

DESCRIPTION

TITLE OF THE INVENTION

DOUGHNUTS AND METHOD FOR PRODUCING SAME

Technical Field

[0001]

The present invention relates to doughnuts of reduced oil absorption in the production of the doughnuts and conferred with soft and chewy texture, and a method for producing the same.

Background Art

[0002]

Doughnuts are one of the foods preferred worldwide irrespective of sex and age, and various doughnuts are also sold in Japan. Such doughnuts include, for example, cake doughnuts, French doughnuts, and yeast doughnuts. All of these doughnuts are obtained as final products by kneading dough of ingredients such as wheat flour and shaping this dough, followed by frying in oil (deep-frying). In the production of the doughnuts, the dough is usually altered to have a porous structure due to the swelling of the ingredients during its frying in oil, and thus easily absorbs oil. Hence, the final products contain a large amount of oil.

[0003]

With recent increase in health consciousness, it has been revealed that the excessive consumption of oil from food promotes the accumulation of cholesterol in the body.

As the harmful effects thereof have been emphasized, there has been a growing trend to cut down the amount of oil and fat consumed in daily diet. Therefore, products having a minimum content of oil have also been intended as to deep-fried foods such as doughnuts.

[0004]

While such products having a reduced content of oil have been intended, various methods for obtaining products having a minimum content of oil in the production of deep-fried foods such as doughnuts have previously been proposed. For example, as methods for reducing the content of absorbed oil from deep-frying by adding various additives in the production of deep-fried foods, Japanese unexamined Patent Application Publication No. 60-130353 discloses a method comprising adding a calcium preparation such as calcium carbonate and calcium acetate to dough; Japanese unexamined Patent Application Publication No. 3-143344 discloses a method comprising adding soybean curd refuse to dough; Japanese unexamined Patent Application Publication No. 2000-210026 discloses a method comprising adding lactalbumin into dough; and Japanese unexamined Patent Application Publication No. 2002-125579 discloses a method comprising adding pectin and vital gluten into doughnut dough.

[0005]

In addition, Japanese unexamined Patent Application Publication No. 2003-210118 discloses a method comprising adding polysaccharides pulverized in a jet mill or the like to ingredients such as wheat flour; Japanese unexamined Patent Application Publication No. 2005-58082

discloses a method comprising adding pectin and glucose oxidase into doughnut dough; Japanese unexamined Patent Application Publication No. 2005-80583 and Japanese unexamined Patent Application Publication No. 2005-80584 each disclose a method using dry yeast or highly glutathione-containing yeast as an oil absorption inhibitor; Japanese unexamined Patent Application Publication No. 2005-192506 discloses a method using an animal protein such as chicken, pork, and beef as a dough-modifying composition; and Japanese unexamined Patent Application Publication No. 2010-268693 discloses a method using a dough composition for deep-frying, comprising an aqueous solution of water-soluble cellulose ether, and cereal flour. These methods disclosed therein are disclosed as methods for reducing the content of absorbed oil from deep-frying in the production of deep-fried foods such as doughnuts. These methods, however, cannot avoid the influence of additives on the taste, texture, or flavor of the deep-fried foods and are not satisfactory from the viewpoint of providing products of the deep-fried foods such as doughnuts having excellent palatability with favorable taste and texture, though the methods can improve oil absorption in the deep-fried foods.

[0006]

Methods using starches are also disclosed as methods for obtaining products having a reduced content of oil by reducing oil absorption from deep-frying in the production of deep-fried foods such as doughnuts. For example, Japanese unexamined Patent Application Publication No. 2001-333691 discloses a method comprising allowing baking

powder for use in the production of deep-fried products such as doughnuts to contain a raising agent consisting of a rapid-acting acidic agent and a medium-acting acidic agent, a raising agent consisting of sodium bicarbonate, and pregelatinized starch so that oil absorption is reduced in deep-fried products; and Japanese unexamined Patent Application Publication No. 2004-33139 discloses a method for producing deep-fried foods which exhibit reduced oil absorption and have crispy texture, comprising using flour for fried foods containing brown rice flour obtained by partially pregelatinizing an ingredient brown rice, followed by drying and pulverization.

[0007]

In addition, Japanese unexamined Patent Application Publication No. 2004-73140 discloses a method for producing doughnuts which exhibit reduced oil absorption, comprising heating starch slurry in the presence of oil and fat and mixing the prepared oil/fat-pregelatinized starch with main ingredients; and Japanese unexamined Patent Application Publication (Translation of PCT Application) No. 2009-537136 discloses a method for reducing oil absorption in deep-fried foods, comprising partially substituting cook-up starch or instant starch in food materials by a hydrophobic starch such as alkyl succinate starch and alkenyl succinate starch. These methods disclosed therein also intend to reduce oil absorption in the production of deep-fried foods such as doughnuts. For these deep-fried foods containing pregelatinized starch, however, it is difficult to obtain taste and texture desired for deep-fried foods such as

doughnuts, for example, glutinous texture like a freshly made rice cake at the time of eating. Thus, these methods do not directly improve the taste or texture of deep-fried foods. Furthermore, if pregelatinized starch is used in a large amount for reducing absorbed oil during deep-frying, uniform doughnuts are difficult to obtain because the doughnut shapes are not stable.

