It is the invention that uses the middle-temperature amylase or low-temperature amylase. When using middle-temperature amylase or low-temperature amylase in the present invention, the optimal reacting temperature for middle-temperature amylase is in the range of 40-75°C, and the maximum using temperature is 90°C; the optimal reacting temperature for low-temperature amylase is in the range of 30-60°C, and the maximum using temperature is 65°C.

20 The middle-temperature amylase or low-temperature amylase can be deactivated subject to heating under relatively low temperature for a relatively short time. The above deactivating method is suitable for obtaining the product with low or none residual activity of amylase.

25 The present invention also provides a preparation method of the yogurt with high-carbohydrate content, wherein the method comprises the step of adding in carbohydrate during preparing the yogurt. The carbohydrate can be in the form of cereal powder, or slurry obtained from cereal powder via hydration and amylase treatment. If the carbohydrate is in the form of cereal powder, it is necessary to add in amylase during the preparation of yogurt. The starch treatment in the present invention is fulfilled by using amylase, preferably, by using middle-temperature amylase or low-temperature amylase.

30

Secondly, the present invention provides a high energy yogurt.

Human body needs to obtain energy from carbohydrate substance. So, high-carbohydrate yogurt is a kind of high energy yogurt.

5 The present invention introduces starch type substance into the preparation of yogurt, and treats the starch with amylase to make a yogurt containing multiple kinds of carbohydrates. This yogurt can provide high energy to human body, and is a kind of high energy food.

10 Thirdly, the present invention provides a yogurt containing coarse cereal, wherein the coarse cereal is partially enzymatically hydrolyzed by amylase.

Coarse grain is a concept opposite to fine grain such as fine rice and wheat flour, and mainly includes: grains, such as maize, millet, purple rice, sorghum, oat, buckwheat, 15 purple sweet potato, barley, bran, etc; and different kinds of dry beans, such as yellow bean, green bean, red bean, mung bean, etc. Brown rice is also a kind of coarse cereal, because the retained outer layer tissue contains dietary fibers. Coarse cereal can provide nutritional substance with high starch content, multiple kinds of vitamins, and dietary fiber.

20 In the present invention, a yogurt with unique flavor is obtained by introducing the substance with high starch content and then amylase treatment into the preparation, or by introducing the high starch content substance treated by amylase into the preparation of yogurt. A typical example of high starch content substance is coarse cereal. The starch 25 treatment in the present invention is fulfilled by using amylase, preferably, by using middle-temperature amylase or low-temperature amylase.

Fourthly, the present invention provides a preparation method of the above yogurt with high-carbohydrate content, or with high energy, or containing coarse cereal.

30 The said method comprises adding in carbohydrate and then conducting the amylase hydrolysis during the preparation of the yogurt.

The said method comprises the following steps:

1. Adding water into the high starch content material, such as barley powder, to make slurry, and adding in amylase for enzymatic hydrolysis, to obtain enzymatically hydrolyzed slurry.
2. Mixing the enzymatically hydrolyzed slurry of step 1) with milk or milk powder, to obtain the raw material for fermentation.
3. Inoculating the fermentation raw material with lactobacteria, and fermenting to produce yogurt.

Step 1) and step 2) can be combined into one step by mixing the powder of starch containing material with fresh milk or milk powder, and adding in amylase for treatment to prepare the raw material for fermentation.

The hydrolysis product obtained from amylase treatment on high starch content material can also be added in after the preparation of the yogurt.

The starch treatment in the present invention is fulfilled by using amylase, preferably, by using middle-temperature amylase or low-temperature amylase.

Lactase can be used jointly in lactobacteria fermentation process of the present invention.

The present invention provides the following specific methods:

1. a method of preparing yogurt, comprising preparing the mixture of starch, water and milk, hydrolyzing the mixture by amylase, preferably by middle-temperature amylase or low-temperature amylase, and fermenting by lactobacteria starter culture to produce the yogurt.

