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(54) **Process for the production of biscuits having improved organoleptic properties**

Verfahren zur Herstellung eines Kekses mit verbesserten organoleptischen Merkmalen

Procédé pour la fabrication de biscuits ayant des propriétés organoleptiques améliorées

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DescriptionField of application

[0001] The present invention relates in general to the technical field of the food industry. More particularly, the present invention relates to a process for the production of biscuits, more particularly short dough biscuits, having improved organoleptic, textural, appearance and nutritional characteristics and to the biscuits thus obtained.

Prior art

[0002] The traditional industrial methods of production of biscuits comprise five main steps: the mixing of the ingredients of the dough, the forming of the biscuits, the baking, the cooling and, finally, the packaging.

[0003] For example, in the production of biscuits of the short dough type, the main ingredients, which comprise for example flour, fats (for example butter or vegetable oils), sugar and eggs, can be mixed in a dough-kneading machine in one or more steps, for variable lengths of times and at variable speeds. The temperature of the dough, which is normally set in the range between 18 and 23°C, is critical during this procedural step as it affects the kneading characteristics of the short dough biscuit dough obtained.

[0004] Subsequently the dough is conveyed to the forming plant, to confer to it the final shape, depending on the product which is to be obtained.

[0005] The biscuits thus formed are then sent on to the baking oven where they are subjected to a baking regime which can vary depending on the product which is to be obtained, generally of about 210°C for 10 minutes approximately and more generally between 190 and 230°C for 8-15 minutes.

[0006] In the food industry, there are various types of oven suitable for the baking of biscuits, whose heat exchange characteristics are suitable for the various types of product. Most of the ovens for biscuits use a limited circulation of air, especially in the first part of the baking where heat is conveyed mostly by radiation from heated surfaces.

[0007] Subsequently the biscuits exiting the oven are left to cool and are subsequently sent on to the packaging stations.

[0008] With these methods, conventional and good-quality short dough biscuits, for example, are obtained which have generally, a lipids content, in weight per total weight, comprised between 17 and 25%, a dietary fibre content below 2%, and a simple sugars content comprised between 18 and 25%, like most short dough biscuits currently found on the market.

[0009] As in many other sectors of the food industry there is however, also in the sector of bakery products, the desire to make available biscuits, in particular short dough biscuits, having improved organoleptic and nutritional properties and having a more genuine taste. For example, there is the desire and the need to make available biscuits which maintain as much as possible undamaged the nutritional properties, the taste and the colours of the raw materials used.

[0010] Additionally there is the need to make available biscuits having an increased dietary fibre content. At the same time, there is also the need to make available biscuits having a reduced lipids content. A reduction in the biscuits of the simple sugars content is also desirable.

[0011] Dietary fibre, both soluble and insoluble, is known, in fact, for being associated with beneficial effects on health. Soluble fibre is associated with the lowering of the blood cholesterol levels and in the risk of cardiovascular diseases, and with the lowering of glycaemia. Insoluble fibre reduces faecal intestinal transit time and contributes towards the modulation of the intestinal flora.

[0012] An excessive consumption of lipids, however, particularly of those deriving from saturated animal fats, such as for example butter, or of polyunsaturated vegetable fats subjected to hydrogenation treatments, such as for example in the production of certain margarines, is known for being associated with an increased risk of cardiovascular diseases and/or for the fact of having a negative effect on health.

[0013] Simple sugars, also, affect the calorific value of the finished product and are an important source of readily available energy. An excessive consumption of sugars, however, is known to be associated with an increased risk of obesity and diabetes.

[0014] It has, however, been found that the use of traditional baking methods, for the preparation of biscuits, in particular short dough biscuits, starting from a dough having a high dietary fibre content and/or low lipids and/or simple sugars content produces short dough biscuits having poor or even unacceptable organoleptic properties. The biscuits thus obtained, in fact, are generally too dense and hard to the bite, the texture is coarse and sandy and the taste unpleasant.

[0015] The technology of heat treatment by impingement is used in many sectors of the food industry to surpass in intensity what can be achieved with normal convective heat exchange. The impingement treatment consists in generating in the oven high speed gas jets, directed straight onto the product to be treated.

[0016] The impingement treatment is successfully used also for bakery products but normally not in the baking of biscuits, as it leads, in normal humidity conditions of the baking air, to an unsatisfactory baking of these latter, with poor development and a closed and hardly crumbly structure.

[0017] A thermal process already used in other industrial sectors is the technology known as *superheated steam*

drying (SHSD). This technique uses for drying processes steam at a temperature higher than boiling point (100°C at ambient pressure). The process has also been proposed at a pressure different from ambient pressure (pressurised or vacuum, and therefore referred to boiling points higher or lower than 100°C).

[0018] In the area of bakery products, the feeding of steam (normally saturated and not superheated) into the baking chamber is rarely used and, in those cases, it is intended either for heating only or for condensation on the surface of the product to achieve a glazed (gelatinised) surface, it not contemplating a systematic, prolonged in time and continuous treatment with superheated steam in order to achieve baking proper.

[0019] Impingement technology, like the use of superheated steam (at $T > 100^{\circ}\text{C}$), is the subject-matter of a certain number of patents.

[0020] Examples of patents and patent applications of this type are US 4,965,435 (Smith et al.), US 6,146,678 (Caridis et al.), US 6,572,911 (Corcoran et al.), US 5,786,566 (Miller et al.), US 5,560,952 (Miller et al.), US 4,701,340 (Bratton et al.) and JP 2000236798 (Manabu et al.). None of these patents relate to the production of biscuits.

[0021] For example, patent US 6,146,678 (Caridis et al.) describes an oven for the baking of food products by *impingement* of a process vapour on the food products. The vapour has a temperature comprised between 260 and 540°F (which corresponds to a range between 127 and 282°C) for 0.8 to 44 minutes. Foodstuffs suitable for this treatment include sausages, chicken, beef, meatballs, tortillas and bread slices for toasting.

[0022] Patent US 6,572,911 (Corcoran et al.) describes an oven for heating and cooking food products, more particularly bakery products. The invention, in particular, is aimed at the baking of bakery products having a dense and soft texture and having a glazed exterior surface. Examples of such products are bagels, soft pretzels, French bread, rye bread and other leavened products.

[0023] US patent application No. 2003/0217645 (Jones et al.) relates to a conveyORIZED oven which comprises a conveyor system for conveying a food product between an entry port and an exit port; an *impingement* device positioned between the entry port and the exit port and arranged in such a way as to direct jets of air towards the food product; and a fan blower, a heater and a moisture delivery device to obtain in the *impingement* device a heated and moisture laden airflow such that these jets of air are at a high temperature and laden with moisture, thereby producing a mixture of air and moisture at the surface of the food product. One application of this oven is for example in the heating of a pizza.

[0024] Patent US 4,965,435 (Smith et al.) relates to a tunnel oven which comprises a cooking compartment through which the food to be cooked is conveyed on a conveyor which is spaced from the front wall of the cooking compartment to provide an air return route and to provide a walkway to facilitate cleaning and maintenance of the oven. A blower discharges air drawn from the cooking compartment into an air distribution chamber formed in an upper portion of the cooking chamber and spaced from the conveyor. A pair of plenums in the cabinet adjacent one edge of the conveyor deliver air from the distribution chamber to a plurality of air dispensing ducts communicating with the plenums on opposite sides of the conveyor. Japanese patent application JP 2000236798 (Manabu et al.) describes a method for the production of a product baked in the oven using superheated steam wherein the concentration of oxygen inside the baking chamber is comprised between 3 and 15%. By using this method products are obtained having a moist, soft and elastic texture, which cannot be obtained by cooking methods of the prior art. The products mentioned as suitable for this type of cooking include sponge cake, chicken, fish, etc.

[0025] A lemon shortbread is available commercially wherein a serving of 1 oz contains 6.00 g of fat, 0.50 g of dietary fibre and 5.00 g of sugars.

[0026] The website <http://www.ciia-c.com/francais/Docs/Process/biscuits%20patisseries%20pizzas.pdf> refers to a process for making biscuits which involves the steps of mixing the ingredients to make a dough, forming semi-finished products, baking, cooling and packaging. The article "Cake baking in conventional, impingement and hybrid ovens" (Li, A. and Walker, C. E.), Journal of Food Science, 61, 1, 1996, 188-191 describes the use of impingement and hybrid ovens in the manufacture of cakes. Biscuits are not described.

[0027] The article "Impingement drying of foods using hot air and superheated steam (Moreira, R.G.), Journal of Food Engineering, 49 (2001) 291-295 describes the use of impingement drying in potato and tortilla chips.

[0028] There exist on the market cookies called Göterborgs Brago Bokstavskek which contain 19% sugar, 12% fat and 13% fibre.

[0029] Short dough biscuits and biscuits in general are very dry foods, having a low moisture content, generally lower than 5% (A_w of about 0.3). In line with what is described above there is therefore, in the prior art, no mention of the successful application of this technology specifically for the production of biscuits, and more particularly of short dough biscuits.

[0030] The technical problem of the present invention is therefore that of making available a simple and economical process for the production of biscuits, in particular short dough biscuits, having improved organoleptic, textural and nutritional properties, more particularly for the production of a biscuit which, compared to a traditional biscuit, maintains to a greater extent the nutritional properties and the taste of BRL273BEP the ingredients used, having at the same time excellent organoleptic properties, such as for example crumbliness, texture and taste.

