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(54) Title: SHELF-STABLE, FILLED FOOD PRODUCT

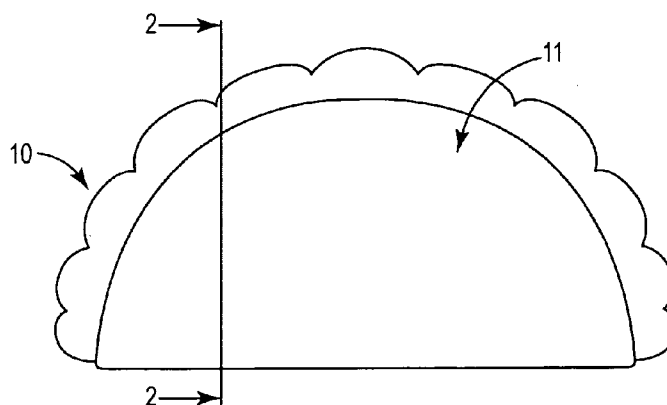


Fig. 1

(57) Abstract: The present invention addresses the aforementioned need by providing a shelf stable filled food product such as a pie, bar, cookie, or pastry. The food product is a combination of a dough-based crust and a fruit filling. This disclosure provides a shelf stable, baked, filled food product having a flour-based crust containing shortening and potassium sorbate, and a fruit-based filling. Any of the baked products may have the filling present on top of the crust, enveloped inside the crust, or present between two crusts. The filling may be apple, blueberry, cherry, lemon, or strawberry. The baked product may include a topping, such as a glaze, a stringer, a crumble, or a streusel.





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SHELF-STABLE, FILLED FOOD PRODUCT

FIELD OF THE INVENTION

This application is directed to filled food products, and methods of making the food products.

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BACKGROUND

Most fruit pies and other fruit-filled ready-to-eat products available in the market have an ambient shelf life of 3 to 4 weeks. At or near the end of this shelf life, these food products are prone to failure due to microbiological issues (e.g., mold growth), fat/flavor degradation, and/or textural failure. In addition, many of the products available in the market are processed via a frying operation, which is less-than-desirable for many consumers. Further, many of the products have a crumbly texture, which can make it difficult to consume the product 'on-the-go'. Some fruit-filled products, such as toaster pastries, are not recommended as ready-to-eat, but preferably undergo an additional preparation step by the consumer.

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A need exists for a convenient, non-fried, ready-to-eat fruit-filled product having satisfactory sensory characteristics and an extended shelf life.

SUMMARY

The present invention addresses the aforementioned need by providing a shelf stable filled food product such as a pie, bar, cookie, or pastry. The food product is a combination of a dough-based crust and a fruit filling.

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In one aspect, this disclosure provides a shelf stable, filled food product having a flour-based crust containing potassium sorbate, and a fruit-based filling having water activity of about 0.5 to 0.7 and pH of about 3 to 4.6. The water activity of the filling is within 20% of the water activity of the crust. The overall baked product has a water activity of about 0.5 to 0.65 and a shelf life greater than about 3 months, in some embodiments greater than 6 months, at ambient temperatures. The fruit-based filling may have a water activity of about 0.6 to 0.65 and a pH of about 3.25 to about 4, and the overall baked product may have a water activity of about 0.52 to 0.65.

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In another aspect, this disclosure provides a shelf stable, baked, filled food product having a flour-based crust containing shortening and potassium sorbate, and a fruit-based filling. The crust has a water activity of about 0.5 to 0.65. The filling has a water activity of about 0.5 to 0.7 and is within 20% of the water activity of the crust.

5 Further, the filling has a pH of about 3 to 4.6. The overall baked product has a shelf life greater than about 3 months, in some embodiments greater than 6 months, at ambient temperatures.

Any of the baked products may have the filling present on top of the crust, enveloped inside the crust, or present between two crusts. The filling may be apple,
10 blueberry, cherry, lemon, or strawberry. The baked product may include a topping, such as a glaze, a stringer, a crumble, or a streusel.

