

[Designation of Document] Specification

[Title of the Invention] HEAT-STABILIZATION OF FOOD
ANTIOXIDANT

[Technical Field]

[0001]

The present invention relates to thermostabilization of a retrogradation preventing agent for food. More particularly, the invention provides a system for thermostabilizing a retrogradation preventing agent for food containing β -amylase as an active ingredient using a naturally derived material (including a modified cellulose) therein.

[Background Art]

[0002]

Food containing a high content of water and made mainly from starch or cereal flour such as rice cakes ("mochi" in Japanese), dumplings ("dango" in Japanese) and other Japanese confectionary is hardened over time after being gelatinized by steam boiling or heating. One of the major causes is retrogradation of starch (aging of starch).

[0003]

By adding water and heating, starch is swollen and converted into a gelatinized state (conversion into α -form) through breaking down of the molecular structure. When this gelatinized starch is cooled, water molecules are gradually released from the swollen starch and the starch molecules

return to the original structure to some extent. This phenomenon is called retrogradation of starch (conversion into β -form). Retrogradation of starch is most likely to be caused in a refrigeration temperature range (4 to 10°C), and the textures of Japanese confectionary such as rice cakes, rice dishes, bread and the like turn into hard and dry.

[0004]

In order to prevent this retrogradation, a large amount of sugar is used, however, it is not preferable because excessive sweetness is imparted to rice cakes and the like. Accordingly, a technique for preventing retrogradation using a saccharifying amylase such as β -amylase has been developed (Patent document 1).

[0005]

However, in the case of a conventionally known retrogradation preventing agent containing β -amylase as an active ingredient, when a material temperature of dough is too high, the enzyme is deactivated and thus a retrogradation preventing effect cannot be obtained. Therefore, it was compelled to perform a treatment with a retrogradation preventing agent after the dough was heated for gelatinization and the material temperature was decreased to 70°C or lower. That is, it was compelled to decrease the material temperature to 70°C or lower by performing a cooling treatment or to stop the operation and wait until the material temperature reached

70°C or lower by natural cooling.

[0006]

Under such circumstances, when a retrogradation preventing agent capable of effectively acting even if a material temperature is high, for example, 90°C or higher is developed, it is not necessary to wait for a long time until the material temperature is decreased to 70°C, or to additionally install a cooling system, and thus, time and costs are significantly reduced.

[0007]

The invention has been made in view of such circumstances and for newly developing a system for imparting thermostability, particularly in response to needs of consumers who demand food safety, a system for imparting thermostability with a naturally derived substance in a retrogradation preventing agent containing β -amylase.

[Citation List]

[Patent Document]

[0008]

[Patent Document 1] JP-B-56-15860

[Summary of the Invention]

[0008a]

According to a first aspect, there is provided a thermostability imparting material which is in a retrogradation preventing agent for food containing β -amylase

as an active ingredient, characterized in that it comprises a processed *Saccharomyces cerevisiae* yeast material and imparts thermostability at 90°C or higher.

[0008b]

According to a second aspect, there is provided a thermostability imparting material which is in a retrogradation preventing agent for food containing β -amylase as an active ingredient, characterized in that it comprises at least one member selected from yam powder and a modified cellulose and imparts thermostability at 90°C or higher.

[0008c]

According to a third aspect, there is provided a retrogradation preventing agent for food characterized in that it comprises 6 to 75% of the thermostability imparting material as defined above to 25% of β -amylase and has thermostability at 90°C or higher.

[0008d]

According to a fourth aspect, there is provided a method for preventing retrogradation of food characterized by heating dough containing cereal flour and/or starch, cooling the heated dough to 90 to 95°C, and then adding the retrogradation preventing agent for food as defined above to the dough.

[0008e]

According to a fifth aspect, there is provided a retrogradation-controlled food characterized in that it is produced by the method as defined above and is prevented from retrograding and thus maintains softness even if it is stored by refrigeration or freezing.

[0008f]

According to a sixth aspect, there is provided a method for producing a rice cake which is prevented from retrograding and maintains softness even if it is stored by refrigeration or freezing, characterized by adding water to non-glutinous rice flour and kneading the mixture, subjecting the resulting dough to a heat treatment at 100°C for 5 to 40 minutes, kneading the resulting dough again, releasing heat until the temperature thereof reaches 90°C, adding the retrogradation preventing agent as defined above thereto, maintaining the dough for 5 to 20 minutes, and then, letting the dough stand to cool.