[0031] More particularly, the technical problem of the present invention is that of making available a simple and

economical process for the production of biscuits, in particular short dough biscuits, having a dietary fibre content higher than the typical values for traditional biscuits (usually not higher than 2% in weight per total weight), and/or having a lipids content lower than the typical values for conventional biscuits (usually not lower than about 17% in weight per total weight), and/or having a simple sugars content lower than the typical values for conventional biscuits (usually not lower than about 20% in weight per total weight), and having at the same time excellent organoleptic properties, such as for example crumbliness, texture, and taste.

Summary of the invention

[0032] Such a problem has been solved by a process for the production of biscuits, comprising, in weight per total weight, a dietary fibre content comprised between 10 and 25%, a lipids content comprised between 10 and 20% and a simple sugars content comprised between 12 and 22% and having a value for specific volume of 2.0-3.5 dm³/kg, characterised in that it comprises the steps of:

- a) mixing the ingredients of a biscuit dough;
- b) forming the biscuit dough to form semi-finished products;
- c) baking the semi-finished products formed from such dough, thus obtaining biscuits;
- d) cooling the biscuits obtained; and
- e) packaging the biscuits;

wherein step c) of baking such semi-finished products comprises a step of exposure thereof to a hot gas consisting of hot air and superheated steam, blown directly on such semi-finished products by means of an impingement system.

[0033] Preferably, the hot gas consisting of hot air and superheated steam has a temperature comprised between 150 and 190°C, preferably between 160 and 175°C.

[0034] The step of exposure to the hot gas consisting of hot air and superheated steam is carried out for the time necessary for achieving the baking of the biscuits, preferably for a time comprised between 4 and 12 minutes, more preferably between 5 and 10 minutes.

[0035] Preferably, such hot gas consisting of hot air and superheated steam has a content of superheated steam comprised between 60 and 99% (in volume per volume), preferably 80%, corresponding to a dew point of between 86 and 99.75°C. The process is preferably carried out at atmospheric pressure.

[0036] In a preferred embodiment, such hot gas is blown by a blowing system comprising a plurality of nozzles positioned at a distance from 4 to 15 cm, preferably from 6 to 12 cm, more preferably from 8 to 10 cm from the baking surface whereupon are positioned the semi-finished products formed from the dough.

[0037] The hot gas is preferably directed towards the abovementioned semi-finished products at a speed between 2 and 12 m/s, preferably between 4 and 10 m/s, more preferably between 6 and 8 m/s.

[0038] Advantageously the hot gas is continuously recirculated, dosed upon entry in the baking chamber and with temperature and moisture content set according to the requirements dictated by the product that is to be obtained.

[0039] In one aspect of the present invention the process produces a biscuit having a dietary fibre content of between 15 and 25%, preferably between 20 and 25%, even more preferably about 25% in weight per total weight.

[0040] Independently of the above-mentioned contents of dietary fibre or in association therewith, the biscuit obtained from the process according to the invention has preferably, in weight per total weight, a lipids content comprised between 12 and 18%, preferably about 15%.

[0041] Independently of the above-mentioned values of the content of dietary fibre and/or lipids or in association therewith, the biscuit obtained with the process according to the invention preferably has a simple sugars content of about 15% in weight per total weight.

[0042] The biscuit obtained with the process according to the method of the invention preferably comprises between 10 and 30%, more preferably between 20 and 30%, even more preferably between 25 and 30% in weight per total weight of dried fruit or pieces of chocolate.

[0043] In the context of the present invention, by "short dough biscuit" and "biscuit of the short dough type" is meant a biscuit which has the dough kneading characteristics, when raw, of a shortcrust pastry dough and a high crumbliness when consumed.

[0044] The present invention also relates to a biscuit obtained from the process of any one of claims 1 to 11.

Brief description of the drawings

[0045]

Figure 1 is a comparison diagram showing the temperature profile in the baking oven of a biscuit of Example 1 prepared according to the traditional process and according to the process of the present invention.

Figure 2 is a diagram which shows a comparison of the sensory evaluation profiles of the biscuits of Example 1 prepared according to the traditional process (unbroken line) and the process of the present invention (dotted line).

Figure 3 is a comparison photograph showing the appearance and volume of the biscuits of Example 1 prepared according to the traditional process and according to the process of the present invention.

Figure 4 is a comparison of the appearance and volume between photographs of the biscuits of Example 2 prepared according to the traditional process and according to the process of the present invention.

Figure 5 is a diagram which shows a comparison of the sensory evaluation profiles of the biscuits of Example 2 prepared according to the traditional process (unbroken line) and according to the process of the present invention (dotted line).

Figure 6 is a comparison of the appearance and volume between photographs of the biscuits of Example 3 prepared according to the traditional process and according to the process of the present invention.

Figure 7 is a diagram which shows a comparison of the sensory evaluation profiles of the biscuits of Example 3 prepared according to the traditional process (unbroken line) and according to the process of the present invention (dotted line).

Figure 8 is a comparison of the appearance and volume between photographs of the biscuits of Example 4 prepared according to the traditional process and according to the process of the present invention.

Figure 9 is a diagram which shows a comparison of the sensory evaluation profiles of the biscuits of Example 4 prepared according to the traditional process (unbroken line) and according to the process of the present invention (dotted line).

Figure 10 is a comparison of the appearance and volume between photographs of the biscuits of Example 5 prepared according to the traditional process and according to the process of the present invention.

Figure 11 is a diagram which shows a comparison of the sensory evaluation profiles of the biscuits of Example 5 prepared according to the traditional process (unbroken line) and according to the process of the present invention (dotted line).

Figure 12 is a comparison diagram showing the specific volume for the biscuits of Examples 2, 4 and 5, prepared according to the traditional process and according to the process of the present invention.

Detailed description of the invention

[0046] The present invention relates to a process for the production of biscuits, characterised in that it comprises the steps of:

- a) mixing the ingredients of a biscuit dough;
- b) forming the biscuit dough to form semi-finished products;
- c) baking the semi-finished products formed from such dough, thus obtaining biscuits;
- d) cooling the biscuits obtained; and
- e) packaging the biscuits;

wherein the step c) of baking such semi-finished products comprises a step of exposure thereof to a hot gas consisting of hot air and superheated steam, blown directly on such semi-finished products by means of an impingement system.

[0047] The biscuit dough may comprise a grain flour, chosen from the group consisting of: type 0 wheat flour, type 00 wheat flour, barley flour, oat flour, rye flour, rice flour, spelt flour, kamut flour, corn flour and mixtures thereof.

[0048] Moreover, according to one embodiment, such grain flour may be wholemeal.

[0049] Moreover, the biscuit dough may comprise a starch chosen from the group consisting of: wheat starch, barley starch, oat starch, rye starch, rice starch, spelt starch, kamut starch, corn starch, potato starch, tapioca starch and mixtures thereof.

[0050] The biscuit dough may, moreover, comprise a sweetening agent chosen from the group consisting of: powdered sugar, cane sugar, icing sugar, glucose syrups with varying content of simple sugars, honey and mixtures thereof.

[0051] Moreover, the biscuit dough may comprise one or more grains chosen from the group consisting of: wheat, barley, oat, rye, rice, spelt, kamut, corn and mixtures thereof, wherein such one or more cereals are subjected to a treatment chosen from among extrusion, puffing, caramelisation and any treatment useful for stabilising the structure and prolonging the conservation thereof.

[0052] The biscuit dough, moreover, may comprise a fat or an oil chosen from the group consisting of: animal fats, vegetable fats, vegetable oils and mixtures thereof

[0053] The biscuit dough may also comprise milk or dairy products chosen from the group consisting of: liquid or powder whole milk, liquid or powder skimmed milk, condensed milk, sweetened condensed milk, yogurt, cream and mixtures thereof

[0054] The biscuit dough may also comprise a dietary fibre chosen from the group consisting of: vegetable soluble dietary fibre, legume soluble dietary fibre, cereal grain soluble dietary fibre (such as for example oat beta glucans), cereal grain insoluble dietary fibre and mixtures thereof.

[0055] Moreover, the biscuit dough may comprise an additional ingredient chosen from the group consisting of: eggs and derivatives, raising agents, water, salt, lecithin of varying origin, preferably from soy or sunflower, dried fruit, nuts and grains, for example almonds, hazelnuts and the like, in pieces or powdered, cocoa powder, for example low fat content, chocolate flakes, chips or drops, flavourings.

[0056] The step of mixing the ingredients is carried out according to traditional methods, preferably at the temperature of 18-25°C.

[0057] Subsequently the dough is subjected to a forming step by means of cutting or moulds or by extrusion, depending on the product to be obtained, according to methods well known in the industry.

[0058] The baking step is performed by the methods described above.

[0059] It has been found that, by suitably adjusting the content of superheated steam in the hot gas, it is possible to obtain a hot gas having a moisture content value such that the suitable conditions are created for the baking of biscuits even at lower temperatures and in shorter times compared to those normally used in traditional methods of biscuit baking. By controlling the content of the superheated steam in the hot gas within the values given above, the conditions are obtained whereby the dew point is between 86 and 100°C.