[0008]

For deep-fried foods such as doughnuts, many consumers prefer not only crispy doughnut texture but glutinous texture like a freshly made rice cake (hereinafter, chewy texture), also because of diversified palatability. In view of such palatability, a method for producing fried foods conferred with rice cake-like texture is also disclosed. For example, Japanese unexamined Patent Application Publication No. 10-313787 discloses fried foods having rice cake-like texture obtained by using ingredient flour containing tapioca starch or modified (etherified, esterified, oxidized, or cross-linked) tapioca starch as a main material mixed with cheese, particularly, in the preparation of frozen dough, to adjust an oil absorption rate to 1.5 to 5% (weight). This method disclosed therein is particularly directed to the production of fried foods using frozen dough and employs tapioca starch or modified tapioca starch as starches to be mixed into dough ingredients. The method disclosed therein, however, even if applied to the production of deep-fried foods such as doughnuts, cannot produce deep-fried foods that retain the original taste

and flavor of deep-fried foods and have soft and chewy texture.

Prior Art Documents

Patent Documents

[0009]

Patent document 1: Japanese unexamined Patent Application
Publication No. 60-130353

Patent document 2: Japanese unexamined Patent Application
Publication No. 3-143344

Patent document 3: Japanese unexamined Patent Application
Publication No. 10-313787

Patent document 4: Japanese unexamined Patent Application
Publication No. 2000-210026

Patent document 5: Japanese unexamined Patent Application
Publication No. 2001-333691

Patent document 6: Japanese unexamined Patent Application
Publication No. 2002-125579

Patent document 7: Japanese unexamined Patent Application
Publication No. 2003-210118

Patent document 8: Japanese unexamined Patent Application
Publication No. 2004-33139

Patent document 9: Japanese unexamined Patent Application
Publication No. 2004-73140

Patent document 10: Japanese unexamined Patent Application
Publication No. 2005-58082

Patent document 11: Japanese unexamined Patent Application
Publication No. 2005-80583

Patent document 12: Japanese unexamined Patent Application
Publication No. 2005-80584

Patent document 13: Japanese unexamined Patent Application
Publication No. 2005-192506

Patent document 14: Japanese unexamined Patent Application
Publication No. 2010-268693

Patent document 15: Japanese unexamined Patent Application
Publication (Translation of PCT Application) No. 2009-
537136

Summary of the Disclosure

Object to be Solved by the Disclosure

[0010]

An object of the present disclosure is to reduce oil absorption during deep-frying in the production of doughnuts as products having a minimum content of oil from health consciousness have been intended in the production of deep-fried foods such as doughnuts, and to provide doughnuts which retain the original taste and flavor of doughnuts, are conferred with soft and chewy texture, and having a reduced content of absorbed oil and excellent palatability with favorable taste and texture, and a method for producing the same.

Means to Solve the Object

[0011]

To attain the object, the present inventors have conducted diligent studies on a method for reducing the content of absorbed oil in the production of doughnuts, retaining the original taste and flavor of doughnuts, and obtaining the intended texture of doughnuts, and have consequently completed the present invention by finding

that doughnut ingredients including wheat flour and starch are allowed to contain a particular starch and/or modified starch, whereby oil absorption during deep-frying can be reduced, and soft and chewy texture can be provided thereto, and furthermore, doughnuts that retain the original taste and flavor of doughnuts and has a reduced content of absorbed oil and excellent palatability with favorable taste and texture can be produced.

[0011a]

In one aspect, there is provided a method for producing doughnuts of reduced oil absorption and conferred with chewy texture, the doughnuts comprising wheat flour and starch as starchy raw material, wherein the starchy raw material consists of wheat flour and a starch and/or modified starch which gelatinization onset temperature is 49.4°C or higher and 62.6°C or lower, and wherein the starch and/or modified starch which gelatinization onset temperature is 49.4°C or higher and 62.6°C or lower is contained at 5 parts by weight or more and 90 parts by weight or less with respect to a total of 100 parts by weight of wheat flour and starch.

[0011b]

In another aspect, there is provided a doughnut of reduced oil absorption and conferred with chewy texture, produced by a method described herein, or a method for reducing oil absorption and conferring chewy texture to doughnuts described herein.

[0011c]

In another aspect, there is provided a premix for producing doughnuts of reduced oil absorption and conferred with chewy texture, the premix for producing doughnuts comprising wheat flour and starch as starchy raw material, wherein the starchy raw material consists of wheat flour and a starch and/or modified starch which gelatinization onset temperature is 49.4°C or higher and 62.6°C or lower, and wherein the starch and/or modified starch which gelatinization onset temperature is 49.4°C or higher and 62.6°C or lower is mixed to be contained at 5 parts by weight or more and 90 parts by weight or less with respect to a total of 100 parts by weight of wheat flour and starch.

[0012]

Specifically, the present disclosure provides a method for producing doughnuts of reduced oil absorption and conferred with chewy texture, wherein a starch and/or modified starch which gelatinization onset temperature is 30°C or higher and 63°C or lower is contained at 5 parts by weight or more and 90 parts by weight or less with respect to a total of 100 parts by weight of wheat flour and starch in doughnuts comprising wheat flour and starch.

[0013]

In the method for producing doughnuts according to the present disclosure, a starch and/or a modified starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower is used as the starch and/or the modified starch to be mixed into the doughnut ingredients including wheat flour and starch. Particularly preferably, a starch and/or a modified starch having a gelatinization onset temperature of 49°C or higher and 63°C or lower can be used. In the method for producing doughnuts according to the present disclosure, the starch and/or the modified starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower, to be mixed into the doughnut

ingredients including wheat flour and starch, can be mixed at a ratio of 5 parts by weight or more and 90 parts by weight or less of the starch and/or the modified starch with respect to 100 parts by weight in total of the wheat flour and the starch. Particularly preferably, the content of the starch and/or the modified starch can be 15 parts by weight or more and 70 parts by weight or less.