[Problems that the Invention is to Solve]

[0009]

An object is to newly develop a system for imparting thermostability (heat resistance) in a retrogradation

preventing agent for food containing β -amylase as an active ingredient.

[Means for Solving the Problems]

[0010]

The present inventors made studies from various viewpoints for achieving the above object and conducted wide screening for thermostability imparting substances by focusing attention on naturally derived substances from a safety viewpoint. As a result, it was found for the first time that a processed yeast material (for example, a killed yeast) exhibits, in combination with β -amylase, an effect of preventing retrogradation of rice cakes (an effect of preventing and inhibiting hardening) without deactivating β -amylase even in rice cake dough at a high temperature of 90°C and can maintain softness of rice cakes even if they are stored by refrigeration. Further, a material applicable as a thermostability imparting agent was newly found in addition to a killed yeast, and thus, the invention has been completed.

[0011]

Hereinafter, embodiments of the invention will be described. Incidentally, the term "preventing retrogradation" as used herein includes not only the case of completely preventing retrogradation, but also the case of inhibiting retrogradation. For example, the term also includes the case where an inhibitory effect on retrogradation

is superior to a control.

[0012]

(1) A thermostability imparting material which is in a retrogradation preventing agent for food containing β -amylase as an active ingredient, characterized in that it comprises a processed yeast material such as a yeast extract or a killed yeast and imparts thermostability at 90°C or higher (for example, 90 to 95°C).

(2) A thermostability imparting material which is in a retrogradation preventing agent for food containing β -amylase as an active ingredient, characterized in that it comprises at least one member selected from a processed yeast material such as a yeast extract or a killed yeast, yam ("yamaimo" in Japanese) powder and a modified cellulose such as a cellulose modified with a methoxyl group or a hydroxypropoxyl group and imparts thermostability at 90°C or higher (for example, 90 to 95°C).

[0013]

(3) The thermostability imparting material according to the above (1) or (2), wherein a yeast used for the processed yeast material for imparting thermostability described in the above (1) or (2) is a yeast belonging to *Saccharomyces cerevisiae*, for example, an edible yeast such as a baker's yeast, a beer yeast or a sake yeast.

[0014]

(4) A retrogradation preventing agent for food characterized in that it comprises the thermostability imparting material according to any one of the above (1) to (3) and β -amylase and has thermostability at 90°C or higher.

(5) The retrogradation preventing agent for food according to the above (4), characterized in that it comprises 5 to 95% by weight (preferably 5 to 65% by weight, more preferably 5 to 60% by weight) of the thermostability imparting material and 5 to 25% by weight (preferably 12 to 25% by weight) of β -amylase (with the proviso that the total amount of both components does not exceed 100%).

(6) The retrogradation preventing agent for food according to the above (4) or (5), characterized in that the food is at least one member selected from Japanese confectionery, bread, cakes, Chinese steamed buns, pizza steamed buns and rice dishes.

[0015]

(7) A method for preventing retrogradation of food characterized by heating (or steam boiling or deep frying) dough (dough with a high water content) containing cereal flour and/or starch, cooling the heated dough to 90 to 95°C (cooling by a cooling device or natural cooling), and then adding the retrogradation preventing agent for food according to any one of the above (4) to (6) to the dough.

[0016]

(8) A retrogradation-controlled food characterized in that it is produced by the method according to the above (7) and is prevented from retrograding and thus maintains softness even if it is stored by refrigeration or freezing.

[0017]

(9) A method for producing a rice cake which is prevented from retrograding and maintains softness even if it is stored by refrigeration or freezing, characterized by adding water to non-glutinous rice flour ("joshinko" in Japanese) and kneading the mixture, subjecting the resulting dough to a heat treatment (for example, steaming in a steamer) at 100°C for 5 to 40 minutes, preferably for 20 to 40 minutes (for example, 30 minutes), kneading the resulting dough again, releasing heat until the temperature thereof reaches 90°C, adding the retrogradation preventing agent according to any one of the above (4) to (6) thereto, maintaining the dough for 5 to 20 minutes (for example, 10 minutes), and then, letting the dough stand to cool.

[Advantage of the Invention]

[0018]

According to the invention, in a retrogradation preventing agent for food containing β -amylase, by using further a thermostability imparting material in combination, thermostability is imparted to the retrogradation preventing agent for food. That is, a thermostability imparting material

such as a killed yeast is allowed to compensate for β -amylase, thereby a high thermostable protective effect is exhibited. In other words, the invention also newly provides a system for imparting thermostability to β -amylase.