[0060] It was also surprisingly noted that, by operating in the conditions mentioned above, in addition to obtaining a reduction in the times of baking, biscuits were obtained which also exhibited peculiar and improved organoleptic and nutritional properties and having a homemade appearance.

[0061] By virtue of the fact that, as mentioned above, the temperatures and the times of baking according to the process of the invention are considerably reduced compared to those usually adopted in traditional baking methods, the biscuits obtained, in addition to having excellent organoleptic qualities, will maintain to a greater extent, compared to traditional biscuits, the nutritional properties, for example vitamins and proteins, of the raw materials used and the taste will be more genuine and fresher.

[0062] In the case, for example, where there is inclusion of fruit, its texture will not be dried up, but chewy, and it will retain a fresher taste compared to that included in traditional biscuits.

[0063] The biscuit, following baking, is then subjected to a cooling step at room temperature in conditions of natural ventilation and is then sent on to the packaging machines according to standard techniques well known in the art.

[0064] The biscuit obtained by means of the process of the present invention has a typical moisture content for a biscuit (5% maximum) and therefore enjoys the same shelf-life of a traditional biscuit.

[0065] The present invention also refers to the biscuit obtained directly by the process of the present invention.

[0066] The biscuits which are obtained by the process of the present invention, by virtue of the conditions to which they are subjected, are greater in size compared to the corresponding biscuits obtained by traditional methods. In fact, the biscuits of the invention exhibit an increase in the specific volume, with the surface exhibiting many cracks, and a greater crumbliness.

[0067] These data are confirmed by measurements of the density (or of specific volume) and texture profile (sensory analysis profile).

[0068] As seen above, the biscuit according to the present invention has a specific volume comprised between 2.0

and 3.5 dm³/kg. These values represent an increase in the specific volume value of between about 12 and 200% compared to the value for a traditional biscuit, more particularly short dough biscuit. This result is considered particularly surprising, particularly as regards high fibre content biscuits, more particularly short dough biscuits.

[0069] Advantageously, in some of the embodiments (see Example 4) such biscuit has a calorie content lower than 400 Kcal/100g, preferably about 390 Kcal/100g, even more preferably about 380 Kcal/ 100g.

[0070] A plant for the continuous production of a biscuit according to the process described above comprises typically:

a) a baking chamber;

b) conveyor means for conveying the incoming semi-finished products, for supporting them during baking and while exiting the baking chamber;

c) means for adjusting the temperature and the content of steam of such hot gas;

d) means for *impingement* of a hot gas in the baking chamber.

[0071] The baking chamber consists of a chamber suitable for the baking of biscuits, for example an *impingement* tunnel oven, having an entrance,

an exit, conveyor means for conveying the semi-finished products and the biscuits which pass through this chamber between the entrance and the exit, and means of *impingement* of a hot gas directed towards the conveyor means.

[0072] The conveyor means may be in the form, for example, of a conveyor belt which has the function of conveying the semi-finished products formed from the dough towards the entrance of the baking chamber and, subsequently, the biscuits exiting the baking chamber. Such conveyor belt may have a continuous metal band structure, a wire net structure of varying mesh size or transport the products to be baked in appropriate housings, optionally shaped.

[0073] The baking oven includes specific means for the measurement and accurate and continuous adjustment both of the temperature and of the moisture content.

[0074] The *impingement* means may be, for example, in the form of nozzles suitable for directing one or more dosed jets of hot gas at a speed of 2-12 m/s, preferably 4-10 m/s, even more preferably 6-8 m/s from a distance from the conveyor means of 4-15 cm, preferably 6-12 cm, more preferably 8-10 cm. This speed and this distance can be adjusted according to the product to be obtained.

[0075] Such nozzles are adequately positioned both above and below the conveyor belt, thus allowing heating also of the conveyor belt. More particularly the speed of impingement of the hot gas may be adjusted to an appropriate intensity and optionally different above and below the conveyor system.

[0076] According to a preferred embodiment of the present invention, the conveyor belt is made to advance at a distance of 0.08 m from the hot gas *impingement* nozzles. In this way the semi-finished products formed from the dough are exposed to the jets of hot gas set at a jet speed of 7 m/s at the temperature of 170°C for a total time of 5 minutes before the biscuits obtained from them are conveyed out of the baking chamber.

[0077] The baking chamber comprises, moreover, one or more ports of suction of the hot gas in order to allow recirculation thereof to the heating means and once again into the baking chamber at the required humidity and temperature.

[0078] The present invention will be further described with reference to the non-limiting and illustrative examples given herein below.

EXAMPLE 1

Biscuit of conventional formulation for short dough biscuit:

[0079] A biscuit dough was prepared according to a recipe for traditional short dough biscuits, as follows (Table 1) :

Table 1 -Traditional short dough biscuits recipe

Ingredients	% (in weight per total weight)
Type 0 flour	56.00
Sugar	17.55
Vegetable fats (palm oil)	14.00
Salt	0.30
Raising agents	0.35

(continued)

Ingredients	% (in weight per total weight)
Water	6.80
Eggs	5.00
Total	100.00

[0080] The ingredients of the short dough biscuit were kneaded according to traditional kneading methods in a planetary mixer with a mixing tool of the blade type, with the mixing of sugar and fat of the basic recipe until a homogenous mixture was obtained, completed with the addition, in subsequent steps, of the remaining ingredients.

[0081] The dough structured in this way was then formed into the final shape with rotary type systems.

[0082] The short dough biscuit thus formed was then subjected, in one case, to traditional baking and, in the other case, to baking according to the process of the present invention, in order to compare the results obtained with the two baking procedures.

[0083] The operating parameters of the oven in the two processes can be summarised as follows (Table 2):

Table 2: Operating parameters of the oven

Parameter	Traditional process	Process of the invention
Temperature	200	170°C
Time	9 min	5 min
Impingement speed	N/A	8 m/s
Distance of the short dough biscuit from the impingement source	N/A	80 mm
Percentage of steam in the hot gas	< 10% on average	80%

[0084] The final short dough biscuit, therefore, had the following percentage proportions of lipids, dietary fibre and simple sugars (Table 3).

Table 3: Percentage proportions of lipids, dietary fibre and simple sugars in the final short dough biscuit

Component:	% (in weight per total weight)
Lipids	18
Dietary fibre	2
Simple sugars	20

[0085] The short dough biscuit which was obtained from the process of the invention had different dimensions and appearance compared to the short dough biscuit obtained by a traditional process (see Figure 1, which summarises the temperature profiles during baking for the two processes, where it is shown that traditional baking is associated to a higher temperature profile compared to the process of the invention and, despite this, a reduction in the baking time in this latter case).

[0086] More particularly an increase in the specific volume (see Figure 12) was observed, accompanied by a surface appearance showing many cracks, with different protrusion patterns and contours (see Figure 3).

[0087] These variations find correspondence also in the structural variations which can be perceived upon tasting, more particularly a greater crumbliness.

[0088] These data are also confirmed by instrumental tests such as the measuring of the density and by the sensory evaluation profile obtained from a sensory analysis performed by a panel of experts (see Figure 2).

EXAMPLES 2-5

[0089] Doughs were prepared for the following biscuits according to the recipes of Table 4 below:

Example 2: Low-calorie biscuit obtained by the reduction of the lipids content;

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Example 3: Biscuit having increased dietary fibre content;

Example 4: Biscuit having a high dietary fibre content and a reduced lipids and simple sugars content; and

Example 5: Biscuit having an increased dietary fibre content and a reduced lipids and simple sugars content.

Table 4: Recipes of the biscuits of Examples 2-5

Example number:	2	3	4	5
Ingredients	% (in weight per total weight)	% (in weight per total weight)	% (in weight per total weight)	% (in weight per total weight)
Type 0 flour	63.00	17.00		
Wholemeal flour		7.00	27.00	38.7
Sugar	14.00	13.00	13.00	13.00
Fats and/or vegetable oils	5.80	16.70	11.00	12.00
Glucose syrup	4.00	2.00	2.00	4.00
Lecithin	1.00			
Eggs				7.60
Milk		5.00	5.00	
Powder skimmed milk		4.50	4.50	4.50
Powder skimmed milk				8.00
Water	11.00			
Dried fruit		2.70		
Milled almond		5.00		
Oat flakes			8.00	
Salt	0.20	0.30	0.20	0.20
Raising agents	1.00	0.80	0.80	1.80
Soluble dietary fibre		6.50	6.50	10.00
Insoluble dietary fibre		19.50	22.00	
Flavourings				0.20
Total	100	100	100	100

[0090] The ingredients of the biscuits of each example were kneaded according to traditional kneading methods in a planetary mixer with mixing tool of the mixing blade type, with the mixing of sugar and fat of the basic recipe until a homogenous mixture was obtained, completed with the addition, in subsequent steps, of the remaining ingredients.

[0091] The doughs structured in this way were then formed into the final shape with rotary type systems and placed on the oven conveyor belt.

[0092] The biscuits of each example thus formed were then subjected, in one case, to traditional baking and, in the other case, to baking according to the process of the present invention, in order to compare the results obtained with

the two baking procedures.