[0014]

In the method for producing doughnuts according to the present disclosure, examples of the starch and/or the modified starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower, to be mixed into the doughnut ingredients including wheat flour and starch, can include one or more starches selected from waxy tapioca starch, hydroxypropyl starch, and/or acetyl starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower. Examples of the hydroxypropyl starch can include hydroxypropyl tapioca starch having a degree of substitution of 0.06 or higher and 0.12 or lower.

[0015]

The present disclosure encompasses a method for reducing oil absorption in produced doughnuts and conferring chewy texture thereto, comprising, in the production of doughnuts comprising wheat flour and starch, adjusting the content of a starch and/or a modified starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower to 15 parts by weight or more and 70 parts by weight or less with respect to 100 parts by weight in total of the wheat flour and the starch.

[0016]

In addition, the present disclosure encompasses doughnuts themselves of reduced oil absorption and conferred with chewy texture, the doughnuts being produced by the method for producing doughnuts or the method for reducing oil absorption in doughnuts and conferring chewy texture thereto according to the present disclosure. Further, the present disclosure encompasses a premix for the production of doughnuts of reduced oil absorption and conferred with chewy texture, the premix being formulated to allow doughnuts comprising wheat flour and starch to comprise 5 parts by weight or more and 90 parts by weight or less of a starch and/or a modified starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower with respect to 100 parts by weight in total of the wheat flour and the starch.

[0017]

More specifically, the present disclosure provides:

- (1) A method for producing doughnuts of reduced oil absorption and conferred with chewy texture, wherein a starch and/or modified starch which gelatinization onset temperature is 30°C or higher and 63°C or lower is contained at 5 parts by weight or more and 90 parts by weight or less with respect to a total of 100 parts by weight of wheat flour and starch in doughnuts comprising wheat flour and starch;
- (2) The method for producing doughnuts of reduced oil absorption and conferred with chewy texture according to (1), wherein a content of starch and/or modified starch which gelatinization onset temperature is 30°C or higher and 63°C or lower is 15 parts by weight or more and 70

parts by weight or less with respect to a total of 100 parts by weight of wheat flour and starch in doughnuts comprising wheat flour and starch;

(3) the method for producing doughnuts of reduced oil absorption and conferred with chewy texture according to (1) or (2), wherein the starch which gelatinization onset temperature is 30°C or higher and 63°C or lower is one or more starches selected from waxy tapioca starch, hydroxypropyl starch and/or acetyl starch;, and

(4) the method for producing doughnuts of reduced oil absorption and conferred with chewy texture according to (3), wherein the hydroxypropyl starch is a hydroxypropyl tapioca starch having a degree of substitution of 0.06 or more and 0.12 or less.

[0018]

The present disclosure also provides:

(5) a method for reducing oil absorption and conferring chewy texture to produced doughnuts, comprising adjusting a content of starch and/or modified starch which gelatinization onset temperature is 30°C or higher and 63°C or lower to 5 parts by weight or more and 90 parts by weight or less with respect to a total of 100 parts by weight of wheat flour and starch in the production of doughnuts comprising wheat flour and starch;

(6) a doughnut of reduced oil absorption and conferred with chewy texture, produced by a method for producing doughnuts according to any one of (1) to (4), or a method for reducing oil absorption and conferring chewy texture to doughnuts according to (5); and

(7) a premix for producing doughnuts of reduced oil absorption and conferred with chewy texture, wherein a starch and/or modified starch which gelatinization onset temperature is 30°C or higher and 63°C or lower is mixed to be contained at 5 parts by weight or more and 90 parts by weight or less with respect to a total of 100 parts by weight of wheat flour and starch in a premix for producing doughnuts comprising wheat flour and starch.

Effect of the Invention

[0019]

The present invention reduces oil absorption during deep-frying so as to satisfy demands from health consciousness and palatability in the production of deep-fried foods such as doughnuts, and provides doughnuts which retain the original taste and flavor of doughnuts, are conferred with soft and chewy texture, and has a reduced content of absorbed oil and excellent palatability with favorable taste and texture, and a method for producing the same. The method for producing doughnuts according to the present invention is provided as a method which can stably produce doughnuts having uniform shapes by using the premix for the production of doughnuts comprising wheat flour and starch according to the present invention.

Mode of Carrying Out the Invention

[0020]

The present invention provides doughnuts of reduced oil absorption during deep-frying and has chewy texture

like a freshly made rice cake, by allowing doughnuts comprising wheat flour and starch to comprise 5 parts by weight or more and 90 parts by weight or less of a starch and/or a modified starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower with respect to 100 parts by weight in total of the wheat flour and the starch, and a method for producing the doughnuts.

[0021]

In the present invention, the doughnuts refer to, for example, cake doughnuts obtained by frying in oil cake dough raised with baking powder, yeast doughnuts obtained by frying in oil bread dough leavened with yeast, and French doughnuts obtained by making soft dough by the addition of a large amount of eggs, filling a bag with the dough, and piping the filling into ring shape, followed by frying in oil.