2. a method of preparing yogurt, comprising preparing the mixture of starch, water and milk, hydrolyzing the mixture by amylase, preferably by middle-temperature amylase or

low-temperature amylase, and fermenting by lactobacteria starter culture and lactase to produce the yogurt.

3. a method of preparing yogurt, comprising preparing the mixture of starch and water, hydrolyzing the mixture by amylase, preferably by middle-temperature amylase or low-temperature amylase, adding in milk, and fermenting by lactobacteria starter culture to produce the yogurt.

4. a method of preparing yogurt, comprising preparing the mixture of starch and water, hydrolyzing the mixture by amylase, preferably by middle-temperature amylase or low-temperature amylase, adding in milk, and fermenting by lactic acid starter culture to produce the yogurt.

In the condition that cereal is the source of starch, the specific method in the present invention comprises:

1. a method of preparing yogurt, comprising preparing the mixture of cereal, water and milk, hydrolyzing the mixture by amylase, preferably by middle-temperature amylase or low-temperature amylase, and fermenting by lactobacteria starter culture to produce the yogurt.

2. a method of preparing yogurt, comprising preparing the mixture of cereal, water and milk, hydrolyzing the mixture by amylase, preferably by middle-temperature amylase or low-temperature amylase, and fermenting by lactobacteria starter culture and lactase to produce the yogurt.

3. a method of preparing yogurt, comprising preparing the mixture of cereal and water, hydrolyzing the mixture by amylase, preferably by middle-temperature amylase or low-temperature amylase, adding in milk, and fermenting by lactobacteria starter culture to produce the yogurt.

4. a method of preparing yogurt, comprising preparing the mixture of cereal and water, hydrolyzing the mixture by amylase, preferably by middle-temperature amylase or

low-temperature amylase, adding in milk, and fermenting by lactic acid starter culture to produce the yogurt.

Fifthly, the purpose of the present invention is to provide a method comprising
5 mixing brown rice and black rice, saccharifying and/or liquefying the mixture to make rice slurry, and mixing the slurry with milk powder, or mixing and hydrolyzing black rice powder, brown rice powder and fresh milk, and fermenting by lactobacteria to produce a coarse cereal yogurt, wherein the total using amount of cereal powder can be up to 1~40wt%, preferably 5~25wt%, more preferably 5~20wt%, and more preferably 10~15wt%, and the
10 obtained product has unique flavor and texture. The starch treatment in the present invention is fulfilled by using amylase, preferably, by using middle-temperature amylase or low-temperature amylase. The middle-temperature amylase or low-temperature amylase can be deactivated subject to heating under relatively low temperature for a relatively short time, which is suitable for obtaining the product with low or none residual amylase activity,
15 namely the high carbohydrate yogurt with low or none residual amylase activity.

In a specific example, the specific recipe and process is:

Black rice: 0-20%; brown rice: 0-20%; white granulated sugar: 5-8%; milk powder: 5~10% (or fresh milk: 45~90%); lactoalbumin: 0-1%; water: 20-80%; adding amount of
20 amylase: 0.05%~0.5% of the dry rice powder; other stabilizers (such as pectin etc.), emulsifier, and flavoring etc. can be added in according to the actual demands, wherein the said percentages are weight percentage;

A. A process of preparing rice slurry separately: dissolving cooked brown rice powder or black rice powder (with a crushing granularity above 80 mesh count) into water, heating
25 for gelatinization, adding in amylase for hydrolysis, deactivating the amylase to obtain the rice slurry ready for use; mixing and dissolving the rice slurry, milk powder, lactoalbumin, granulated sugar and other substances, sterilizing, cooling down, inoculating with lactobacteria, fermenting until pH is lower than 4.6, cooling down and stirring to make stirred yogurt, or cooling down without stirring to make set yogurt,
30 wherein the yogurt is stored under 2-10°C. The rice slurry can also be prepared by adding amylase into the gelatinized raw rice powder for hydrolysis, or by adding water into rice and cooking, milling cooked rice into slurry, and adding in amylase for hydrolysis.