[0093] The operating parameters of the oven can be summarised as follows (Table 5):

Table 5: Operating parameters of the oven

	Traditional process	Process of the invention			
Example number		2	3	4	5
Parameters					
Temperature	200	170°C	170°C	170°C	170°C
Time	9 min	5 min	7 min	5 min	6 min
Impingement speed	N/A	5.5 m/s	7.0 m/s	8.0 m/s	7.0 m/s
Distance of the biscuit from the impingement source	N/A	80 mm	80 mm	80 mm	80 mm
Percentage of steam in the hot gas	<10% on average	80%	70%	70%	70%

[0094] The final biscuits had, therefore, the following percentage proportions of lipids, dietary fibre and simple sugars (Table 6).

Table 6: Percentage proportions of lipids, dietary fibre and simple sugars in the final biscuits

Example number	2	3	4	5
Component:	% (in% weight per total weight)	% (in weight per total weight)	% (in weight per total weight)	% (in weight per total weight)
Lipids	10	18	14	14
Dietary fibre	3	25	25	11
Simple sugars	20	20	15	14
Calorie content			390 kcal/100 g	
Specific volume				3.5 dm ³ /kg

[0095] The traditional baking of biscuits having low lipids content (Example 2) gives them closed structures and hardness at the bite, in addition to difficulty in swallowing. With the process of the present invention open structures are generated which maintain a crumbliness comparable to conventional biscuits, a cracked appearance (see Figures 4 and 5) and an increase in the size, also shown by the measurements of the specific volume (see Figure 12).

[0096] The formulation of the biscuits of Example 3, relating to high dietary fibre content biscuits, when subjected to traditional baking produces biscuits with closed structure which are hard to the bite and with a very sandy structure, hardly acceptable organoleptically. The baking according to the process of the invention gives the product a cracked and open surface (see Figure 6), a crumbly and open structure and therefore improved from the organoleptic point of view, and improvements also in the taste, which is fuller and of greater intensity, as shown by the sensory evaluation profile shown in Figure 7.

[0097] The final biscuit of Example 4, having a low lipids and simple sugars content and a high fibre content, kneaded according to the method of the invention, has a cracked surface (see Figure 8), a greater specific volume (see Figure 12), an open structure and a high crumbliness, characteristics which are completely different from the corresponding biscuit baked according to the traditional method, which is instead hard to the bite, with closed structure and low crumbliness (see also the sensory evaluation profile shown in Figure 9).

[0098] The final biscuit of Example 5, having a low lipids and simple sugars content and an increased fibre content, manufactured according to the method of the invention, has a cracked surface (see Figure 10), higher specific volume (see Figure 12), an open structure and high crumbliness, also shown by the sensory profile produced by a panel of experts where it was found in particular that the chewability and breakability increase compared to the traditionally prepared counterpart (see Figure 11).

[0099] Thanks to the technology of the present invention, therefore, it is possible to obtain excellent results from the organoleptic point of view from doughs having a composition significantly richer in dietary fibre compared to a traditional biscuit dough, and from a dough lower in lipids and from a dough having reduced simple sugars content.

[0100] The advantages of this technique lie also in the fact of requiring less energy compared to conventional methods of baking and of allowing the production of improved foods from the organoleptic and nutritional point of view.

[0101] In fact, since the baking according to this process takes place with reduced concentration of oxygen in the chamber, the oxidation reactions are limited. This characteristic, in association with the fact that the temperatures and the times of baking are reduced, allows biscuits to be obtained which have an improved nutritional profile, wherein the vitamins, the proteins and the lipids of the raw materials are maintained undamaged. Moreover the taste will be more genuine and the texture more pleasant.

[0102] Finally, the process of the present invention is simple and economical to carry out because the superheated steam can be recycled from the baking chamber, heated again and reused, with considerable energy saving. This technique is also suitable for being integrated easily in already existing systems of continuous production of biscuits.

Claims

1. Process for the production of biscuits, comprising, in weight per total weight, a dietary fibre content comprised between 10 and 25%, a lipids content comprised between 10 and 20% and a simple sugars content comprised between 12 and 22% and having a value for specific volume of 2.0 - 3.5 dm³/kg, **characterised in that** it comprises the steps of:

- a) mixing the ingredients of a biscuit dough;
- b) forming said biscuit dough to form semi-finished products;
- c) baking the semi-finished products formed from said dough, thus obtaining biscuits;
- d) cooling the biscuits obtained; and
- e) packaging said biscuits;

wherein the step c) of baking said semi-finished products comprises a step of exposure thereof to a hot gas consisting of hot air and superheated steam, blown directly on said semi-finished products by means of an impingement system.

2. Process of claim 1, wherein said hot gas consisting of hot air and superheated steam has a temperature comprised between 150 and 190°C, preferably between 160 and 175°C.

3. Process according to claim 1 or 2, wherein said step of exposure to said hot gas consisting of hot air and superheated steam is carried out for the time necessary for achieving the baking of the biscuits, preferably for a time comprised between 4 and 12 minutes, more preferably between 5 and 10 minutes.

4. Process according to any one of the previous claims, wherein said hot gas consisting of hot air and superheated steam has a content of superheated steam, in volume per total volume, comprised between 60% and 99%, preferably 80%.

5. Process according to any one of the previous claims, wherein said process is carried out at atmospheric pressure.

6. Process according to any one of the previous claims, wherein said hot gas is blown by a blowing system comprising a plurality of nozzles positioned at a distance from 4 to 15 cm, preferably from 6 to 12 cm, more preferably from 8 to 10 cm from the baking surface whereupon said semi-finished products formed from the dough are positioned.

7. Process according to claim 6, wherein said hot gas is directed towards said semi-finished products at a speed comprised between 2 and 12 m/s, preferably between 4 and 10 m/s, more preferably between 6 and 8 m/s.

8. Process according to any one of the previous claims, wherein said process produces a biscuit having a dietary fibre content comprised between 15 and 25%, more preferably between 20 and 25%, even more preferably about 25% in weight per total weight.

9. Process according to claim any one of claims 1 to 7, wherein said process produces a biscuit having a lipids content comprised between 12 and 18%, preferably about 15% in weight per total weight.

10. Process according to claim any one of claims 1 to 7, wherein said process produces a biscuit having a simple sugars content of about 15% in weight per total weight.

11. Process according to any one of the previous claims, wherein said process produces a biscuit which comprises between 10 and 30%, preferably between 20 and 30%, more preferably between 25 and 30% in weight per total weight of dried fruit or pieces of chocolate.

5 12. Biscuit obtained from the process of any one of claims 1 to 11.

Patentansprüche

10 1. Verfahren zur Herstellung von Keksen, umfassend, in Gewicht pro Gesamtgewicht, einen Ballaststoffgehalt beinhaltend zwischen 10 und 25%, einen Fettanteil beinhaltend zwischen 10 und 20% und einen Einfachzuckergehalt umfassend zwischen 12 und 22% und welcher einen Wert für ein spezifisches Volumen von 2,0 - 3,5 dm³/kg aufweist, **dadurch gekennzeichnet, dass** es die folgenden Schritte umfasst:

- 15 a) Vermischen der Zutaten eines Keksteiges;
b) Formen des Keksteiges, um halbfertige Produkte zu bilden;
c) Backen der halbfertigen Produkte, welche aus dem Teig geformt wurden, um Kekse zu erhalten;
d) Kühlen der erhaltenen Kekse; und
e) Verpacken der Kekse;

20 wobei der Schritt c) des Backens der halbfertigen Produkte einen Schritt umfasst, in welchem diese einem heißen Gas ausgesetzt werden, bestehend aus Heißluft und Heißdampf, ausgesetzt werden welches direkt auf die halbfertigen Produkten mittels eines Aufblasesystems geblasen wird.

25 2. Verfahren nach Anspruch 1, wobei das heiße Gas, welches aus Heißluft und Heißdampf besteht, eine Temperatur beinhaltend zwischen 150 und 190 °C, bevorzugt zwischen 160 und 175 °C aufweist.

30 3. Verfahren nach Anspruch 1 oder 2, wobei der Schritt des dem heißen Gas Aussetzens, welches aus Heißluft und Heißdampf besteht, für eine notwendige Zeit durchgeführt wird, um das Backen der Kekse zu erreichen, bevorzugt für eine Zeit beinhaltend zwischen 4 und 12 Minuten, bevorzugter zwischen 5 und 10 Minuten.

35 4. Verfahren nach einem der vorhergehenden Ansprüche, wobei das heiße Gas, welches aus Heißluft und Heißdampf besteht, einen Gehalt an Heißdampf aufweist, in Volumen pro Gesamtvolumen, beinhaltend zwischen 60% und 99%, bevorzugt 80%.

5. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Verfahren bei Atmosphärendruck durchgeführt wird.

40 6. Verfahren nach einem der vorhergehenden Ansprüche, wobei das heiße Gas durch ein Blassystem geblasen wird, welches eine Vielzahl von Düsen umfasst, die in einem Abstand von 4 bis 15 cm, bevorzugt von 6 bis 12 cm, bevorzugter von 8 bis 10 cm von der Backoberfläche angeordnet sind, auf welcher die halbfertigen Produkte, die aus dem Teig geformt wurden, angeordnet sind.

45 7. Verfahren nach Anspruch 6, wobei das heiße Gas in Richtung der halbfertigen Produkte gerichtet ist mit einer Geschwindigkeit beinhaltend zwischen 2 und 12 m/s, bevorzugt zwischen 4 und 10 m/s, bevorzugter zwischen 6 und 8 m/s.