The above summary of the various embodiments of the disclosure is not intended to describe each illustrated embodiment or every implementation of the disclosure. These and various other features and advantages will be apparent from a reading of the
15 following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be more completely understood in consideration of the following detailed description of various embodiments of the invention in connection
20 with the accompanying drawings, in which:

FIG. 1 is a top view of a filled food product according to the present disclosure.

FIG. 2 is a cross sectional end view of the filled food product taken along line 2-2 of FIG. 1.

FIG. 3A is a top view of an embodiment of a filled food product, and FIG. 3B is
25 an end view of the product.

FIG. 4A is a top view of another embodiment of a filled food product, and FIG. 4B is an end view of the product.

FIG. 5A is a top view of yet another embodiment of a filled food product, and FIG. 5B is an end view of the product.

FIG. 6A is a top view of yet another embodiment of a filled food product, and
30 FIG. 6B is cross sectional end view of the product.

FIG. 7 is a schematic side view of an embodiment of a packaged filled food product.

FIG. 8 is a process schematic depicting a method for making a filled food product.

While the disclosure is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the disclosure to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the disclosure as defined by the appended claims.

DETAILED DESCRIPTION

The present disclosure provides filled food products (usually single serving products) that are shelf stable for at least 1 month at room temperature after packaging, in some embodiments at least 3 months, and in other embodiments at least 6 months, and in other embodiments up to 9 months. The food product has a crust formed from flour, water, fat, sweetener (liquid or dry) and potassium sorbate and a fruit filling. The present disclosure also provides a method of making filled food products that are shelf stable for at least 1 month at room temperature after packaging, in some embodiments at least 3 months or at least 6 months, and up to 9 months in some embodiments.

In achieving extended shelf life of the filled food products of this disclosure, the moisture level and moisture migration is managed or restricted by means of product design. Particularly, it is the low differential concentration of moisture between the crust and the filling, together with a preselected level of fat in the crust and the total acidity of the product, that produces the long shelf life.

Without being bound by theory, it is believed that the lower moisture differential between the crust and the filling inhibits moisture migration into the crust from the filling, thus inhibiting the growth of mold, degradation of crust texture, and the formation of off-flavors in the crust. The level of fat in the crust compensates for the low moisture content in the crust. In addition, added fat mitigates staling by complexing starch molecules (present in flour), which otherwise have a tendency to associate over a period of time and result in loss of taste and texture over the shelf life of the product.

In the following description, reference is made to the accompanying drawings that form a part hereof and in which are shown by way of illustration at least one specific embodiment. The following description provides additional specific embodiments. It is

to be understood that still other embodiments are contemplated and may be made without departing from the scope or spirit of the present disclosure. The following detailed description, therefore, is not to be taken in a limiting sense. While the present disclosure is not so limited, an appreciation of various aspects of the disclosure will be gained
5 through a discussion of the examples provided below.

Unless otherwise indicated, all numbers expressing feature sizes, amounts, and physical properties are to be understood as being modified by the term “about.” Accordingly, unless indicated to the contrary, the numerical parameters set forth are approximations that can vary depending upon the desired properties sought to be
10 obtained by those skilled in the art utilizing the teachings disclosed herein.

As used herein, the singular forms “a”, “an”, and “the” encompass embodiments having plural referents, unless the content clearly dictates otherwise. As used in this specification and the appended claims, the term “or” is generally employed in its sense including “and/or” unless the content clearly dictates otherwise.

For purposes of this disclosure, water activity, or a_w , is measured as per AOAC 978.18, moisture content is as per AOAC 925.45, and pH is as per AOAC 943.02, where
15 “AOAC” is the “Association of Analytical Communities.”