[0019]

Further, according to the invention, even if high-temperature dough at 90°C or higher is used (for example, 90 to 100°C), deactivation of β -amylase is significantly inhibited. Therefore, a high inhibitory effect on retrogradation (hardening) of food is exhibited and softness of food is maintained even if it is stored by refrigeration and/or freezing.

[0020]

As described above, according to the invention, even in the case where the temperature of dough is high, the dough does not need to be cooled and can be subjected to a treatment with a retrogradation preventing agent as such. Accordingly, a cooling device is not needed and also time (waiting time) requiring for cooling is not needed, and thus, a production step related to cooling is omitted and the treatment with a retrogradation preventing agent can be performed at low cost in a short time. As a result, it becomes possible to produce a retrogradation-controlled food at low cost in a short time. Moreover, the thermostability imparting agents are all naturally derived, and therefore are extremely excellent from

the viewpoint of food safety. Further, a modified cellulose is also highly safe.

[Brief Description of Drawings]

[0021]

[Fig.1] Fig. 1 shows the comparative results of hardness (stress) and sensory evaluation of the respective rice cakes produced by changing the dough temperature at the time of addition of a preparation of a retrogradation preventing agent for food containing 25% of β -amylase and 75% of a modified cellulose (25 to 100°C, Test groups 6 to 9) and a control group after storage at 4°C for 4 days. The left longitudinal axis shows a relative comparative value of the hardness to that of the control group (open rectangle, unit: %); the right longitudinal axis shows a sensory evaluation score (solid rectangle, score: 1: very soft, 2: softer, 3: softness is maintained, 4: somewhat hard, 5: hard); and the horizontal axis shows No. of Test groups (the control group is shown by C).

[Fig.2] Fig. 2 shows the comparative results of hardness (stress) and sensory evaluation of the respective rice cakes produced by changing the dough temperature at the time of addition of a preparation of a retrogradation preventing agent for food containing 25% of β -amylase and 75% of yam powder (25 to 100°C, Test groups 10 to 13) and a control group after storage at 4°C for 4 days. The respective axes show the same items as in Fig. 1.

[Fig.3] Fig. 3 shows the comparative results of hardness (stress) and sensory evaluation of the respective rice cakes produced by changing the dough temperature at the time of addition of a preparation of a retrogradation preventing agent for food containing 25% of β -amylase and 75% of a processed yeast material (25 to 100°C, Test groups 14 to 17) and a control group after storage at 4°C for 4 days. The respective axes show the same items as in Fig. 1.

[Fig.4] Fig. 4 shows the results of comparing rice cakes produced by using a retrogradation preventing agent for food containing no thermostability imparting material, a retrogradation preventing agent for food containing an emulsifier, or a retrogradation preventing agent for food containing a modified cellulose (Test groups 18 to 20) which were stored at -20°C for 7 days and thereafter thawed to 25°C with respect to the hardness (stress) and sensory evaluation. The left longitudinal axis shows a value of hardness (open rectangle, unit: %) when the hardness of the Test group 20 was taken as 100%; the right longitudinal axis shows a sensory evaluation score (solid rectangle, score: 1: very soft, 2: softer, 3: softness is maintained, 4: somewhat hard, 5: hard); and the horizontal axis shows No. of Test groups.

[Fig.5] Fig. 5 shows the comparative results of hardness (stress) and sensory evaluation of rice cakes produced by using each retrogradation preventing agent for food containing

β -amylase in an amount of 12% and a modified cellulose in an amount varying from 3 to 18% (Test groups 21 to 24) after storage at 4°C for 4 days. The left longitudinal axis shows a value of hardness (open rectangle, unit: %) when the hardness of the Test group 21 was taken as 100%; the right longitudinal axis shows a sensory evaluation score (solid rectangle, score: 1: very soft, 2: softer, 3: softness is maintained, 4: somewhat hard, 5: hard); and the horizontal axis shows a blending amount (%) of the modified cellulose in the preparation.

[Fig.6] Fig. 6 shows the comparative results of hardness (stress) and sensory evaluation of rice cakes produced by using each retrogradation preventing agent for food containing β -amylase in an amount of 12% and yam powder in an amount varying from 0 to 27% (Test groups 25 to 29) after storage at 4°C for 4 days. The left longitudinal axis shows a value of hardness (open rectangle, unit: %) when the hardness of the Test group 25 was taken as 100%; the right longitudinal axis shows a sensory evaluation score (solid rectangle, score: 1: very soft, 2: softer, 3: softness is maintained, 4: somewhat hard, 5: hard); and the horizontal axis shows a blending amount (%) of the yam powder in the preparation.