50 8. Verfahren nach eine der vorhergehenden Ansprüche, wobei das Verfahren einen Keks herstellt, welcher einen Ballaststoffgehalt beinhaltend zwischen 15 und 25%, bevorzugter zwischen 20 und 25%, und noch bevorzugter ungefähr 25% in Gewicht pro Gesamtgewicht aufweist.

9. Verfahren nach einem der Ansprüche 1 bis 7, wobei das Verfahren einen Keks herstellt, welcher einen Fettgehalt beinhaltend zwischen 12 und 18%, bevorzugt etwa 15% in Gewicht pro Gesamtgewicht aufweist.

55 10. Verfahren nach einem der Ansprüche 1 bis 7, wobei das Verfahren einen Keks herstellt, welcher einen Einfachzuckergehalt von etwa 15% in Gewicht pro Gesamtgewicht aufweist.

11. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Verfahren einen Keks herstellt, welcher zwischen

10 und 30%, bevorzugt zwischen 20 und 30%, mehr bevorzugt zwischen 25 und 30% in Gewicht pro Gesamtgewicht von Trockenfrüchten oder Schokoladenstücken aufweist.

12. Keks, welcher durch das Verfahren nach einem der Ansprüche 1 bis 11 erhalten wurde.

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Revendications

1. Procédé destiné à produire des biscuits, comprenant, en poids par poids total, une teneur en fibres alimentaires comprise entre 10 % et 25 %, une teneur en lipides comprise entre 10% et 20 %, et une teneur en glucides simples comprise entre 12 % et 22 %, et qui présente une valeur de volume spécifique comprise entre 2,0 dm³/kg et 3,5 dm³/kg, **caractérisé en ce qu'il** comprend les étapes consistant à :
 - a) mélanger les ingrédients d'une pâte à biscuits ;
 - b) former ladite pâte à biscuits de façon à former des produits semi-finis ;
 - c) cuire les produits semi-finis formés à partir de ladite pâte, en obtenant de ce fait des biscuits ;
 - d) refroidir les biscuits obtenus ; et
 - e) emballer lesdits biscuits ;
- dans lequel l'étape c) consistant à cuire lesdits produits semi-finis, comprend une étape consistant à les exposer à un gaz chaud qui se compose d'air chaud et de vapeur surchauffée, soufflé directement sur lesdits produits semi-finis au moyen d'un système par contact.
2. Procédé selon la revendication 1, dans lequel ledit gaz chaud qui se compose d'air chaud et de vapeur surchauffée, présente une température qui se situe entre 150 °C et 190 °C, de préférence entre 160 °C et 175 °C.
3. Procédé selon la revendication 1 ou la revendication 2, dans lequel ladite l'étape d'exposition audit gaz chaud qui se compose d'air chaud et de vapeur surchauffée, est exécutée pendant le temps qu'il faut de façon à procéder à la cuisson des biscuits, de préférence avec une durée comprise entre 4 mn et 12 mn, de préférence entre 5 mn et 10 mn.
4. Procédé selon l'une quelconque des revendications précédentes, dans lequel le gaz chaud qui se compose d'air chaud et de vapeur surchauffée présente une teneur en vapeur surchauffée, en volume par volume total, comprise entre 60 % et 99 %, de préférence égale à 80 %.
5. Procédé selon l'une quelconque des revendications précédentes, dans lequel ledit procédé est exécuté à la pression atmosphérique.
6. Procédé selon l'une quelconque des revendications précédentes, dans lequel ledit gaz chaud est soufflé par un système de soufflerie qui comprend une pluralité de buses disposées à une distance comprise entre 4 cm et 15 cm, de préférence entre 6 cm et 12 cm, mieux encore entre 8 cm et 10 cm, à partir de la surface de cuisson sur laquelle sont positionnés lesdits produits semi-finis formés à partir de la pâte.
7. Procédé selon la revendication 6, dans lequel ledit gaz chaud est dirigé vers lesdits produits semi-finis à une vitesse comprise entre 2 m/s et 12 m/s, de préférence entre 4 m/s et 10 m/s, mieux encore entre 6 m/s et 8 m/s.
8. Procédé selon l'une quelconque des revendications précédentes, dans lequel ledit procédé permet de produire un biscuit qui présente une teneur en fibres alimentaires comprise entre 15 % et 25 %, mieux entre 20 % et 25 %, mieux encore approximativement égale à 25 %, en poids par poids total.
9. Procédé selon l'une quelconque des revendications 1 à 7, dans lequel ledit procédé permet de produire un biscuit qui présente une teneur en lipides comprise entre 12 % et 18 %, de préférence approximativement égale à 15 %, en poids par poids total.
10. Procédé selon l'une quelconque des revendications 1 à 7, dans lequel ledit procédé permet de produire un biscuit qui présente une teneur en glucides simples approximativement égale à 15 %, en poids par poids total.
11. Procédé selon l'une quelconque des revendications précédentes, dans lequel ledit procédé permet de produire un

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biscuit qui comprend entre 10 % et 30 %, de préférence entre 20 % et 30 %, mieux entre 25 % et 30 %, en poids par poids total, de fruits secs ou de morceaux de chocolat.

12. Biscuit obtenu selon le procédé selon l'une quelconque des revendications 1 à 11.

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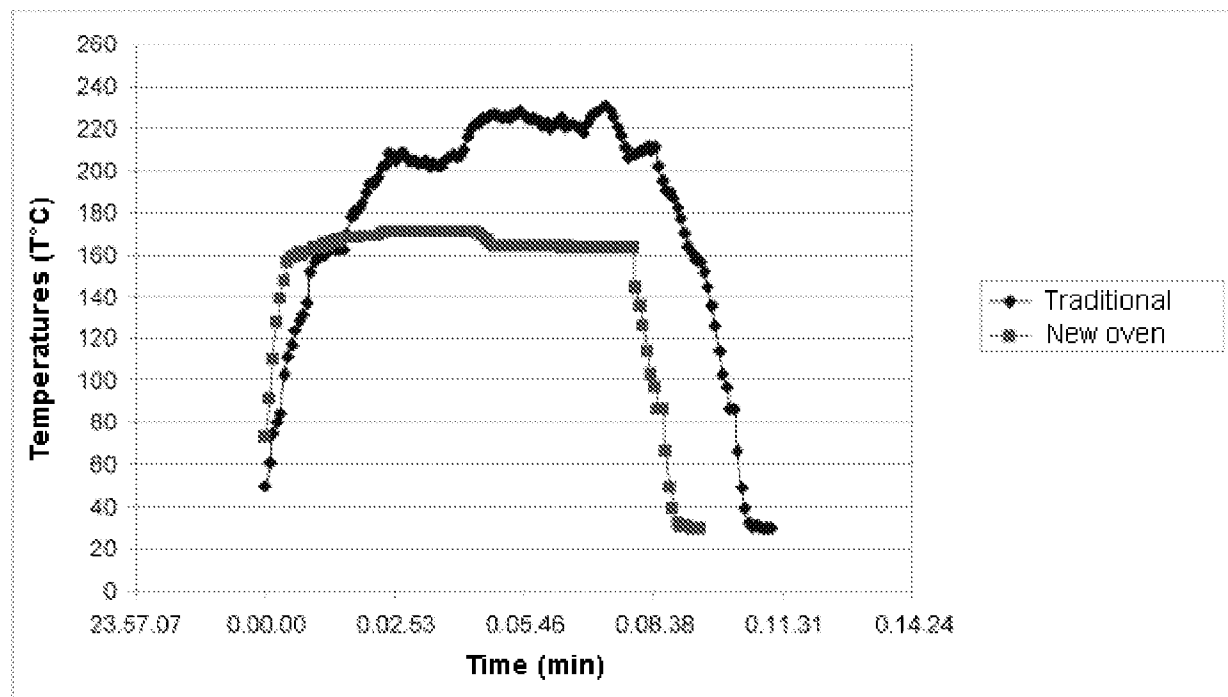