Referring now to the figures, a fruit filled food product according to the present disclosure is illustrated in FIGS. 1 and 2. Filled food product 10 (having an outer surface
20 11) has a dough-based crust 12 and a fruit-based filling 14. Crust 12, in this embodiment, which is a fruit-filled enclosed pie, has an outer surface 13 and an inner surface 15 in contact with filling 14. It should be understood that entire inner surface 15 may not be in contact with filling 14, but in some embodiments, an air pocket may be present between filling 14 and inner surface 15, for example, due to the reduction in size
25 of the fruit in filling 14 during, for example, the baking processes. In this embodiment, outer surface 13 of crust 12 forms outer surface 11 of food product 10.

A filled food product such as product 10, in its ready-to-eat state, may have a size of, for example, from about 100 to 150 grams, with a crust to filling ratio of about 1.8:1 to about 2.2:1 (e.g., about 2:1).

FIGS. 3 through 6 illustrate other embodiments of fruit filled food products
30 according to this disclosure. Similar to the fruit-filled enclosed pie product 10, the other products include a crust in contact with fruit filling.

Unlike FIGS. 1 and 2 which illustrate product 10 with filling 14 completely enclosed within crust 12, FIGS. 3A and 3B illustrate an open-top pie product 20 (having an outer surface 21) formed with a crust 22 and filling 24. Crust 22 includes an outer surface 23 and a filling-engaging surface 25. Only a portion of outer surface 21 of product 20 is formed by crust 22; in this embodiment, filling 24 forms a portion of outer surface 21.

FIG. 4A and 4B illustrate another embodiment of a filled product, particularly food product 30, formed by two crusts 32A, 32B and a filling 34. Product 30 has a sandwich-like construction, with filling 34 positioned between crusts 32A, 32B, so that each crust 32A, 32B has a filling-engaging surface 35A, 35B.

A filled food product such as product 30, in its ready-to-eat state, may have a size of, for example, from about 50 to 60 grams (e.g., about 55 grams), with a total crust to filling ratio of about 5:1 to about 6:1 (e.g., about 5.2:1).

FIGS. 5A and 5B illustrate a fruit-filled enclosed pie, similar to that of FIGS. 1 and 2. Filled food product 40 (having an outer surface 41) has a dough-based crust 42 and a fruit-based filling 44. Crust 42 has an outer surface 43 and an inner surface 45 in contact with filling 44. Outer surface 43 of crust 42 forms essentially the entire outer surface 41 of food product 40. Product 40 includes a topping 46, particularly a sugar- and/or fat-based stringer (i.e., a distinct thread of glaze or frosting), over outer surface 43 of crust 42.

A filled food product such as product 40, in its ready-to-eat state, may have a size of, for example, from about 80 to 120 grams (e.g., about 100 grams), with a total crust to filling ratio of about 1:1 to about 2:1 (e.g., about 1.5:1).

Another fruit-filled food product is illustrated in FIGS. 6A and 6B as product 50. Filled food product 50 has a dough-based crust 52 and a fruit-based filling 54. Crust 52 has an outer surface 53 and a filling-engaging surface 55. Product 50 includes a topping 56, particularly crumbs or streusel over filling 54.

A filled food product such as product 50, in its ready-to-eat state, may have a size of, for example, from about 50 to 60 grams (e.g., about 50 grams), with a total crust to filling ratio of about 2:1 to about 3:1 (e.g., about 2.5:1 to 2.7:1).

In each of the filled food products of this disclosure, the crust is in contact with fruit-filling, and in some embodiments, the crust forms the entire outer surface of the products.

Crust 12 is formed from conventional dough ingredients, including any or all of flour, fat or shortening, water, salt, sweetener, moisture-retaining ingredients, and optional ingredients such as flavoring and coloring. Crust 12 may be a relatively dense crust, a soft crust, a light flakey crust, or may have any characteristics desired, as long as the water activity, fat content, and pH level of the crust are in accordance with the present disclosure.

A variety of different flours can be used for crust 12, and the different flours can be selected to give a variety of textures, tastes, and appearances to the final filled product 10. Useful flours include, but are not limited to, hard wheat flour, soft wheat flour, corn flour, high amylose flour, rice flour, and low amylose flour. The relative proportions of the types of flours used can be varied as desired.