[Fig.7] Fig. 7 shows the comparative results of hardness (stress) and sensory evaluation of rice cakes produced by using each retrogradation preventing agent for food containing β -amylase in an amount of 12% and a processed yeast material

in an amount varying from 6 to 10% (Test groups 30 to 32) after storage at 4°C for 4 days. The left longitudinal axis shows a value of hardness (open rectangle, unit: %) when the hardness of the Test group 30 was taken as 100%; the right longitudinal axis shows a sensory evaluation score (solid rectangle, score: 1: very soft, 2: softer, 3: softness is maintained, 4: somewhat hard, 5: hard); and the horizontal axis shows a blending amount (%) of the processed yeast material in the preparation.

[Fig.8] Fig. 8 shows the comparative results of hardness (stress) and sensory evaluation of rice cakes produced by using each retrogradation preventing agent for food containing a modified cellulose in an amount of 75% and β -amylase in an amount varying from 6 to 12% (Test groups 33 to 36) after storage at 4°C for 4 days. The left longitudinal axis shows a value of hardness (open rectangle, unit: %) when the hardness of the Test group 33 was taken as 100%; the right longitudinal axis shows a sensory evaluation score (solid rectangle, score: 1: very soft, 2: softer, 3: softness is maintained, 4: somewhat hard, 5: hard); and the horizontal axis shows a blending amount (%) of the β -amylase in the preparation.

[Fig.9] Fig. 9 shows the comparative results of hardness (stress) and sensory evaluation of rice cakes produced by using each retrogradation preventing agent for food containing yam powder in an amount of 75% and β -amylase in an amount varying from 0 to 12% (Test groups 37 to 43) after storage at 4°C for

4 days. The left longitudinal axis shows a value of hardness (open rectangle, unit: %) when the hardness of the Test group 37 was taken as 100%; the right longitudinal axis shows a sensory evaluation score (solid rectangle, score: 1: very soft, 2: softer, 3: softness is maintained, 4: somewhat hard, 5: hard); and the horizontal axis shows a blending amount (%) of the β -amylase in the preparation.

[Fig.10] Fig. 10 shows the comparative results of hardness (stress) and sensory evaluation of rice cakes produced by using each retrogradation preventing agent for food containing a processed yeast material in an amount of 75% and β -amylase in an amount varying from 6 to 12% (Test groups 44 to 47) after storage at 4°C for 4 days. The left longitudinal axis shows a value of hardness (open rectangle, unit: %) when the hardness of the Test group 44 was taken as 100%; the right longitudinal axis shows a sensory evaluation score (solid rectangle, score: 1: very soft, 2: softer, 3: softness is maintained, 4: somewhat hard, 5: hard); and the horizontal axis shows a blending amount (%) of the β -amylase in the preparation.

[Description of Embodiments]

[0022]

The present invention is characterized in that in a retrogradation preventing agent containing β -amylase as an active ingredient, a thermostability imparting material is

added and used.

Note: Said retrogradation preventing agent is sometimes referred to as anti-aging agent.

[0023]

As the thermostability imparting material, one of a processed yeast material, yam powder and a modified cellulose is used or two or more types thereof are used in combination.

[0024]

As the processed yeast material, any of a variety of processed materials such as a killed yeast and a yeast extract is used. As the killed yeast, one obtained by killing an edible yeast by a heat treatment or the like and then powderizing the resulting yeast is used. As the yeast extract, one obtained by killing a yeast and then powderizing the water-soluble fraction is used. In either case, a commercially available product can be suitably used. For example, as the commercially available yeast extract, Yeast extract Junmi C-005 (product of Oriental Yeast Co., Ltd.), Koumi (product of Kirin Kyowa Foods Company, Limited.), Saberex (product of Asahi Food & Healthcare Co., Ltd.) and the like can be exemplified. As the edible yeast, a commercially available product may be used as such, or it may be once cultured and the resulting yeast cells may be collected and killed by a heat treatment, an ultrasonic treatment or the like. For example, after a yeast is cultured, the cultured yeast cells are subjected to a heat treatment

(preferably at 80°C or lower), and the resulting yeast cells may be separated, concentrated and then dried.

[0025]

As the yeast, a yeast belonging to *Saccharomyces cerevisiae*, for example, a baker's yeast, a beer yeast, a sake yeast or the like can be used, and a commercially available product can also be suitably used. For example, as the commercially available yeast, Oriental Yeast (product of Oriental Yeast Co., Ltd.), Yeast SR (product of Kaneka Corporation) and the like can be exemplified.