Fig. 1. Baking temperatures diagram

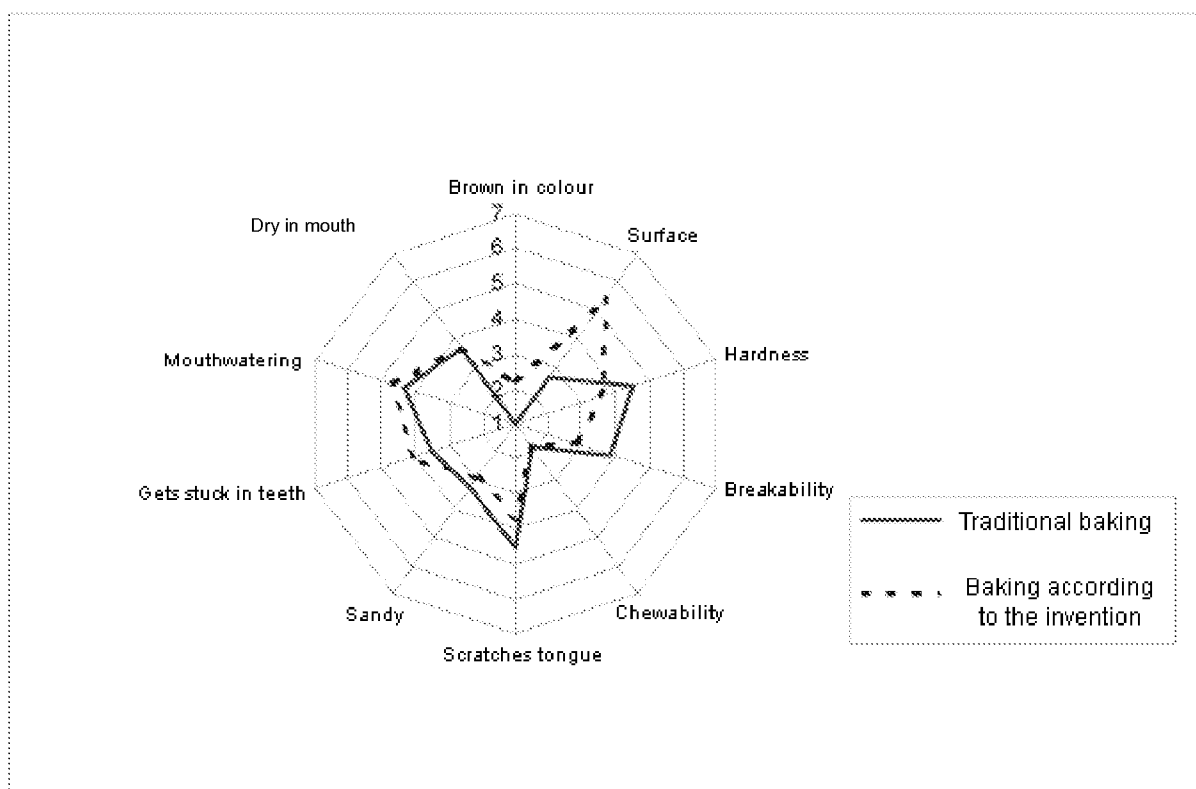
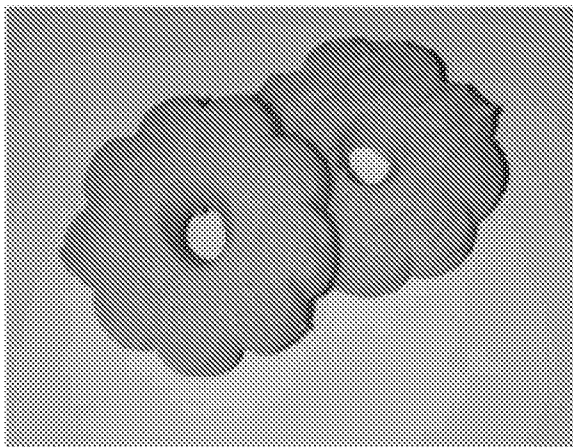


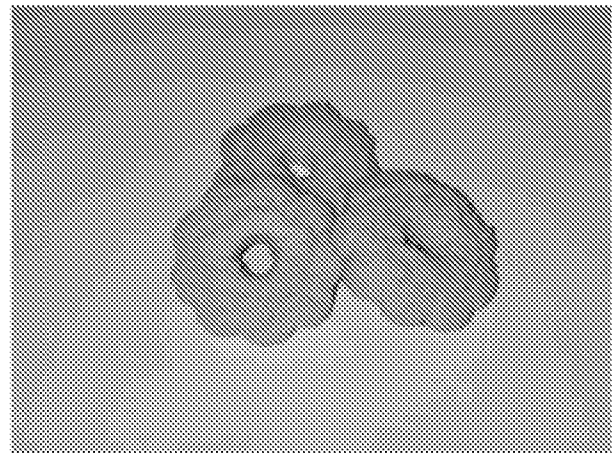
Fig. 2. Example 1: Sensory evaluation profile



Fig. 3. Example 1: Comparison by appearance and volume



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Fig. 4. Example 2: Comparison by appearance and volume