Natural shortenings, animal or vegetable, or synthetic shortenings can be used in crust 12. In some embodiments, shortening, fat, oil, etc. may be referred to as lipid(s). Generally, shortening is comprised of triglycerides, fats and fatty oils made predominantly of triesters of glycerol with fatty acids. Fats and fatty oils useful in producing shortening include cotton seed oil, ground nut oil, soybean oil, sunflower oil, grapeseed oil, sesame oil, olive oil, corn oil, canola oil, vegetable oil, safflower oil, palm oil, palm kernel oil, coconut oil, or combinations thereof.

The shortening may be composed of monounsaturated fatty acids, polyunsaturated fatty acids, and/or trans fatty acids. In some embodiments, the total saturated fatty acids in the shortening is 38-52% (e.g., 38-44%), with the total monounsaturated fatty acids being 21-39%, the total polyunsaturated acids being 3-20% (e.g., 6-8%), and the total trans fatty acids being 0-4% (e.g., 0.5-1%). In other embodiments, the total saturated fatty acids in the shortening is about 43%, with the total monounsaturated fatty acids being about 30-31%, the total polyunsaturated acids being about 19%, and the total trans fatty acids being a maximum of 1%. In yet other embodiments, the total saturated fatty acids in the shortening is about 38-44%, with the total monounsaturated fatty acids being about 38%, the total polyunsaturated acids being about 6-8%, and the total trans fatty acids being a maximum of 4% (e.g., 0.5-1%).

In some embodiments, the shortening in crust 12 is a solid or a semi-solid shortening, having a solid fat content (SFC) of 37-60 at 10 °C, 18-28 at 21.1 °C, 9-19 at 26.7 °C, 3-13 at 33.3 °C, and 0-8 at 40 °C. In some embodiments, the shortening in crust

12 has a solid fat content (SFC) of 37-43 at 10 °C, 23-27 at 21.1 °C, 14-17 at 26.7 °C, 5-8 at 33.3 °C, and 2-5 at 40 °C.

Crust 12 may have a total fat or lipid level of 10-20 wt%, in some embodiments 12-18 wt%. A level of 15 wt% is one exemplary level.

5 Examples of moisture-retaining ingredients include humectant(s), hydrocolloid(s) and gum(s).

 Examples of suitable humectants include glycerin and sorbitol. Suitable hydrocolloids include hydrophilic polymers that can be of vegetable, animal, microbial, or synthetic origin. Hydrocolloids generally contain many hydroxyl groups and can be polyelectrolytes. Some functional properties of hydrocolloids can include water binding, thickening and gelling (thus impacting yield value), emulsion stabilization, prevention of ice recrystallization, and organoleptic properties. Many materials can be described as gums and hydrocolloids. One useful hydrocolloid is gelatin. Suitable gums could also be described as hydrocolloids (such as agar, alginate, carrageenans, carboxymethylcellulose, cellulose, guar gum, gum arabic, locust bean gum, and xanthan gum). Other illustrative polysaccharides that are hydrocolloids include arabinoxylan, curdlan, gellan, β -glucan, pectin, and starch. A combination of multiple hydrocolloids or gums may be used. In some embodiments, a combination of locust bean gum and xanthan gum is preferred, for it has been found that this combination has a surprisingly high water retention capability.

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As indicated above, crust 12 may include additionally ingredients such as flavorant(s), flavoring(s), sweetener(s), emulsifier(s), acidulant(s), or antimicrobial(s).

 Examples of suitable flavorants or flavorings include spices and specific flavorings such as fruit, vanilla, butter, mint, chocolate and the like. The flavorant in matrix 16 can be a liquid, such as an oil, or dry, such as in powdered form.