[0026]

As the modified cellulose, a cellulose modified with a methoxyl group, a hydroxypropoxyl group or the like, for example, methyl cellulose, hydroxypropyl methylcellulose, sodium carboxymethyl cellulose and calcium carboxymethyl cellulose can be exemplified. These are all modified celluloses approved as food additives in Japan and there is no special problem with regard to safety.

[0027]

The thermostability imparting material (sometimes referred to as thermostability imparting raw material or thermostability imparting agent) according to the invention may be added to dough independently separated from the retrogradation preventing agent containing β -amylase, or both may be mixed and prepared into a thermostabilized

retrogradation preventing agent and the resulting agent may be added to dough (in an amount of from 0.1 to 10%, preferably from 0.5 to 5% based on the flour). In either case, they may be added in divided portions or all at once.

[0028]

A composition of the preparation of the thermostabilized retrogradation preventing agent is, for example, as follows. As the retrogradation preventing agent, 5 to 25% (preferably 12 to 25%) of β -amylase (a commercially available β -amylase preparation can be used) is added and 5 to 95% (preferably 5 to 65%, more preferably 5 to 60%) of the thermostability imparting material is added, and the total amount is made up to 100% using cornstarch as a filler. In particular, it is more preferred that to the thermostabilized retrogradation preventing agent which contains the β -amylase preparation in an amount of 12%, in the case of the modified cellulose, it is added in an amount of from 6 to 75%, and in the case of the processed yeast material, it is added in an amount of from 8 to 75%; and to the thermostabilized retrogradation preventing agent which contains the β -amylase preparation in an amount of from 4 to 12%, yam powder is added in an amount of from 18 to 75%. Incidentally, % denotes % by weight. The compositional ratios of the retrogradation preventing agent and the thermostability imparting material are determined such that the total amount (sum amount) thereof does not exceed 100%,

and when the total amount is less than 100%, a filler may be added to make the total amount 100%. Further, in the case where these are separately added, the addition amounts thereof may be determined as described above.

[0029]

The invention is directed to food which retrogrades, and prevents or inhibits the retrogradation thereof. Examples of the food to be targeted include Japanese confectionary such as rice cakes, dumplings, steamed buns made mainly from non-glutinous rice, glutinous rice, wheat, buckwheat, or flour thereof (for example, non-glutinous rice flour (for example "joshinko" in Japanese), glutinous rice flour (for example, "shiratomako" in Japanese), wheat flour, or buckwheat flour); and in addition to these, bread, cakes, Chinese steamed buns, Chinese steamed buns containing sweet bean jam, steamed meat buns, pizza steamed buns and the like made mainly from wheat flour. Such food which is made from cereal flour or starch and retrogrades after a heat treatment can all be targets of the invention. Rice dishes themselves (including steamed white rice, steamed rice mixed with barley, steamed rice mixed with red beans, steamed rice mixed with assorted ingredients, various types of steamed glutinous rice mixed with assorted ingredients, steamed rice mixed with miscellaneous cereals, rice porridge, and the like) can also be targets of the invention.

[0030]

In order to implement the invention, dough is prepared by adding water to cereal flour or starch, the resulting dough is subjected to a heat treatment by steaming, baking or frying, and then the thermostabilized retrogradation preventing agent is added, if necessary, mixed well with the heated dough, and the dough is maintained under a warming condition for a given time, and thus, retrogradation can be prevented.

[0031]

Further, in the invention, thermostability is imparted to the retrogradation preventing agent, therefore, it is not necessary to decrease the material temperature to 70°C or lower after a heat treatment and a treatment with the retrogradation preventing agent can be performed at a high temperature of from 90 to 95°C (it can be performed even at 95 to 98°C). Thus, a significant effect that a waiting time required for cooling can be reduced or a cooling device can be omitted is exhibited. Further, since the retrogradation preventing treatment can be performed before decreasing the material temperature, contamination with miscellaneous bacteria can be prevented, and therefore, the invention is excellent also from this point of view.

[0032]

Hereinafter, Examples of the present invention will be described, however, the invention is not limited only to these

Examples.

[Example 1]

[0033]

Various types of rice cakes were produced as follows. Then, β -amylase activities were measured and a sensory evaluation was carried out by panelists (10 male and 10 female trained panelists), and the following results were obtained.

[0034]

(A) Method for test production of rice cakes

(Composition of rice cakes)

Non-glutinous rice flour	100%
Water	82%
Sugar	30%
Preparation	1%

[0035]

(Method for test production of rice cakes with vertical steam kneader (manufactured by Iida Seisakusyo Co., Ltd.))