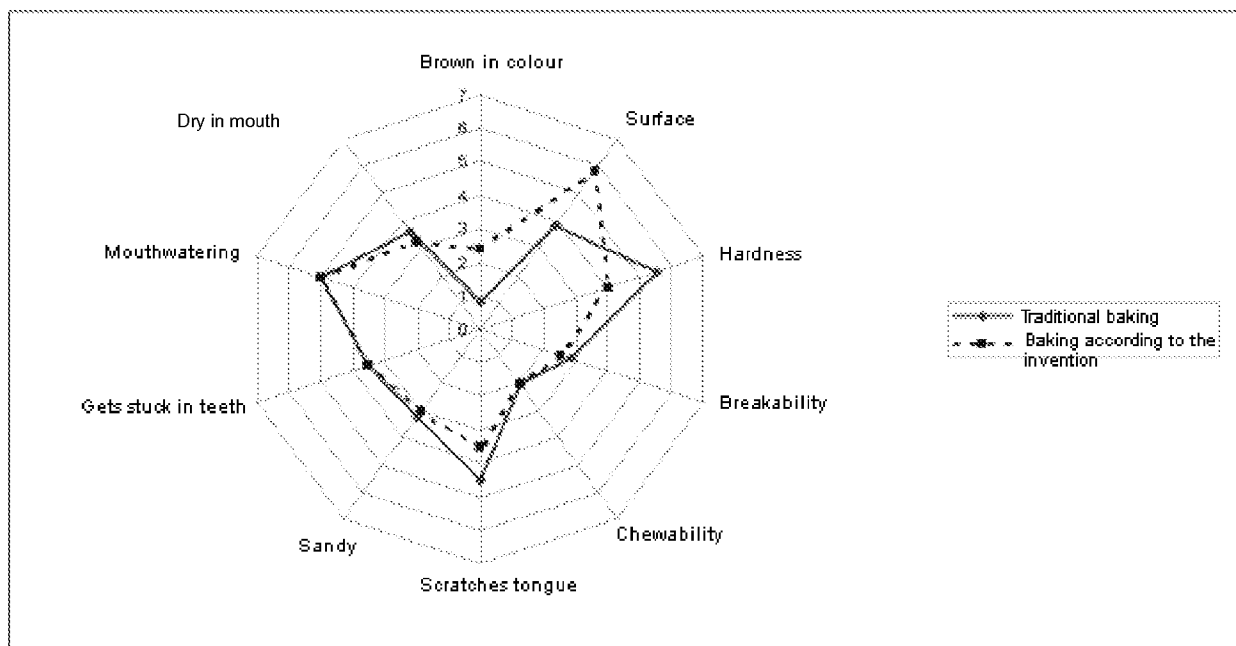


Fig. 5. Example 2: Sensory evaluation profile

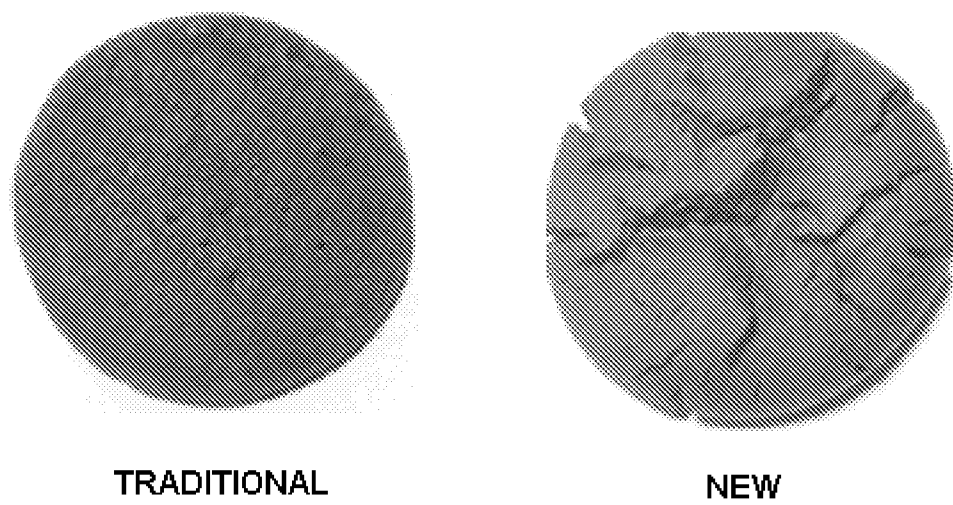


Fig. 6. Example 3: Comparison by appearance and volume

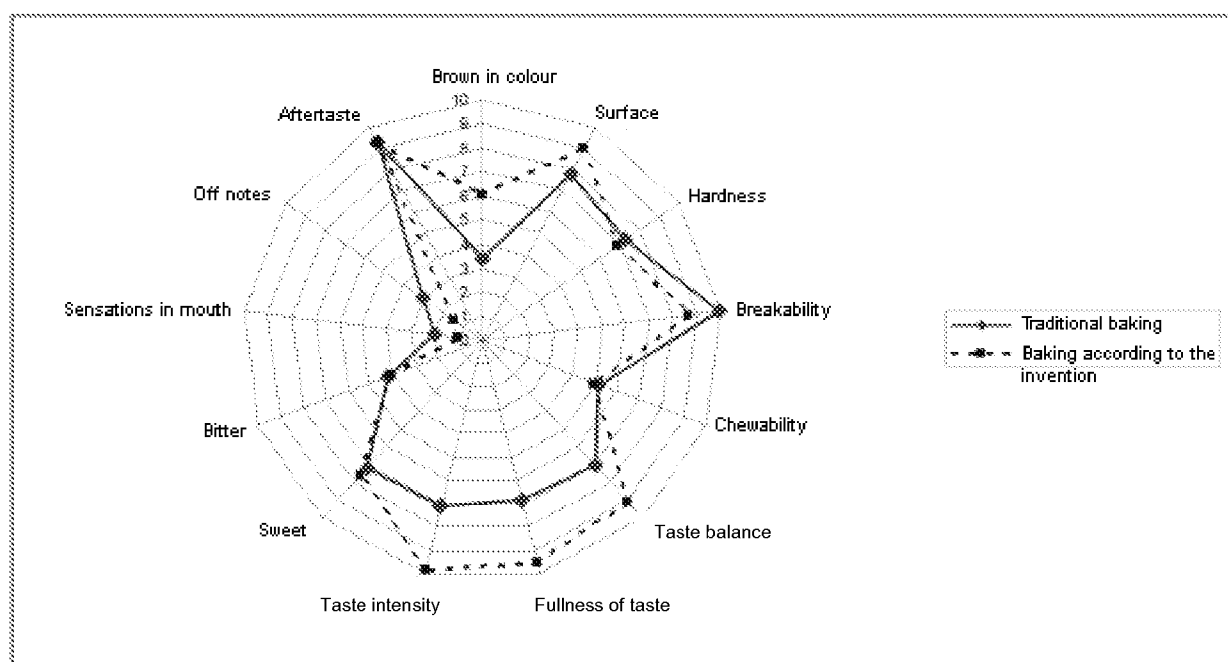
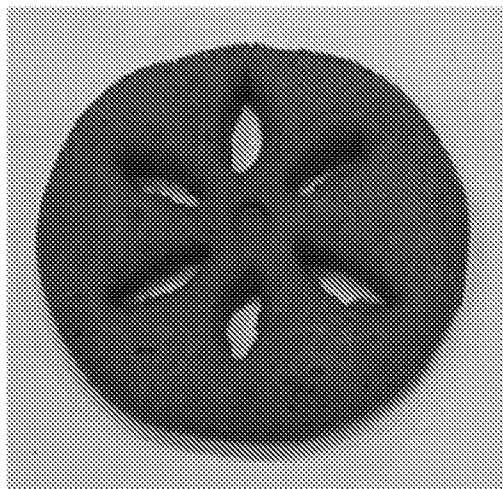
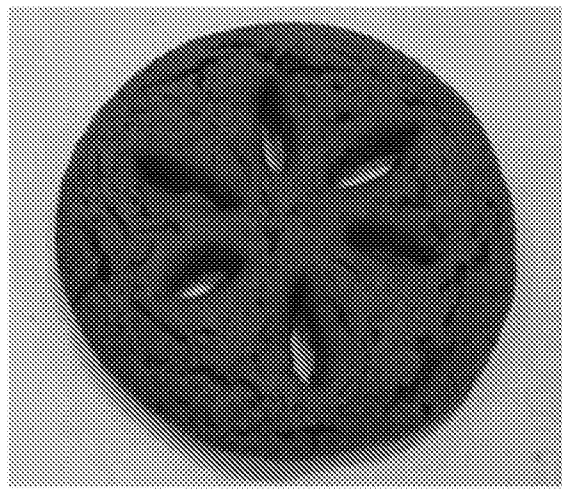


Fig. 7. Example 3: Sensory evaluation profile



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Fig. 8. Example 4: Comparison by appearance and volume

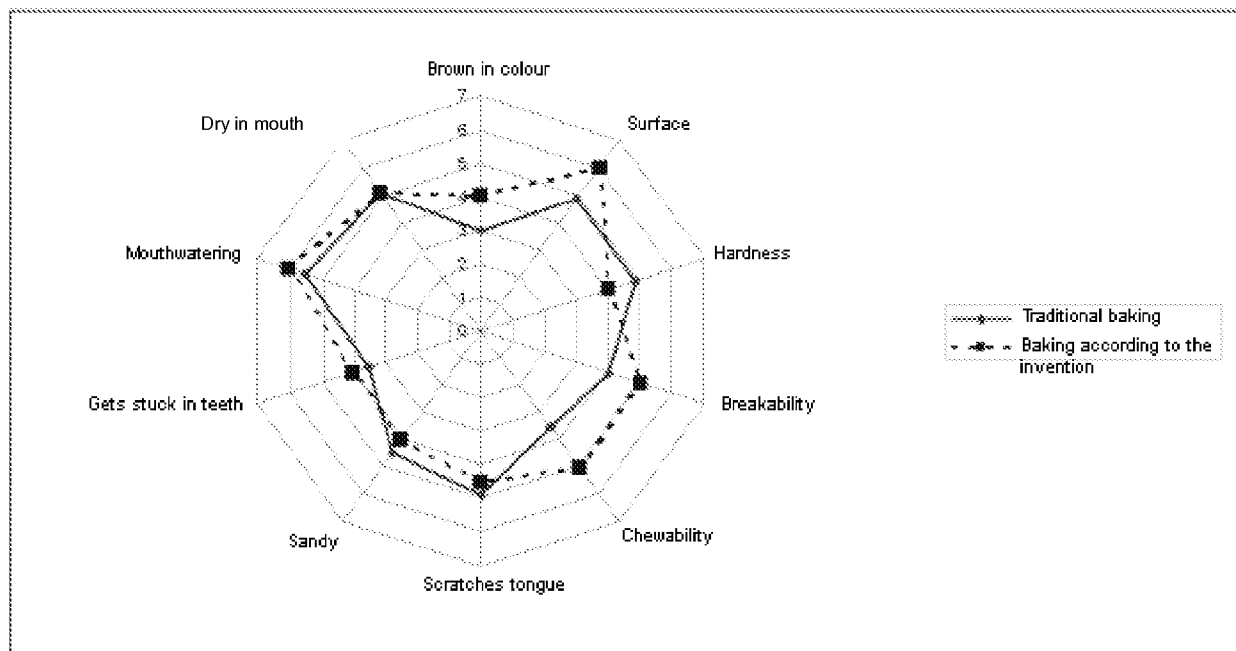
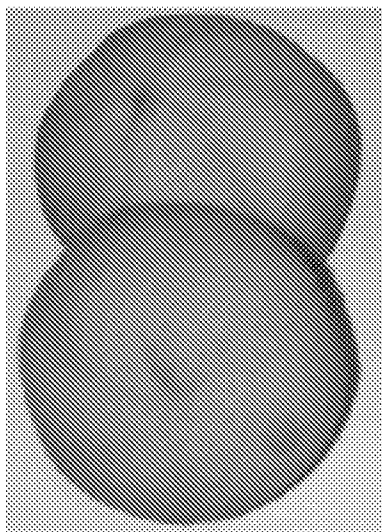
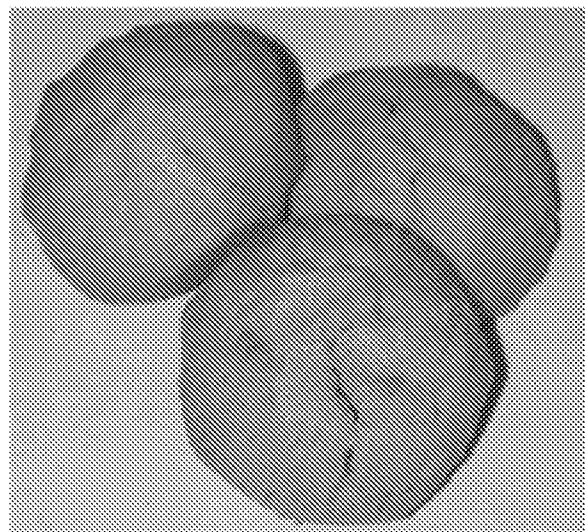


Fig. 9. Example 4: Sensory evaluation profile



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Fig. 10. Example 5: Comparison by appearance and volume