[0022]

In the present invention, an unmodified starch is referred to as a starch or a raw starch, whereas a chemically treated and/or physically treated starch is referred to as a modified starch. General examples of the modified starch include hydroxypropylated, acetylated, cross-linked, oxidized, and acid-dipped starches. In this context, the hydroxypropylation refers to a treatment of reacting a starch with propylene oxide. The acetylation refers to a treatment of reacting a starch with acetic anhydride or a vinyl acetate monomer or the like. These treatments can be carried out according to routine methods. The cross-linking refers to a treatment of, for example, reacting a starch by the addition of a cross-linking agent

such as metaphosphate and phosphorus oxychloride and can be carried out according to a routine method. The oxidation refers to a treatment of allowing sodium hypochlorite to act on a starch. The acid dipping refers to a treatment of allowing sulfuric acid to act on a starch. These treatments can be carried out according to routine methods. Also, a starch pulverized by heating a starch using a drum dryer, an extruder, a spray dryer, or the like in the presence of water to temporarily gelatinize the starch, followed by drying is referred to as a pregelatinized starch. The gelatinization onset temperature of the pregelatinized starch is generally lower than 30°C.

[0023]

The gelatinization of a starch refers to a phenomenon in which the starch granules rapidly absorb water in water to form a strongly viscous liquid. The temperature at which the gelatinization starts is referred to as a gelatinization onset temperature. The gelatinization onset temperature can be measured using, for example, Brabender Viscograph (manufactured by C.W. Brabender Instruments, Inc.).

[0024]

In the present invention, examples of the modified starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower can include a starch prepared to have a gelatinization onset temperature of 30°C or higher and 63°C or lower by chemical treatment. For the gelatinization onset temperatures of these starches, examples of starches having a particularly preferred

gelatinization onset temperature can include starches having a gelatinization onset temperature of 49°C or higher and 63°C or lower. Preferred examples of the modified starch can include hydroxypropylated starch and/or acetylated starch. Examples of a starting material for such a modified starch can include starches such as corn starch, waxy corn starch, potato starch, waxy potato starch, wheat starch, waxy wheat starch, tapioca starch, waxy tapioca starch, sago starch, mung bean starch, pea starch, rice starch, glutinous rice starch, and sweet potato starch.

[0025]

In the present invention, for the hydroxypropylated starch and/or the acetylated starch used as the modified starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower, the degree of substitution (indicated by the number of moles of substituents per anhydrous glucose residue in the starch) serves as an index that indicates the substitution ratio of a hydroxypropyl group in the hydroxypropylated starch or the ratio of an acetyl group in the acetylated starch. In the present invention, the degree of substitution is preferably 0.02 or more and 0.20 or less, more preferably 0.06 or more and 0.15 or less. Within this range, provided that the gelatinization onset temperature is 30°C or higher and 63°C or lower, oil absorption during deep-frying can be reduced and preferred glutinous texture like a freshly made rice cake is achieved. The degree of substitution can be measured according to a method described in Denpun-Kanren Toshitsu Jikkenho (Experimental

Methods on Starch and Related Carbohydrates in English)
(Nakamura, Kainuma ed., Gakkai Shuppan Center).

[0026]

In the present invention, waxy tapioca starch can be used as the raw starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower.

[0027]

According to the present invention, the doughnuts comprising wheat flour and starch contain 5 parts by weight or more and 90 parts by weight or less, more preferably 15 parts by weight or more and 70 parts by weight or less, of a starch and/or a modified starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower with respect to 100 parts by weight in total of the wheat flour and the starch, whereby oil absorption during deep-frying can be reduced, and doughnuts having glutinous texture like a freshly made rice cake can be obtained. If the content of the starch and/or the modified starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower exceeds 90 parts by weight, the resulting doughnuts are hard and are not preferred, though oil absorption can be reduced. If the content of the starch and/or the modified starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower is smaller than 5 parts by weight, the effect of reducing absorbed oil and glutinous texture like a freshly made rice cake are insufficient.

[0028]

The method for producing doughnuts according to the present invention can be performed by mixing wheat flour

and a starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower, as production ingredients of doughnuts comprising wheat flour and starch, according to the mixing ratio of the present invention at the time of production of the doughnuts. The production ingredients of doughnuts can be prepared as a premix according to the mixing ratio of the present invention. In the method for producing doughnuts according to the present invention, the premix flour thus prepared by mixing in advance can also be used as the production ingredients of doughnuts.

[0029]

In the method for producing doughnuts according to the present invention, a leavening agent and/or a raising agent, such as yeast and/or baking powder, sugar, water, optional auxiliary ingredients, and the like can be used, if necessary, in addition to the wheat flour and the starch as ingredients.

[0030]

Examples of the auxiliary ingredients that can be used in the method for producing doughnuts according to the present invention include, but are not limited to: animal or vegetable oil and fat such as butter, margarine, lard, shortening, corn oil, olive oil, salad oil, palm oil, and powdered oil and fat; dairy products such as cow's milk, fresh cream, concentrated milk, condensed milk, powdered milk, powdered skim milk, yogurt, cheese, and liquid cheese; a meat product such as ham, sausage, bacon, and minced meat; an egg product such as a raw eggs, a dehydrated egg, dried albumen, and dried yolk; a vegetable

and a fruit and a puree or a dried product thereof, such as strawberry, tomato, carrot, onion, spinach, apple, mandarin orange, peach, pineapple, and raisin; a nut such as walnut, cashew nut, peanut, and almond; a liquor such as brandy, liqueur, and rum; a marine product such as shrimp, salted cod roe, krill, and brown seaweed; a seed such as sesame, a sunflower seed, and pine nut; a spice such as pepper, cinnamon, garlic, and curry powder; and others such as common salt, chocolate, cocoa, consomme, soy sauce, custard cream, bean jam, and various flavors. Any of components useful for seasoning can be used according to preference. These seasoning components may be contained in the doughnuts of the present invention by kneading into dough, wrapping of filling as in Chinese steamed buns or dumplings, topping on the surface, or combined use of these approaches.