B. A process of mixing and hydrolyzing rice slurry and milk: mixing cooked brown rice powder or black rice powder (with a crushing granularity above 80 mesh count) with fresh milk, lactoalbumin, granulated sugar and other substances, adding in amylase for hydrolysis, sterilizing, cooling down, inoculating with lactobacteria, fermenting until pH is lower than 4.6, cooling down and stirring to make stirred yogurt, or cooling down without stirring to make set yogurt, wherein the yogurt is stored under 2-10°C.

In the above processes, the milk powder can be partially substituted by fresh milk, or the fresh milk can be partially or fully substituted by milk powder based on the actual demands.

As stated above, besides black rice or brown rice, the above processes can also be suitable for other coarse cereal, such as purple sweet potato, oat, maize, barley or millet etc.

In the present invention, the following terms have the following meanings:

Yogurt indicates the dairy product made by using cow milk or goat milk or reconstituted milk as raw materials, subject to sterilizing and lactobacteria fermentation.

Cereal comprises rice, wheat, maize, millet and etc, mainly belonging to gramineae plants. Cereal grain mainly indicates the seeds of gramineae plants, comprising rice, wheat, maize, and other coarse cereals, such as millet, black rice, buckwheat, oat, pearl barley rice, sorghum and etc. Processed cereal can be used as staple food, mainly providing 50%-80% of heat energy, 40%-70% of protein and above 60% of vitamin B1 to human body.

Coarse cereal indicates the cereal granule, cereal granule powder and etc, which can provide dietary fibers.

Amylase is a kind of enzyme to hydrolyze starch. Normally amylase acts on soluble starch, amylose, glycogen and other α -1, 4-dextran by hydrolyzing α -1, 4-glucosidic bond. The amylase indicated in the present invention is selected from the group consisting of α -

amylase, β -amylase, glucoamylase or the mixture thereof. Currently there are lots of commercial amylases on the market.

Amylase can be sorted into high-temperature amylase, middle-temperature amylase and low-temperature amylase according to the optimal reaction temperature. The optimal temperature for high-temperature amylase is in the range of 95°C-97°C, and the effective temperature is in the range of 90°C-100°C. Some high-temperature amylases have optimal temperature in the range of 90°C-95°C, but can still perform as a catalyst under 105°C.

The amylase used in the present invention is any type of amylase, preferably is middle-temperature amylase or low-temperature amylase. The optimal reaction temperature of the amylase used in the present invention is lower than 90°C, preferably lower than 80°C, more preferably lower than 70°C, more preferably lower than 60°C, more preferably lower than 50°C, and more preferably lower than 40°C. When the optimal temperature is lower than 90°C, there are lots of amylases can meet the demand of the present invention. Preferably, the amylase used in the present invention performs the optimal catalyzing function in the temperature range of 40-80°C.

The amylase used in the present invention can be obtained from bacteria, fungi, and other microbes. The amylase can be obtained from even wider sources.

Lactobacteria indicates the bacteria which can produce lactic acid from the fermentation of glucose or lactose. The lactobacteria used in the present invention is selected from the group consisting of *Streptococcus thermophilus*, *Lactobacillus bulgaricus*, *Lactobacillus delbrueckii* subsp. *lactis*, *Lactobacillus acidophilus*, *Bifidobacterium* sp., *Lactobacillus casei*, *Lactobacillus fermentum*, *Lactobacillus gasseri*, *Lactobacillus helveticus*, *Lactobacillus johnsonii*, *Lactobacillus paracasei*, *Lactobacillus plantarum*, *Lactobacillus reuteri*, *Lactobacillus rhamnosus*, *Lactobacillus salivarius*, *Lactococcus lactis* or the combination thereof. In the present invention, the concept of "lactobacteria starter culture" is used to cover various kinds of substance with fermentation activity, which can be used for the lactic acid fermentation during the production of yogurt, wherein the substance with fermentation activity indicates the lactic acid-forming bacteria.