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 Examples of suitable sweeteners include sucrose (cane or beet sugar), fructose (e.g., regular and high fructose corn syrup), tapioca syrup, dextrose, maltose, and reduced or zero calorie sweeteners such as saccharide, sucralose and stevia extracts. In some embodiments, powdered sugar (sucrose) is used.

30 Emulsifiers include nonionic, anionic, and/or cationic surfactants that can be used to influence the texture and homogeneity of a mixture, increase stability, improve eating quality, and prolong palatability. Emulsifiers include compounds such lecithin, mono- and diglycerides of fatty acids, propylene glycol mono- and diesters of fatty acids,

glyceryl-lacto esters of fatty acids, polyglycerol polyricinoleate, ethoxylated mono- and diglycerides and the like.

Examples of suitable acidulants are glucono delta-lactone, citric acid, ascorbic acid, and malic acid.

5 Examples of suitable antimicrobials, anti-oxidants, or other preservatives or mold inhibitors include sodium salts of propionic or sorbic acids, potassium sorbate, sodium diacetate, vinegar, monocalcium phosphate, lactic acid, sodium benzoate, tertiary butylhydroquinone, and mixtures thereof.

10 Additional components may be present in crust 12 to facilitate processing, or to improve the taste, texture, or hydration behavior of crust 12 and product 10. Examples of such ingredients include salt (NaCl), nonfat dry milk, whey protein, molasses, sodium stearoyl lactylate (dough strengthener), and leavening agents.

The dough forming crust 12, prior to baking, has a water activity (a_w) from 0.6-0.75, in some embodiments 0.6-0.7 (e.g., about 0.6, about 0.68, about 0.69).

15 Fruit-based filling 14 may be any suitable filling that includes fruit ingredients, the fruit being any of tree fruit (such as apples, pears, peaches, cherries, figs), berries (such as blueberries, raspberries, blackberries, strawberries, lingonberries, currants), and citrus (such as orange, lemon, lime). Additional ingredients may also be present to enhance the filling, ingredients such as rhubarb (e.g., strawberry-rhubarb), raisins, 20 pumpkin, and dairy products (e.g., yogurt). Filling 14 may be, for example, a smooth, homogenous mixture, may be a chunky mixture, may contain intact fruit seeds or may include intact fruit chunks in a smoother carrier sauce.

25 Filling 14 is preferably acidic, having a pH of less than 5.5 or less than 5, for example, less than about 4.6. In some embodiments, filling 14 has a pH of 3-4.6, in some embodiments 3.25-4 (e.g., about 3.25, about 3.4 or 3.38, about 4). Filling 14 has a water activity (a_w) from 0.5-0.7, in some embodiments 0.6-0.65 (e.g., about 0.6, about 0.625, about 0.63).

30 The ready-to-eat product contains, in most embodiments, about 50-85 wt% crust, about 15-50 wt% filling, and up to about 2 wt% topping (e.g., glaze, stringer, crumbles or streusel). In other embodiments, the product is about 60-75 wt% crust, about 24-40 wt% filling, and up to about 2 wt% topping. In yet other embodiments, the product is 66-75 wt% crust, 24-35 wt% filling, and 1 wt% topping. The ratio of crust to filling will be depend on the construction of the product; for example, a sandwich product, such as

product 30 of FIGS. 4A and 4B, will typically have more crust than a single-layer crust product, such as product 50 of FIGS. 6A and 6B.

Table 1 provides an exemplary list of ingredients as well as exemplary formulation ranges for the ingredients in the fruit-filled product.