[0031]

In addition to the features of the wheat flour and the starch used as ingredients, a general doughnut production method can be applied to the method for producing doughnuts according to the present invention. For example, yeast doughnuts are generally produced by adding common salt, sugar, other auxiliary materials, and water together with yeast to cereal flour composed mainly of the wheat flour and the starch, kneading the mixture, and then performing the respective steps of leavening, shaping, final leavening, and frying in oil. Cake doughnuts are produced by adding baking powder, sugar, other auxiliary materials, and water to cereal flour composed mainly of the wheat flour and the starch,

kneading the mixture, and performing the respective steps of shaping and frying in oil.

[0032]

Hereinafter, the present invention will be described specifically with reference to Test Examples and Examples. However, the present invention is not intended to be limited by these examples.

Examples

[0033]

(Production and evaluation of modified starch)

Commercially available wheat starch, potato starch, corn starch, waxy corn starch, tapioca starch, and waxy tapioca starch were prepared. Various modified starches were produced by methods known in the art, and the degrees of substitution and/or the degrees of cross-linking of the modified starches were measured, if necessary, by routine methods.

[0034]

(Measurement of gelatinization onset temperature)

The gelatinization onset temperature of each starch was measured using Brabender Viscograph (manufactured by C.W. Brabender Instruments, Inc.).

30 to 40 g of the starch was added into a beaker containing 450 ml of distilled water (ratio of the starch: 6 to 8%) and stirred. Then, the starch solution was transferred to a metal cylindrical container included in the apparatus. The starch solution was heated while a stirring bar included in the apparatus was rotated at 75 rpm. The starch solution was stabilized at 30°C. Then,

the viscosity of the starch solution was measured while the temperature was elevated at a rate of 1.5°C/min. The temperature at which the viscosity of the starch solution started to increase was used as the gelatinization onset temperature. In the case of a starch already gelatinized at this point in time, the gelatinization onset temperature was smaller than 30°C.

[0035]

(Doughnut production)

Doughnuts were produced by the steps shown in Table 1. The ingredients were mixed according to each mixing ratio mentioned later.

[0036]

[Table 1]

Name of step	Conditions, etc.
Mixing	Low speed of 139 rpm for 60 sec
	Medium speed of 285 rpm for 60 sec
	Kneading temperature adjusted to 22°C ± 0.5°C
Still standing	Floor time: 15 min
Division	Dough weight: 40 g
Doughnut shape formation	Doughnut cutter manufactured by Belshaw Adamatic
Frying	Add doughnut-shaped dough to oil of 185°C, keep for 60 sec, then reverse, and keep for 50 sec

[0037]

The produced doughnuts were evaluated as follows.

[0038]

(Measurement of oil absorption rate of doughnut)

The weight of fry oil immediately before deep-frying was defined as W1, and the weight of the fry oil immediately after the deep-frying was defined as W2. The oil absorption of each doughnut was calculated from the change in the weight of the fry oil between before and after the deep-frying. The oil absorption rate of the

doughnut was calculated according to Oil absorption of the doughnut / Doughnut dough weight $\times$ 100. In the oil absorption evaluation, difference in oil absorption rate from the reference was assessed as follows.

Poor: The oil absorption rate was increased.

Fair: The oil absorption rate was decreased by 0% or more to less than 1%.

Good: The oil absorption rate was decreased by 1% or more to less than 3%.

Excellent: The oil absorption rate was decreased by 3% or more.

[0039]

(Texture evaluation of doughnut)

Five well trained panelists evaluated the texture of each obtained doughnut.

Evaluation items are shown below. The evaluation results are indicated by an average score from the five panelists.

[0040]

<Glutinous texture like freshly made rice cake (as compared with reference)>

5: Very glutinous

4: Glutinous

3: Equivalent to the reference

2: Having weak glutinous texture

1: Having very weak glutinous texture

[0041]

<Soft texture (as compared with reference)>

5: Very soft

4: Soft

3: Equivalent to the reference

2: Slightly hard

1: Hard

[0042]

<Oiliness perceived at time of actual eating (as compared with reference)>

5: Not oily

4: Less oily

3: Equivalent to the reference

2: Slightly oily

1: Oily

[0043]

<In the texture evaluation, the scores were assessed as follows>

Poor: Lower than 2

Fair: 2 or higher and lower than 3

Good: 3 or higher and lower than 4

Excellent: 4 or higher

[0044]

[Test 1: Evaluation of doughnut containing unmodified starch: Example 1 and Comparative Examples 1 to 5]

[0045]

(Preparation of doughnut)

A doughnut containing soft flour alone as cereal flour (reference) and a doughnut containing 20% by mass of a starch with respect to the total mass of cereal flour were prepared by mixing the doughnut ingredients shown in Table 2. The type of the starch is shown in Table 3.