Another name of lactase is β -galactosidase, the key function of which is to hydrolyze lactose into glucose and galactose.

To sum up, the present invention adopts the technology of starch enzymolysis, which can make the adding amount of cereal in the yogurt reach 20%, preferably 15%, to obtain final product with very unique taste and texture. Preferably, coarse cereal is added into the yogurt. When black rice powder or brown rice powder is used as raw material, amylase is used to hydrolyze the starch content partly to make mixed rice slurry, which is mixed with milk powder and fermented by starter culture, the obtained coarse cereal rice yogurt has unique flavor and a coarse cereal content of 20wt%, preferably 15wt%. It can be seen from the above data that the present invention provides a high coarse grain content yogurt, which is a novel product.

The present invention provides a new type of dairy product, which can be supplied to the consumers. The product can serve supplementary of good proteins from milk, intake of adequate energy from carbohydrate, and intake of multiple trace elements from coarse cereal. The product can be used as good meal replacement food or dessert.

The present invention provides a method, wherein the whole production process can be realized under a temperature lower than 100°C, specifically, under a relatively low temperature. Therefore, taking into account the selection of yogurt packaging materials, the present invention provides a method which is more suitable for providing yogurt products packaged by various kinds of materials.

The technical approach of the present invention is introducing hydrolysis product of starch into the yogurt. Any technology which does not depart from this approach is within the scope of the present invention.

To describe the present invention specifically, the following examples are given, wherein, all the examples are the description of this invention, and are not the limitation to this invention. Therefore, all the following examples describe this invention with examples, and can not be granted as any kind of limitation.

EXAMPLES

In the following examples, the used cooked coarse cereal powder can be purchased from market directly, e.g. Beijing Shuofang Shangde Technology Developing Co., Ltd. (Shangde Food for short), which supplies various kinds of super fine cereal powders with crashing granularity of 200 mesh count. The used cooked coarse cereal powder can be also self-prepared by using black rice, brown rice and other coarse cereal. A self-preparation method comprises: roasting the cereal until the cereal is cooked and gives out slightly roasted flavor, crashing by cereal crusher and sieving with 80 mesh count sieve; or boiling and steaming black rice or brown rice with adequate amount of water until cooked, adding in water and milling, wherein the ratio of rice to water is in the range of 1:4~1:10. If the viscosity is high during the milling, amylase can be added in before the milling to reduce the viscosity effectively. De-fat milk powder, full-fat milk powder and concentrated lactoalbumin (with model number of WPC80) are all purchased from Fonterra which is a New Zealand company.

Example 1 :

75g of self-prepared brown rice powder, 75g of self-prepared black rice powder, 10g of de-fat milk powder, 10g of concentrated lactoalbumin, 60g of sugar, 560g of fresh milk, and 210g of water, are all mixed homogenously. Add in 0.3g of amylase (with specific model number of Validase BAA 1500L, obtained from DSM Food Specialties B.V., Alexander Fleminglaan 1, 2613 AX Delft, the Netherlands, with enzyme activity of 1500000MWU/g), maintain the temperature in the range of 45-65°C, stir and hydrolyze for 30-60mins, until the equivalent value of reducing sugar in the mixture is above 20, heat the material to 65-70°C, 200-220Bar for homogenization; sterilize under 95°C for 5mins, cool down to 43°C, add in 0.002-0.004U of lactobacteria starter culture (adopting direct-vat set lactobacteria starter culture, with model number of DELVO-YOG SVV31 DSL, obtained from DSM Food Specialties B.V., Alexander Fleminglaan 1, 2613 AX Delft, the Netherlands, comprising *Streptococcus thermophilus* and *Lactobacillus bulgaricus*), after mixing evenly, fill into the packing containers, ferment under 43°C for 5-6 hours until pH value reaches 4.5~4.6, cool down until the temperature is lower than 10°C, and then a set coarse cereal yogurt is produced. The obtained product needs to be stored under 2-10°C with shelf life of 21 days. Adopt the same recipe and process, add in strain, mix homogenously, transfer the material

into fermenter for fermentation until the pH value reaches 4.5~4.6, cool down and stir for demulsification, cool down until the temperature is lower than 10°C, fill into the packing containers, and then a stir coarse cereal yogurt is produced. The sensory evaluation result of the final products is indicated in Table 1.