(1) Place non-glutinous rice flour and water in the kneader and knead them for 3 minutes.

(2) Steam and knead the mixture while stirring at 100°C for 5 minutes.

(3) Add sugar thereto and knead the mixture for 2 minutes.

(4) Add the preparation to the resulting dough at 90°C.

(5) Cool the dough with water.

(6) Shape the dough into rice cakes.

(7) Store the resulting rice cakes at 4°C.

[0036]

Analysis items

(1) Amount of maltose contained in rice cakes

Liquid chromatography: product of Shimadzu Corporation,
10A series

(2) Stress (hardness) of rice cakes

Rheometer RE-3305, manufactured by Yamaden Co., Ltd.

[0037]

(C) Composition of preparation

The composition of the preparation is as shown in the
following Table 1.

[0038]

[Table 1]

Composition of preparation

	1	2	3	4	5
β -amylase preparation	12%	12%	12%	12%	12%
Cornstarch (filler)	88%	73%	61%	70%	78%
Emulsifier		15%			
Yam powder			27%		
Modified cellulose				18%	
Processed yeast material					10%
Total	100%	100%	100%	100%	100%

[0039]

· Emulsifier: product of Riken Vitamin Co., Ltd., Emulsy MM-100

· Yam powder: product of Sunrai Foods, Honkaku yamaimo powder

SA (authentic yam powder SA)

· Modified cellulose: product of Shin-Etsu Chemical Co., Ltd.,

METULOSE SFE 4000

Component: hydroxypropyl methyl cellulose

· Processed yeast material: product of Oriental Yeast Co., Ltd.,

Yeast extract Junmi C-005

· β -amylase preparation: product of Nagase Chemtech Co., Ltd.,

#1500S

15000 AUN/g

1 ml of an enzyme solution is added to 5 ml of a 1.2% gelatinized starch solution (pH 5.5, 50 mM acetate buffer) and a reaction is allowed to proceed at 40°C for 20 minutes.

An activity to produce a reducing power equivalent to 100 μ g of glucose per minute is defined as 1 AUN.

[0040]

(D) Test results

The test results (concentrations of maltose after storage at 4°C for one day) are shown in the following Table 2.

[0041]

[Table 2]

Test group	Amount of maltose produced (%)
1	1.8
2	3.2
3	4.4

4	5.5
5	4.2

[0042]

The Test groups 3, 4, and 5 showed a higher amount of maltose produced than Test group 2.

[0043]

(E) Texture sensory evaluation

After the rice cakes were stored at 4°C for 4 days, a texture sensory evaluation was carried out by panelists and the results shown in the following Table 3 were obtained.

[0044]

[Table 3]

Hardness of rice cakes after storage at 4°C for 4 days

Test group	Sensory evaluation	Hardness analysis (%)
1	hard	230
2	somewhat hard	100
3	soft	82
4	soft	82
5	soft	82

[0045]

A higher inhibitory effect on retrogradation (hardening) of rice cakes was observed as compared with the case of addition of an emulsifier, and softness of rice cakes could be maintained even if they were stored by refrigeration.

[0046]

(F) Summary

As is apparent from the above results, by allowing a modified cellulose, a processed yeast material or yam powder to compensate for β -amylase, a higher thermostable protective effect was observed as compared with the case of addition of an emulsifier (see JP-A-1-215243) which has heretofore been known as a material for thermostabilizing β -amylase as well as the additive-free case.

Further, a higher inhibitory effect on retrogradation (hardening) of rice cakes was observed as compared with the case of addition of an emulsifier as well as the additive-free case, and softness of rice cakes could be maintained even if they were stored by refrigeration.

[Example 2]

[0047]

In order to confirm the influence of the dough temperature at the time of addition of the retrogradation preventing agent for food on the retrogradation preventing effect in the production of rice cakes, various types of rice cakes were produced by using a retrogradation preventing preparation containing 25% of a β -amylase preparation and 75% of a thermostability imparting material (a modified cellulose, yam powder or a processed yeast material) under four different dough temperature conditions at the time of addition of the preparation: 25°C, 50°C, 75°C and 100°C, while the composition

of the rice cakes and the production conditions other than the dough temperature at the time of addition of the preparation were the same as in Example 1. As the respective thermostability imparting materials, the same products as in Example 1 were used. The compositions of the preparations, the dough temperatures at the time of addition of the preparations in the respective Test groups are shown in Tables 4 to 6. The rice cakes of Test group 1 (a retrogradation preventing agent for food which does not contain a thermostability imparting material was added under the dough temperature condition of 90°C) in Example 1 were assigned to be a control group (C), and the rice cakes stored at 4°C for 4 days were compared with respect to stress determination and sensory evaluation of rice cakes performed in the same manner as in Example 1.