[0046]

[Table 2]

	Reference doughnut	Starch-containing doughnut
Starches	-	20
Wheat flour ^{*1}	100	80
White superior soft sugar	30	30
Glucose	10	10
Common salt	0.3	0.3
Vegetable fat and oil	15	15
Condensed milk	10	10
Water	25	25 ± α ^{*2}
Liquid whole egg	30	30
Baking powder	3.5	3.5

*1: A mixture of strong flour and soft flour at a mass ratio of 1:3 was used as wheat flour.

*2: The amount of water added was adjusted such that dough viscosity was ± 3 mPa·s of the dough viscosity of the reference.

[0047]

[Table 3]

	Type of starch	Abbreviation of starch	Gelatinization onset temperature (°C)
Comparative Example 1	Wheat starch	W	77.9
Comparative Example 2	Potato	B	65.8
Comparative Example 3	Corn	C	63.2
Comparative Example 4	Waxy corn	WC	69.7
Comparative Example 5	Tapioca	T	65.9
Example 1	Waxy tapioca	WT	62.6

[0048]

(Doughnut evaluation of Test 1)

Results of evaluating the doughnuts prepared in Test 1 are shown in Table 4. As shown in Table 4, in the case of the unmodified starches, the oil absorption rate was remarkably suppressed as compared with the reference only when waxy tapioca starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower was used. Also, chewy texture was preferred.

[0049]

[Table 4]

		Reference	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5	Example 1
Abbreviation		-	W	B	C	WC	T	WT
Oil absorption	Rate	22.5	27.4	24.4	28.8	24.5	25.8	17.4
	Difference from reference	-	4.9	1.9	6.3	2.0	3.3	-5.1
Chewy texture		3.0	2.8	3.4	2.6	3.0	3.4	4.0
Soft texture		3.0	3.8	3.0	3.6	3.2	3.0	4.2
Oiliness		3.0	2.6	3.0	2.6	3.0	3.0	3.0
Oil absorption evaluation		-	Poor	Poor	Poor	Poor	Poor	Excellent
Texture evaluation	Chewy texture	-	Fair	Good	Fair	Good	Good	Excellent
	Soft texture	-	Good	Good	Good	Good	Good	Excellent
	Oiliness	-	Fair	Good	Fair	Good	Good	Good

[0050]

[Test 2: Evaluation of doughnut containing modified tapioca starch: Examples 2 to 7 and Comparative Examples 6 to 8]

[0051]

(Preparation of doughnut)

A doughnut containing wheat flour alone as cereal flour (reference) and a doughnut containing 20% by mass of a starch with respect to the total mass of cereal flour were prepared by mixing the doughnut ingredients shown in Table 5. The wheat flour used and the amount of water added are the same as in Test 1. The type of processing of the modified tapioca starch is shown in Table 6.

[0052]

[Table 5]

	Reference doughnut	Starch-containing doughnut
Starches	-	20
Wheat flour	100	80
White superior soft sugar	30	30
Glucose	10	10
Common salt	0.3	0.3
Vegetable fat and oil	15	15
Condensed milk	10	10
Water	25	25±α
Liquid whole egg	30	30
Baking powder	3.5	3.5

[0053]

[Table 6]

	Type of processing	Degree of substitution	Degree of cross-linking	Abbreviation of modified tapioca starch	Gelatinization onset temperature (°C)
Example 2	PO ^{*1}	0.070	-	TP1	58.9
Example 3	PO	0.110	-	TP2	54.7
Example 4	PO + cross-linking	0.060	9.8	TP-CL 1	59.7
Example 5	PO + cross-linking	0.120	10.0	TP-CL 2	55.8
Example 6	Acetyl	0.085	-	TA1	60.6
Example 7	Oxidation	-	-	T-OX	57.4
Comparative Example 6	PO	0.018	-	TP3	65.3
Comparative Example 7	Acetyl	0.017	-	TA2	63.9
Comparative Example 8	Cross-linking	-	10.0	T-CL	66.1

*1: PO = hydroxypropylation

[0054]

(Doughnut evaluation of Test 2)

Results of evaluating the doughnuts prepared in Test 2 are shown in Table 7. As shown in Comparative Example 5 of Test 1, the oil absorption rate was increased in the doughnut containing unmodified tapioca starch, as compared with the reference, whereas the oil absorption rate was

decreased in the doughnut containing modified tapioca starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower through particular processing, as compared with the reference. Particularly, when hydroxypropyl starch had a degree of substitution of 0.06 or more and 0.12 or less, the oil absorption rate was decreased and chewy texture was more preferred. The oil absorption rate was increased in the doughnut containing modified tapioca starch having a gelatinization onset temperature exceeding 63°C, as compared with the reference. Particularly, when the modified tapioca starch was obtained by cross-linking alone, strong oiliness was perceived at the time of eating. In the case of using pregelatinized tapioca starch (gelatinization onset temperature = lower than 30°C), uniform shapes cannot be formed and chewy texture was also insufficient.