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Table 1

Ingredient	Possible Range(s) (wt%) in Product
Fruit-filling	15-50 25-40
Flour(s)	25-50 30-35
Sweetener(s)	3-25 3-22 5-10
Shortening	5-22 6-20 9-18 15
Water	2-15 3-10
Glycerin	2-8 3-5
Glucono delta lactone	0-3 0.2-2 0.5-0.7
Flavoring(s)	0-2 0.2-0.6
Salt	0-2 0.05-1 0.1-0.3
Moisture-retaining ingredient(s)	0-2 0.01-1
Potassium sorbate	0-2 0.01-1.5 0.1-0.2
Distilled mono-glyceride(s)	0-6 0.1-5 0.1-0.2
Polysorbate	0-6 0.1-5 0.1-0.2
Colorant	0-2 0.02-0.06

FIG. 7 illustrates an embodiment of packaged fruit-filled food product, similar to the food product of FIGS. 1 and 2. Retail product 60 has a packaging or overwrap 62 with an internal volume 63 for receiving product. In this embodiment, a food product 64 according to the present disclosure and as described above is enveloped in packaging 62. Packaging or overwrap 62 may be any conventional packaging and include materials such as paper, polymeric material (including metallized polymeric material), metal foil, paperboard, cardboard, and the like. The packaging may be flexible (as is polymeric film) and/or rigid (as is a paperboard container). In some embodiments, the packaging is a metallized flexible laminate package. In this embodiment, packaging 62 includes a paperboard layer 65 on which product 64 is seated.

In the packaged retail state, product 60, and other products according to this disclosure, such as products 10, 20, 30, etc., have a moisture content of 5-8%, in some embodiments 6-7% (e.g., 6.5%), a water activity (a_w) from 0.5-0.65 (e.g., about 0.5, about 0.52, about 0.6, about 0.63, about 0.65) in some embodiments 0.6-0.65, and a pH of 3-5.5, in some embodiments 3.4-4.6 (e.g., about 3.8, about 4, about 4.3).

The filled food products have been described when in a ready-to-be-sold or ready-to-be-consumed state. The food products are a complex, hydrated system. The overall moisture within the food products does not significantly change over time (i.e., from the time of production to at least 1 month later, in some embodiments at least 3 months later), and also the distribution of moisture within the product also does not significantly change.

The food products, in their ready-to-consume state, have a moist crust and a moist fruit-filling, both which have highly desirable organoleptic properties. These desirable properties remain at least 1 month, usually at least 3 months, sometimes at least 6 months after packaging, and sometimes up to 9 months after packaging, without staling of the flavor(s) of the crust and filling. Additionally, the products avoid mold growth thereon and therein for at least one month, usually at least 3 months, sometimes at least 6 months, and sometimes up to 9 months.

Moisture Management

As described above, the shelf life of the filled food products of this disclosure is based on the management of moisture level and moisture migration within the product. The food products of this disclosure are designed to have little, if any, moisture

migration between the crust and the filling. In prior art filled products, the high level of moisture in the crust results in short shelf-life, often due to mold growing on the crust, degradation of texture or due to off-flavors caused by the high level of moisture in the crust combined with the fat in the crust. The food products of this disclosure have a low moisture level and water activity in both the crust and the filling, which help limit the occurrence of fat deterioration via hydrolytic rancidity.

Crust 12, and other crusts of this disclosure, has a water activity (a_w) of about 0.4 to 0.65, in some embodiments about 0.6, when the product is in a ready-to-eat form. Fruit-based filling 14 has a water activity of about 0.4 to 0.7, in some embodiments no more than 0.65. Additionally, the water activities of crust 12 and filling 14, prior to incorporation together to form the filled product, are within 20% of each other, in some embodiments within 10% of each other, and in other embodiments within 5% of each other.

Prior to baking, however, the unbaked product (composed of the raw crust and filling) has a water activity (a_w) of less than 0.85, in some embodiments 0.65-0.85, and in other embodiments, 0.57-0.85. After baking, however, the product has a water activity (a_w) of less than 0.65, in some embodiments 0.5-0.65, and in other embodiments, 0.6-0.65 (e.g., 0.63 or 0.65). When measured 1 month after having been baked, the water activity of the baked product has changed less than 10%, in some embodiments less than 5%, from the water activity of the product 48 hours after being baked.

Exemplary Methods of Making the Filled Food Products

As described above in respect to FIGS. 1 and 2, filled food product 10 (and other products according to this disclosure) has a crust 12 in contact with fruit filling 14. FIG. 8 illustrates one embodiment of a process for forming a food product according to the present disclosure, the food product being any one of product 10, 20, 30, etc. described above.