[0048]

[Table 4]

Composition of preparation and dough temperature at the time of addition of preparation

Test group	6	7	8	9
β -amylase preparation (%)	25	25	25	25
Modified cellulose (%)	75	75	75	75
Total (%)	100	100	100	100
Dough temperature at the time of addition of preparation (°C)	100	75	50	25

[0049]

[Table 5]

Composition of preparation and dough temperature at the time of addition of preparation

Test group	10	11	12	13
β -amylase preparation (%)	25	25	25	25
Yam powder (%)	75	75	75	75
Total (%)	100	100	100	100
Dough temperature at the time of addition of preparation (°C)	100	75	50	25

[0050]

[Table 6]

Composition of preparation and dough temperature at the time of addition of preparation

Test group	14	15	16	17
β -amylase preparation (%)	25	25	25	25
Processed yeast material (%)	75	75	75	75
Total (%)	100	100	100	100
Dough temperature at the time of addition of preparation (°C)	100	75	50	25

[0051]

The test results (results of hardness and sensory evaluation) are shown in Figs. 1 to 3. As is apparent from these results, there was no difference in the retrogradation preventing effect when the dough temperature at the time of addition of the preparation was in the range of from 25 to 100°C

in the rice cakes produced by using the retrogradation preventing agent containing any of the thermostability imparting materials of the modified cellulose, yam powder and processed yeast material, and softness of the rice cakes could be maintained even if they were stored at 4°C unlike the case of the control group, and it was shown that the retrogradation preventing effect of the preparation functions effectively.

[Example 3]

[0052]

In order to confirm the retrogradation preventing effect at the time when the rice cakes are thawed after storage by refrigeration, rice cakes with the same composition as in Example 1 were produced under the same production conditions as in Example 1 by using each of three types of retrogradation preventing agents for food with the composition shown in the following Table 7. After storage at -20°C for 7 days, these rice cakes were thawed to 25°C and compared with respect to stress determination and sensory evaluation of rice cakes performed in the same manner as in Example 1.

[0053]

[Table 7]

Composition of preparation

Test group	18	19	20
β -amylase preparation (%)	12	12	12
Cornstarch (%)	88	73	70
Emulsifier (%)		15	
Modified cellulose (%)			18
Total (%)	100	100	100

[0054]

The test results (results of hardness and sensory evaluation) are shown in Fig. 4. As is apparent from these results, the rice cakes produced by using the preparation containing the modified cellulose (Test group 20) were more excellent in the retrogradation preventing effect as compared with the rice cakes produced by using the preparation containing no thermostability imparting material (Test group 18) with respect to both hardness (stress) and sensory evaluation. Incidentally, the rice cakes produced by using the preparation containing the emulsifier (Test group 19) were superior to Test group 18 with respect to the stress, however, in the sensory evaluation, they were evaluated to be somewhat hard similarly to Test group 18 and the quality thereof was not satisfactory.

[Example 4]

[0055]

In order to confirm the influence of the blending amount of the thermostability imparting material in the retrogradation preventing agent for food on the retrogradation preventing effect, rice cakes with the same composition as in Example 1 were produced under the same production conditions as in Example 1 by using each of various types of retrogradation preventing preparations containing 12% of a β -amylase preparation and a different amount of a thermostability imparting material (a modified cellulose, yam powder or a processed yeast material). The compositions of the preparations in the respective Test groups are shown in the following Tables 8 to 10. The rice cakes stored at 4°C for 4 days were compared with respect to stress determination and sensory evaluation of rice cakes performed in the same manner as in Example 1.