[0055]

[Table 7]

		Reference	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Comparative Example 6	Comparative Example 7	Comparative Example 8
Abbreviation		-	TP1	TP2	TP-CL 1	TP-CL 2	TA1	T-OX	TP3	TA2	T-CL
Oil absorption	Rate	22.5	20.5	15.1	19.3	18.5	21.3	20.7	23.2	23.8	24.0
	Difference from reference	-	-2.0	-7.4	-3.2	-4.0	-1.2	-1.8	1.0	1.5	1.5
Chewy texture		3.0	3.6	4.8	3.6	4.8	3.8	3.0	3.2	3.2	2.8
Soft texture		3.0	3.8	4.2	3.6	4.0	3.8	2.8	3.2	3.2	3.6
Oiliness		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.4	2.0
Oil absorption evaluation		-	Good	Excellent	Excellent	Excellent	Good	Good	Poor	Poor	Poor
Texture evaluation	Chewy texture	-	Good	Excellent	Good	Excellent	Good	Good	Good	Good	Fair
	Soft texture	-	Good	Excellent	Good	Excellent	Good	Fair	Good	Good	Good
	Oiliness	-	Good	Good	Good	Good	Good	Good	Good	Fair	Fair

[0056]

[Test 3: Evaluation of doughnut having varying content of starch in ingredient cereal flour: Examples 8 to 13 and Comparative Example 9]

[0057]

(Preparation of doughnut)

A doughnut containing soft flour alone as cereal flour (reference) and a doughnut containing X% by mass of hydroxypropyl tapioca starch with respect to the total mass of cereal flour were prepared by mixing the doughnut ingredients shown in Table 8. The wheat flour used and the amount of water added are the same as in Test 1. The amount of the starch mixed is shown in Table 9.

[0058]

[Table 8]

	Reference doughnut	Starch-containing doughnut
Hydroxypropyl tapioca starch	-	X
Wheat flour	100	100-X
White superior soft sugar	30	30
Glucose	10	10
Common salt	0.3	0.3
Vegetable fat and oil	15	15
Condensed milk	10	10
Water	25	25±a
Liquid whole egg	30	30
Baking powder	3.5	3.5

[0059]

[Table 9]

	Mass% of starch (X)	Abbreviation of formulation	Gelatinization onset temperature (°C)
Comparative Example 9	2	TP-2	54.7
Example 8	5	TP-5	54.7
Example 9	15	TP-15	54.7
Example 10	20	TP-20	54.7
Example 11	50	TP-50	54.7
Example 12	70	TP-70	54.7
Example 13	90	TP-90	54.7

[0060]

(Doughnut evaluation of Test 3)

Results of evaluating the doughnuts prepared in Test 3 are shown in Table 10. When 5% by mass or more of hydroxypropyl tapioca starch was contained with respect to the total mass of cereal flour, the oil absorption rate was decreased by 1% or more as compared with the reference.

When the content of the hydroxypropyl tapioca starch exceeded 90% by mass, doughnut shapes were easily distorted during deep-frying, though the oil absorption rate of the obtained doughnut was decreased. The content of the hydroxypropyl tapioca starch was preferably 5% to 90% because the oil absorption rate can be suppressed within a range that yields uniform shapes. The content of the hydroxypropyl tapioca starch was found to be more preferably 15% by mass to 70% by mass with respect to the total mass of ingredient cereal flour, from the viewpoint that the oil absorption rate of the doughnut can be further suppressed and chewy texture is also preferred.

[0061]

[Table 10]

	Reference	Comparative Example 9	Example 8	Example 9	Example 10	Example 11	Example 12	Example 13
Abbreviation	-	TP-2	TP-5	TP-15	TP-20	TP-50	TP-70	TP-90

		22.5	22.0	20.0	19.4	16.6	19.1	19.0	19.6
Oil absorption	Rate	22.5	22.0	20.0	19.4	16.6	19.1	19.0	19.6
	Difference from reference	-	-0.5	-2.5	-3.1	-5.9	-3.4	-3.5	-2.9
	Chewy texture	3.0	3.6	3.8	4.4	4.8	5.0	4.0	4.0
	Soft texture	3.0	3.2	3.6	4.0	4.0	3.8	3.6	2.6
	Oiliness	3.0	3.0	3.0	3.0	3.0	3.0	3.2	3.8
	Oil absorption evaluation	-	Fair	Good	Excellent	Excellent	Excellent	Excellent	Good
	Chewy texture	-	Good	Good	Excellent	Excellent	Excellent	Excellent	Excellent
	Soft texture	-	Good	Good	Excellent	Excellent	Good	Good	Fair
	Oiliness	-	Good	Good	Good	Good	Good	Good	Good

[0062]

[Test 4: Evaluation of doughnut containing modified starch other than tapioca starch: Examples 14 to 19 and Comparative Example 10]

[0063]

(Preparation of doughnut)

A doughnut containing wheat flour alone as cereal flour (reference) and a doughnut containing 20% by mass of a starch with respect to the total mass of cereal flour were prepared by mixing the doughnut ingredients shown in Table 11. The wheat flour used and the amount of water added are the same as in Test 1. The type of the starch used in the modified starch and the type of processing are shown in Table 12.