In a preliminary step 100, a hydration slurry 70 is formed by combining moisture retaining ingredients (e.g., locust bean gum and parts xanthan gum) with water and other optional ingredients. In one particular embodiment, dry ingredients (e.g., gum(s), potassium sorbate, sugar) are added to warmed water; the dry ingredients may be added all at once, or a little at a time (e.g., one spoon at a time).

In step 102, a dough 72 that will form the crust of the final food product is prepared. In step 102, dry ingredients (e.g., flour, whey solids, sugar, sodium stearoyl lactylate, salt) are thoroughly mixed. To this, fat or shortening is added, and the mixture is thoroughly combined, in some embodiments, the mixture is creamed. The wet
5 ingredients (e.g., hydration slurry 70, glycerin, anti-oxidant (i.e., tertiary butylhydroquinone) and flavoring) are added to the flour/fat mixture. The wet ingredients may be added directly to the dry ingredients or may be combined together prior to adding to the dry ingredients. Hydration slurry 70 may be cooled to ambient temperature or a refrigerated temperature (e.g., 50-55°F) prior to use in step 102. At this
10 stage, dough 72 has a water activity (a_w) less than 0.85, for example 0.65 to 0.85, for example 0.57 to 0.85.

Dough 72 is combined with a fruit filling 74 in step 104 to form an unbaked filled product 76. Dough 72 may be refrigerated or otherwise cooled after step 102 prior to step 104. Fruit filling 74 has a water activity of about 0.4 to 0.8 and a pH of about 3.4 to
15 4.6.

Forming step 104 can be any process suitable for combining dough 72 with fruit filling 74 to form the desired product. The particular forming process will depend, of course, on the configuration of the desired product. For example, to form a product such as sandwiched product 30 of FIGS. 4A and 4B, dough 72 will be formed into two sheets
20 and laminated with filling 74 therebetween. As another example, to form a product such as product 20 of FIGS. 3A and 3B, dough 72 and filling 74 can be co-extruded.

The resulting filled product 76 is then baked in step 105 to form a baked product 78, which, optionally after cooling, can have a topping 79 (e.g., glaze, stringer, streusel) applied thereto in step 106. The resulting finishing product 80 can then be packaged to
25 provide a saleable filled food product. Typically, packaging is done within 30 to 60 minutes of applying any topping 79.

The food products of this disclosure may be made by alternate methods, such as the following exemplary process.

In a first step, shortening(s) (e.g., butter, oil, lard) is mixed with sweetener(s)
30 (e.g., sugar) to form a mixture (optionally, a creamed mixture) to which is added other liquid ingredients (e.g., molasses, corn syrup, glycerin, water, colorant(s)) and blended until uniform. To this, eggs (e.g., whole eggs, egg whites, egg yolks) and salt are added.

After thoroughly combining, flour and then oats (e.g., rolled oats) are added. The resulting dough is spread in a pan, optionally lined with parchment paper.

A fruit filling (e.g., strawberry) is spread evenly over the dough.

In a next step, a streusel topping is formed by thoroughly mixing shortening (e.g., butter), sweetener (e.g., sugar), oats and flour. The streusel topping is evenly spread over the filling.

The resulting layered product is then baked (e.g., at 350°F for 12 minutes) to form a baked product.

In a variation of this process, the dough is divided and spread in two pans. In one pan, over the dough, fruit filling is evenly spread. In the second pan, streusel topping is evenly spread over the dough.

The two pans are then baked (e.g., at 350°F for 10 minutes). After being cooled, the baked slabs are removed from the pans and the streusel slab is placed on the fruit filling, with the streusel side up.

The resulting food products, from any of the methods of this disclosure, have a moisture content from 5-8%, in some embodiments 6-7% (e.g., 6.5%), and a water activity (a_w) from 0.5-0.65, in some embodiments 0.6-0.65 (e.g., 0.63).