Example 2:

According to the method of Example 1, wherein the brown rice powder and black rice powder are the 200 mesh count super fine powders purchased from Shangde Food. The sensory evaluation result of the final products is indicated in Table 1.

Example 3:

According to the method of Example 1, wherein the type of the lactobacteria starter culture is DELVO-YOG MY1821 DSL (obtained from DSM Food Specialties B.V., Alexander Fleminglaan 1, 2613 AX Delft, The Netherlands, comprising *Streptococcus thermophilus*, *Lactobacillus bulgaricus*, *Lactobacillus acidophilus*, *Bifidobacterium sp. Lactobacillus casei*). The sensory evaluation result of the final products is indicated in Table 1.

Example 4 :

According to the method of Example 1, wherein 1g of lactase (with model number of Maxilact LG2000, obtained from DSM Food Specialties B.V., Alexander Fleminglaan 1, 2613 AX Delft, The Netherlands, with activity of 2000NLU/g) is added in together with the lactobacteria starter culture, and adding amount of sugar is reduced to 55g. The sensory evaluation result of the final products is indicated in Table 1.

Example 5 :

According to the method of Example 1, wherein brown rice powder is not used, and using amount of black rice powder is 150g. The sensory evaluation result of the final products is indicated in Table 1.

Example 6 :

According to the method of Example 1, wherein black rice powder is not used, and using amount of brown rice powder is 150g. The sensory evaluation result of the final products is indicated in Table 1.

Example 7:

According to the method of Example 1, wherein black rice powder and brown rice powder are not used, and using amount of oat powder is 150g. The sensory evaluation
5 result of the final products is indicated in Table 1.

Example 8 :

According to the method of Example 1, wherein black rice powder and brown rice powder are not used, and using amount of millet powder is 150g. The sensory evaluation
10 result of the final products is indicated in Table 1.

Example 9 :

According to the method of Example 1, wherein black rice powder is not used, using amount of brown rice powder is 50g, and using amount of milk is 660g. The sensory
15 evaluation result of the final products is indicated in Table 1.

Example 10:

According to the method of Example 1, wherein black rice powder is not used, using amount of brown rice powder is 200g, and using amount of milk is 510g. The sensory
20 evaluation result of the final products is indicated in Table 1.

Example 11:

75g of self-prepared brown rice powder, 75g of self-prepared black rice powder, and 700g of water are mixed homogenously. Heat to 85°C and maintain the temperature, stir for
25 20mins for gelatinization, cool down to 60°C, add in 0.3g of amylase (with model number of Validase BAA 1500L, obtained from DSM Food Specialties B.V., Alexander Fleminglaan 1, 2613 AX Delft, the Netherlands, with enzyme activity of 1500000MWU/g), hydrolyze for 30mins, and deactivate the enzyme under 95°C for 10mins to obtain 850g or rice slurry; 70g of full-fat milk powder, 10g of de-fat milk powder, 10g of concentrated lactoalbumin,
30 and 60g of sugar, are dissolved into the said prepared 850g of rice slurry, stirred for 30mins for hydration, and heated to 65-70°C, 200-220Bar for homogenization; sterilize under 95°C for 5mins, cool down to 43°C, add in 0.002-0.004U of lactobacteria starter culture (adopting direct-vat set lactobacteria starter culture, with model number of DELVO-YOG SVV31 DSL,

obtained from DSM Food Specialties B.V., Alexander Fleminglaan 1, 2613 AX Delft, the Netherlands, comprising *Streptococcus thermophilus* and *Lactobacillus bulgaricus*), after mixing evenly, fill into the packing containers, ferment under 43°C for 5-6 hours until pH value reaches 4.5~4.6, cool down until the temperature is lower than 10°C, and then a set coarse cereal yogurt is produced. The product needs to be stored under 2-10°C with shelf life of 21 days. The sensory evaluation result of the final products is indicated in Table 1.