[0064]

[Table 11]

	Reference doughnut	Starch-containing doughnut
Starches	-	20
Wheat flour	100	80
White superior soft sugar	30	30
Glucose	10	10
Common salt	0.3	0.3
Vegetable fat and oil	15	15
Condensed milk	10	10
Water	25	25±α
Liquid whole egg	30	30
Baking powder	3.5	3.5

[0065]

[Table 12]

	Starting material starch	Type of processing	Degree of substitution	Degree of cross-linking	Abbreviation of starch	Gelatinization onset temperature (°C)
Example 14	Potato	PO ^{*1}	0.11	-	BP	56.6
Example 15	Potato	PO + cross-linking	0.1	9.6	BP-CL	57.6
Example 16	Potato	Acetyl	0.05	-	BA	59.2
Example 17	Potato	Oxidation	0.06	9.8	B-OX	49.4
Example 18	Waxy tapioca	PO	0.11	-	WTP	54.8
Example 19	Corn	PO	0.15	-	CP	54.6
Comparative Example 10	Waxy corn	Octenyl succinate	-	-	WCO	65.5

*1: PO = hydroxypropylation

[0066]

(Doughnut evaluation of Test 4)

Results of evaluating the doughnuts prepared in Test 4 are shown in Table 13. The oil absorption rate was also decreased in the doughnut containing a modified starch having a gelatinization onset temperature of 30°C or higher and 63°C or lower through the particular processing of potato starch, waxy tapioca starch, or corn starch, as compared with the reference. Particularly, the hydroxypropyl potato starch and the hydroxypropyl waxy tapioca starch were largely effective for decreasing absorbed oil.

[0067]

[Table 13]

		Reference	Example 14	Example 15	Example 16	Example 17	Example 18	Example 19	Comparative Example 10
Abbreviation		-	BP	BP-CL	BA	B-OX	WTP	CP	WCO
Oil absorption	Rate	22.5	16.3	21.3	20.3	21.1	17.5	18.4	22.7
	Difference from reference	-	-6.2	-1.2	-2.2	-1.4	-5.0	-4.1	0.2
Chewy texture		3.0	4.2	3.6	3.4	3.0	4.0	3.8	2.8

Soft texture	3.0	4.0	3.6	3.8	2.4	4.2	3.8	3.6
Oiliness	3.0	3.0	3.0	3.0	3.2	3.0	3.0	2.8
Oil absorption evaluation	-	Excellent	Good	Good	Good	Excellent	Excellent	Poor
Texture evaluation	Chewy texture	-	Excellent	Good	Good	Good	Excellent	Good
	Soft texture	-	Excellent	Good	Good	Fair	Excellent	Good
	Oiliness	-	Good	Good	Good	Good	Good	Fair

Industrial Applicability

[0068]

The present invention reduces oil absorption during deep-frying so as to satisfy demands from health consciousness and palatability in the production of deep-fried foods such as doughnuts, and provides doughnuts which retain the original taste and flavor of doughnuts, are conferred with soft and chewy texture, and has a reduced content of absorbed oil and excellent palatability with favorable taste and texture, and a method for producing the same.

CLAIMS

1. A method for producing doughnuts of reduced oil absorption and conferred with chewy texture, the doughnuts comprising wheat flour and starch as starchy raw material, wherein the starchy raw material consists of wheat flour and a starch and/or modified starch which gelatinization onset temperature is 49.4°C or higher and 62.6°C or lower, and wherein the starch and/or modified starch which gelatinization onset temperature is 49.4°C or higher and 62.6°C or lower is contained at 5 parts by weight or more and 90 parts by weight or less with respect to a total of 100 parts by weight of wheat flour and starch.

2. The method for producing doughnuts of reduced oil absorption and conferred with chewy texture according to claim 1, the doughnuts comprising wheat flour and starch as starchy raw material, wherein the starchy raw material consists of wheat flour and a starch and/or modified starch which gelatinization onset temperature is 49.4°C or higher and 62.6°C or lower, and wherein a content of starch and/or modified starch which gelatinization onset temperature is 49.4°C or higher and 62.6°C or lower is 15 parts by weight or more and 70 parts by weight or less with respect to a total of 100 parts by weight of wheat flour and starch.

3. The method for producing doughnuts of reduced oil absorption and conferred with chewy texture according to claim 1 or 2, wherein the starch which gelatinization onset temperature is 49.4°C or higher and 62.6°C or lower is one or more starches selected from waxy tapioca starch, hydroxypropyl starch and/or acetyl starch.

4. The method for producing doughnuts of reduced oil absorption and conferred with chewy texture according to claim 3, wherein the hydroxypropyl starch is a

hydroxypropyl tapioca starch having a degree of substitution of 0.06 or more and 0.12 or less.

5. A method for reducing oil absorption and conferring chewy texture to produced doughnuts, the doughnuts comprising wheat flour and starch as starchy raw material, wherein the starchy raw material consists of wheat flour and a starch and/or modified starch which gelatinization onset temperature is 49.4°C or higher and 62.6°C or lower, which method comprises adjusting a content of starch and/or modified starch which gelatinization onset temperature is 49.4°C or higher and 62.6°C or lower to 5 parts by weight or more and 90 parts by weight or less with respect to a total of 100 parts by weight of wheat flour and starch.

6. A doughnut of reduced oil absorption and conferred with chewy texture, produced by a method for producing doughnuts according to any one of claims 1 to 4, or a method for reducing oil absorption and conferring chewy texture to doughnuts according to claim 5.

7. A premix for producing doughnuts of reduced oil absorption and conferred with chewy texture, the premix for producing doughnuts comprising wheat flour and starch as starchy raw material, wherein the starchy raw material consists of wheat flour and a starch and/or modified starch which gelatinization onset temperature is 49.4°C or higher and 62.6°C or lower, and wherein the starch and/or modified starch which gelatinization onset temperature is 49.4°C or higher and 62.6°C or lower is mixed to be contained at 5 parts by weight or more and 90 parts by weight or less with respect to a total of 100 parts by weight of wheat flour and starch.