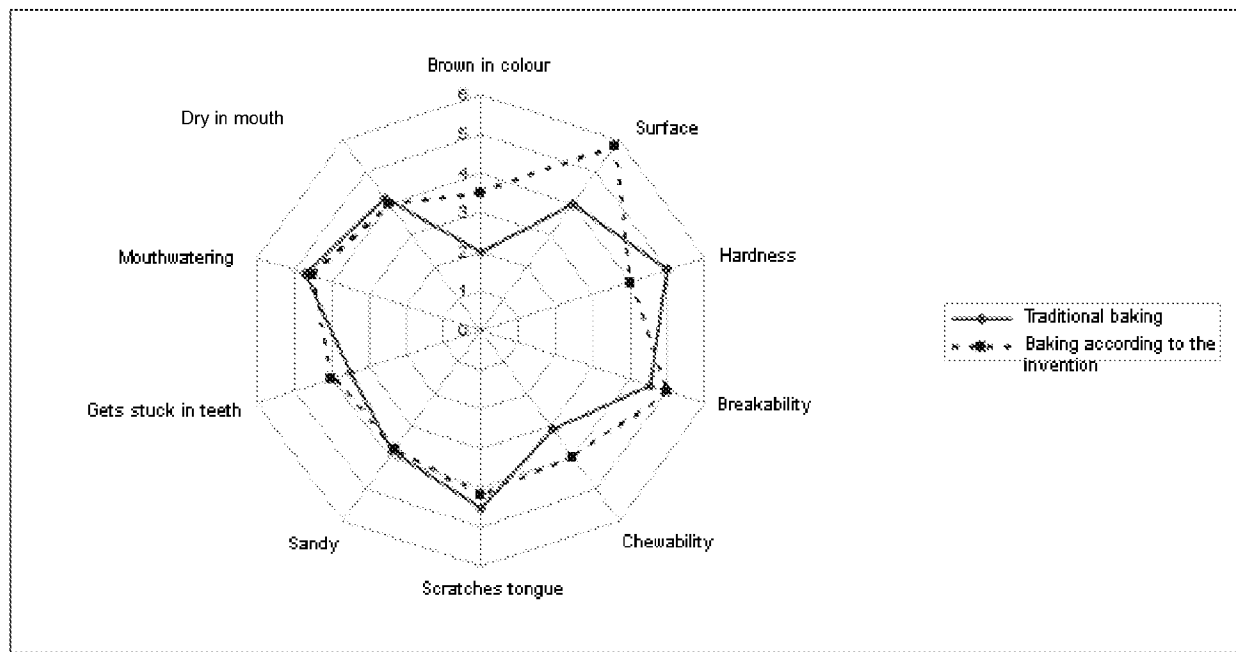


Fig. 11. Example 5: Sensory evaluation profile

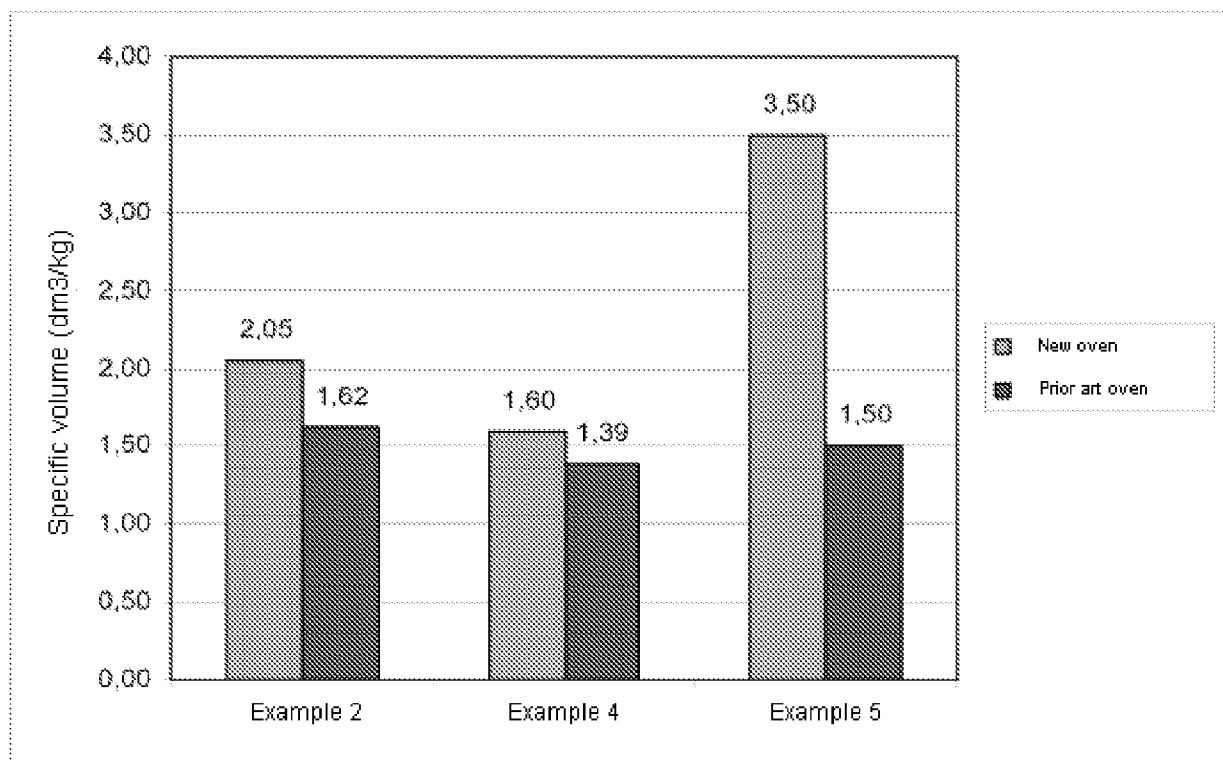


Fig. 12. Examples 1, 4 and 5: Comparison by specific volume

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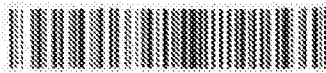
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ELJÁRÁS JAVÍTOTT ÉRZÉKSZERV JELLEMZŐKKEL BÍRÓ KEKSZEK ELŐÁLLÍTÁSÁRA

SZABADALMI IGÉNYPONTOK

1. Eljárás kekszek (biscuit) előállítására, amelyek tartalmaznak, teljes tömegre számítva, étkezési rosttartalmat (dietary fibre content) 10 és 25 tömeg % közötti tartományban, lipid tartalmat 10 és 20 tömeg % közötti tartományban, és egyszerű cukor (simple sugar) tartalmat 12 és 22 tömeg % közötti tartományban, és amelyek fajlagos térfogata (specific volume) a 2.0 és 3.5 dm³/kg közötti értéktartományban van, **azzal jellemezve, hogy ez az eljárás a következő lépéseket tartalmazza:**

- összekeverjük a keksz tésztájának alkotórészeit;
- kialakítjuk a keksz tésztát (dough), hogy kialakuljanak félkész (semi-finished) termékek;
- kisütjük az említett tésztából kialakított félkész termékeket, így kapunk kekszeket;
- lehűtjük a kapott kekszeket; és
- becsomagoljuk az említett kekszeket;

ahol az említett félkész termékek c) sütési lépése tartalmaz egy olyan lépést, hogy a termékeket forró gáznak tesszük ki, amely forró levegőből és túlhevített gőzből áll, és ezt közvetlenül fújuk rá (blow) az említett félkész termékekre egy ütközéses (impingement) rendszer segítségével.

2. Az 1. igénypont szerinti eljárás, ahol az említett forró gáz, amely forró levegőből és túlhevített gőzből áll, olyan hőmérséklettel bír, amely a 150 és 190°C közötti tartományban, előnyösen a 160 és 175°C közötti tartományban van.

3. Az 1. vagy 2. igénypont szerinti eljárás, ahol a forró levegőből és túlhevített gőzből álló említett forró gáznak kitevés említett lépését olyan időtartamon keresztül hajtjuk végre, amely szükséges a kekszek megsütésének eléréséhez, ahol ez előnyösen olyan időtartam, amely 4 perc és 12 perc között van, előnyösebben 5 és 10 perc között.

4. Az 1-3. igénypontok bármelyike szerinti eljárás, ahol a forró levegőből és túlhevített gőzből álló említett forró gáz olyan túlhevített gőz tartalommal bír, amely, térfogat/teljes térfogatra számítva, 80% és 99% között van, előnyösen 80%.

5. Az 1-4. igénypontok bármelyike szerinti eljárás, ahol az említett eljárást atmoszferikus nyomáson hajtjuk végre.

6. Az 1-5. igénypontok bármelyike szerinti eljárás, ahol az említett forró gázt egy fúvaló (blowing) rendszer révén fúvatjuk (blow), amely rendszer tartalmazza fúvókák (nozzle) sokaságát 4-15 cm távolságnál, előnyösen 6-12 cm távolságnál, előnyösebben 8-10 cm távolságnál elhelyezkedve attól a sütési felülettől (baking surface), amelyre a tésztából kialakított említett félkész termékek el vannak helyezve.

7. A 6. igénypont szerinti eljárás, ahol az említett forró gáz az említett félkész termék irányában olyan sebességgel halad, amely a 2 és 12 m/s (méter/másodperc) közötti tartományban, előnyösen a 4 és 10 m/s közötti tartományban, előnyösebben a 6 és 8 m/s közötti tartományban van.

8. Az 1-7. igénypontok bármelyike szerinti eljárás, ahol az említett eljárás olyan kekszet alakít ki, amely 15 és 25 tömeg % közötti tartományban levő, előnyösen 20 és 25 tömeg % közötti tartományban levő, előnyösebben mintegy 25 tömeg % étkezési rosttartalommal bír a termék teljes tömegére vonatkoztatva.

9. Az 1-7. igénypontok bármelyike szerinti eljárás, ahol az említett eljárás olyan kekszet alakít ki, amely 12 és 18 tömeg % közötti tartományban levő, előnyösen mintegy 15 tömeg % lipid tartalommal bír a termék teljes tömegére vonatkoztatva.

10. Az 1-7. igénypontok bármelyike szerinti eljárás, ahol az említett eljárás olyan kekszet alakít ki, amelynek egyszerű cukor tartalma mintegy 15 tömeg % a termék teljes tömegére vonatkoztatva.

11. Az 1-10. igénypontok bármelyike szerinti eljárás, ahol az említett eljárás olyan kekszet alakít ki, amely 10 és 30 tömeg % közötti tartományban, előnyösen 20 és 30 tömeg % közötti tartományban, előnyösebben 25 és 30 tömeg % közötti tartományban tartalmaz szárított gyümölcsöt vagy csokoládédarabokat a termék teljes tömegére vonatkoztatva.

12. Kekszt, amely az 1-11. igénypontok bármelyike szerinti eljárással kapható meg.