Example 12:

According to the method of Example 11, wherein the used lactobacteria starter culture is DSM DELVO-YOG MY1821 DSL (obtained from DSM Food Specialties B.V., Alexander Fleminglaan 1, 2613 AX Delft, the Netherlands, comprising *Streptococcus thermophilus*, *Lactobacillus bulgaricus*, *Lactobacillus acidophilus*, *Bifidobacterium sp.*, and *Lactobacillus casei*). The sensory evaluation result of the final products is indicated in Table 1.

Example 13:

50g of brown rice, 50g of black rice, and 140g of water are mixed homogenously. Steam and boil under pressure until cooked, cool down adequately, add in 260g of water with a temperature of 20~50°C, meanwhile add in 0.2g of amylase (with model number of Validase BAA 1500L, obtained from DSM Food Specialties B.V., Alexander Fleminglaan 1, 2613 AX Delft, the Netherlands, with enzyme activity of 1500000MWU/g), stir and mill to prepare rice slurry, hydrolyze the rice slurry under a constant temperature of 60°C for 30mins for hydrolyzation, and deactivate the enzyme under 95°C for 10mins to obtain 500g of rice slurry; 420g de-fat milk, 10g of concentrated lactoalbumin, and 70g of sugar are mixed with the said prepared 500g of rice slurry. Stir for 30mins for hydration, heat the material to 65-70°C, 200-220Bar for homogenization; sterilize under 95°C for 5mins, cool down to 43°C, add in 0.002-0.004U of lactobacteria starter culture (adopting direct-vat set lactobacteria starter culture with model number of DELVO-YOG SVV31 DSL, obtained from DSM Food Specialties B.V., Alexander Fleminglaan 1, 2613 AX Delft, the Netherlands, comprising *Streptococcus thermophilus* and *Lactobacillus bulgaricus*), after mixing evenly, fill in packing containers, ferment under 43°C for 5-6 hours until pH value reaches 4.5~4.6, cool down until the temperature is lower than 10°C, and then a set coarse cereal yogurt is produced. The product needs to be stored under 2-10°C with shelf life of 21 days. The

sensory evaluation result of the final products is indicated in Table 1.