[0056]

[Table 8]

Composition of preparation

Test group	21	22	23	24
β -amylase preparation (%)	12	12	12	12
Cornstarch (%)	70	76	82	85
Modified cellulose (%)	18	12	6	3
Total (%)	100	100	100	100

[0057]

[Table 9]

Composition of preparation

Test group	25	26	27	28	29
β -amylase preparation (%)	12	12	12	12	12
Cornstarch (%)	61	70	79	85	88
Yam powder (%)	27	18	9	3	0
Total (%)	100	100	100	100	100

[0058]

[Table 10]

Composition of preparation

Test group	30	31	32
β -amylase preparation (%)	12	12	12
Cornstarch (%)	78	80	82
Processed yeast material (%)	10	8	6
Total (%)	100	100	100

[0059]

The test results (results of hardness and sensory evaluation) are shown in Figs. 5 to 7. As shown by these results, it was revealed that rice cakes which are prevented or suppressed from retrograding and have good quality can be obtained when the blending amount of each thermostability imparting material in the retrogradation preventing preparation is as follows: the blending amount of the modified cellulose is 6% or more; the blending amount of the yam powder

is 18% or more; and the blending amount of the processed yeast material is 8% or more.

[Example 5]

[0060]

In order to confirm the influence of the blending amount of β -amylase in the retrogradation preventing agent for food on the retrogradation preventing effect, rice cakes with the same composition as in Example 1 were produced under the same production conditions as in Example 1 by using each of various types of retrogradation preventing preparations containing 75% of a thermostability imparting material and a different amount of a β -amylase preparation. The compositions of the preparations in the respective Test groups are shown in the following Tables 11 to 13. The rice cakes stored at 4°C for 4 days were compared with respect to stress determination and sensory evaluation performed in the same manner as in Example 1.

[0061]

[Table 11]

Composition of preparation

Test group	33	34	35	36
β -amylase preparation (%)	12	10	8	6
Cornstarch (%)	13	15	17	19
Modified cellulose (%)	75	75	75	75
Total (%)	100	100	100	100

[0062]

[Table 12]

Composition of preparation

Test group	37	38	39	40	41	42	43
β -amylase preparation (%)	12	10	8	6	4	2	0
Cornstarch (%)	13	15	17	19	21	23	25
Yam powder (%)	75	75	75	75	75	75	75
Total (%)	100	100	100	100	100	100	100

[0063]

[Table 13]

Composition of preparation

Test group	44	45	46	47
β -amylase preparation (%)	12	10	8	6
Cornstarch (%)	13	15	17	19
Processed yeast material (%)	75	75	75	75
Total (%)	100	100	100	100

[0064]

The test results (results of hardness and sensory

evaluation) are shown in Figs. 8 to 10. As shown by these results, it was revealed that, in the case where rice cakes contain 1% of a retrogradation preventing preparation, the rice cakes which are prevented or suppressed from retrograding and have good quality can be obtained when the blending amount of β -amylase is as follows: the blending amount of β -amylase is 12% or more in the preparation containing the modified cellulose; the blending amount of β -amylase is 4% or more in the preparation containing the yam powder; and the blending amount of β -amylase is 12% or more in the preparation containing the processed yeast material.

[Designation of Document] Claims

[Claim 1]

A thermostability imparting material which is in a retrogradation preventing agent for food containing β -amylase as an active ingredient, characterized in that it comprises a processed *Saccharomyces cerevisiae* yeast material and imparts thermostability at 90°C or higher.

[Claim 2]

A thermostability imparting material which is in a retrogradation preventing agent for food containing β -amylase as an active ingredient, characterized in that it comprises at least one member selected from yam powder and a modified cellulose and imparts thermostability at 90°C or higher.

[Claim 3]

A retrogradation preventing agent for food characterized in that it comprises 6 to 75% of the thermostability imparting material according to claim 1 or 2 and 5 to 25% of β -amylase and has thermostability at 90°C or higher.

[Claim 4]

The retrogradation preventing agent for food according to claim 3, characterized in that the food is at least one member selected from Japanese confectionery, bread, cakes, Chinese steamed buns, pizza steamed buns and rice dishes.

[Claim 5]

A method for preventing retrogradation of food characterized by heating dough containing cereal flour and/or starch, cooling the heated dough to 90 to 95°C, and then adding the retrogradation preventing agent for food according to any one of claims 3 to 4 to the dough.

[Claim 6]

A retrogradation-controlled food characterized in that it is produced by the method according to claim 5 and is prevented from retrograding and thus maintains softness even if it is stored by refrigeration or freezing.

[Claim 7]

A method for producing a rice cake which is prevented from retrograding and maintains softness even if it is stored by refrigeration or freezing, characterized by adding water to non-glutinous rice flour and kneading the mixture, subjecting the resulting dough to a heat treatment at 100°C

for 5 to 40 minutes, kneading the resulting dough again, releasing heat until the temperature thereof reaches 90°C, adding the retrogradation preventing agent according to any one of claims 3 to 4 thereto, maintaining the dough for 5 to 20 minutes, and then, letting the dough stand to cool.