Table 1: Result of sensory evaluation on coarse cereal yogurt

Example number	Product color	Flavor	Mouthfeel	Texture
1	Dark purple	Roasted black rice flavor, balanced sweetness and acidity, fermented milk flavor	Slightly grainy and non-ropy	Homogenous and smooth, proper viscosity
2	Dark purple	Roasted black rice flavor, balanced sweetness and acidity, fermented milk flavor	Smooth and non-ropy	Homogenous and smooth, proper viscosity
3	Dark purple	Roasted black rice flavor, balanced sweetness and acidity, strong fermented flavor	Slightly grainy,	Homogenous and smooth, proper viscosity, slightly ropy
4	Dark purple	Roasted black rice flavor, balanced sweetness and acidity, fermented milk flavor	Slightly grainy and non-ropy	Homogenous and smooth, proper viscosity
5	Dark purple	Roasted black rice flavor, balanced sweetness and acidity, fermented milk flavor	Slightly grainy and non-ropy	Homogenous and smooth, proper viscosity
6	Light brown	Roasted brown rice flavor, balanced sweetness and acidity, fermented milk flavor	Slightly grainy and non-ropy	Homogenous and smooth, proper viscosity
7	Light brown	Roasted oat flavor, slight acidity, fermented milk flavor	Slightly grainy and non-ropy	Homogenous and smooth, proper viscosity
8	Light gray	Roasted millet flavor, balanced sweetness and acidity, fermented milk flavor	Slightly grainy and non-ropy	Homogenous and smooth, proper viscosity
9	Light brown	Roasted brown rice flavor, balanced sweetness and acidity, fermented milk flavor	Slightly grainy and non-ropy	Homogenous and smooth, slightly low viscosity
10	Light brown	Roasted brown rice flavor, balanced sweetness and acidity, fermented milk flavor	Slightly grainy and non-ropy	Homogenous and smooth, slightly high viscosity
11	Dark purple	Roasted black rice flavor, balanced sweetness and acidity, fermented milk flavor	Slightly grainy and non-ropy	Homogenous and smooth, proper viscosity
12	Dark purple	Roasted black rice flavor, balanced sweetness and acidity, strong fermented flavor	Slightly grainy,	Homogenous and smooth, proper viscosity, slightly ropy
13	Purple	Black rice flavor, balanced sweetness and acidity, fermented milk flavor	Smooth and non-ropy	Homogenous and smooth, proper viscosity

Claims

1. A yogurt containing product of starch hydrolysis, wherein the product of starch hydrolysis is the product from amylase hydrolysis of cereal, preferably coarse cereal.

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2. The yogurt according to Claim 1, wherein the yogurt is characterized by that adding amount of coarse cereal is 1-40wt%.

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3. The yogurt according to Claim 1, wherein the said yogurt is stirred yogurt, set yogurt, or frozen yogurt.

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4. The yogurt according to Claim 1, wherein the said coarse cereal is selected from the group consisting of maize, millet, purple rice, black rice, sorghum, oat, buckwheat, purple sweet potato, barley, bran, brown rice or the mixtures thereof.

5. The yogurt according to Claim 4, wherein the said coarse cereal is preferably selected from the group consisting of millet, black rice, oat, barley, brown rice or the mixtures thereof.

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6. The yogurt according to Claim 5, wherein in the said coarse cereal is selected from black rice and brown rice.

7. A method of preparing a yogurt containing the product of starch hydrolysis, the method comprising the following steps:

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1). Adding water into high starch content material to make slurry, adding in amylase for enzymatic hydrolysis to obtain enzymatically hydrolyzed slurry;

2). Mixing the enzymatically hydrolyzed slurry of step 1) with milk or milk powder, to obtain fermentation raw material;

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3). Inoculating the fermentation raw material with lactobacteria, and fermenting to form yogurt.

8. The method according to Claim 7, wherein the said high starch content material is coarse cereal.

9. The method according to Claim 8, wherein the said coarse cereal is selected from the group consisting of maize, millet, purple rice, black rice, sorghum, oat, buckwheat, purple sweet potato, barley, bran, brown rice or the mixtures thereof.

5 10. The method according to Claim 7, wherein the said coarse cereal is a combination of black rice and brown rice.

11. The method according to Claim 7, wherein the said lactobacteria is selected from the group consisting of *Streptococcus thermophilus*, *Lactobacillus bulgaricus*,
10 *Lactobacillus delbrueckii subsp. lactis*, *Lactobacillus acidophilus*, *Bifidobacterium sp.*, *Lactobacillus casei*, *Lactobacillus fermentum*, *Lactobacillus gasseri*, *Lactobacillus helveticus*, *Lactobacillus johnsonii*, *Lactobacillus paracasei*, *Lactobacillus plantarum*, *Lactobacillus reuteri*, *Lactobacillus rhamnosus*, *Lactobacillus salivarius*, and *Lactococcus lactis* or the mixtures thereof.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/063678

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23C9/12 A23C9/13
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, BIOSIS, FSTA, COMPENDEX, WPI Data

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Further documents are listed in the continuation of Box C.



See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

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"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

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