Exemplary Filled Food Products

In one particular example (Example 1), a food product 10 was formed from the ingredients listed in Tables 2-4 using the process of FIG. 8, described above.

In another particular example (Example 2), a food product 40 was formed from the ingredients listed in Tables 2-4 using the process of FIG. 8, described above.

Table 2: Hydration Slurry Ingredients

	Example 1	Example 2
Ingredient	Wt%	Wt%
Locust bean gum	0.2	0.2
Xanthan gum	0.2	0.2
Powdered colorant	0.04	0.4
Potassium sorbate	0.06	0.06
Granulated sugar	11.7	11.5
Water (heated)	87.8	87.82

Table 3: Dough Ingredients

	Example 1	Example 2
Ingredient	Wt%	Wt%
Flour (soft red winter blend)	50.8	--
Flour (oat flour, unbleached)	--	50.82
Shortening (palm/soy)	20.0	--
Shortening (lard)	--	20.0
Hydration slurry (from Table 2)	15.02	15.02
Glycerin	4.7	4.7
Sweet whey solids	2.38	2.38
Salt	1	1
Flavor (butter)	0.35	0.35
Flavor (vanilla)	0.2	0.2
Sodium stearoyl lactylate	0.19	0.19
Tertiary butylhydroquinone	0.02	--
Granulated sugar	5.34	5.34

For Example 1: 66 parts of Dough Ingredients from Table 3 were formed into sheets having a thickness of about 4 mm. 34 parts of apple filling were deposited in the middle of the dough and spread evenly. The dough was folded around the fruit to form a tube shape. The two open ends of the dough were crimped with a fork, and the product was baked at 375 °F for 14 minutes.

For Example 2: 58.3 parts of Dough Ingredients from Table 3 were formed into sheets having a thickness of about 3 mm. 35 parts of strawberry filling were deposited in the middle of the dough and spread evenly. The dough was folded around the fruit to form a tube shape. The two open ends of the dough were crimped with a fork, and the product was baked at 375 °F for 13 minutes.

Table 4: Glaze Ingredients

	Example 1
Ingredient	Wt%
Powdered sugar	60.05
Water	17.31
Corn syrup solids 42DE	12.64
Shortening (palm/soy)	9.0
Gelatin	0.5
Flavor (vanilla)	0.23
Mono glycerides	0.13
Potassium sorbate	0.14

For Example 1: The glaze of Table 4 was thinly spread onto the cooled, baked product prepared above.

- 5 For Example 2: A stringer of white confectionary coating was applied to the warm, baked product prepared above.

Shelf-Life Testing

- Food product samples, prepared as above, were stored for 9 weeks under the following conditions to simulate warehouse distribution and to test accelerated shelf life.
- 10 (1) 90 °F with 15% RH - to simulate hot dry stress
- (2) weather room conditions (cycling through a temperature of 90 °F for 12 hours followed by 70 °F for 12 hours, 65% RH) – to simulate hot humid stress
- (3) frozen storage (0 °F) – to use as control with minimal degradation of
- 15 flavor and sensory attributes

The food product samples were pulled from the ‘hot dry’ and ‘hot humid’ storage conditions every three weeks to evaluate organoleptic properties including: texture, flavor, and overall acceptability. All evaluations were performed after allowing the samples to equilibrate at room temperature for at least 24 hours.

- 20 A five point evaluation scale was used to grade samples. Score of 4 or above was deemed as shelf life failure.

1 = Like fresh product.

2 = Like fresh until compared to 0°F sensory reference. There maybe a flavor loss or slight change in texture.

3 = Product is not “like fresh” but has no clearly objectionable characteristics. The difference should be apparent even without going back to the sensory reference.

5 4 = There are some off notes detected or the texture is marginal.

5 = Product is objectionable and should clearly not be available to the consumer.

Under the storage conditions of 90 °F with 15% relative humidity (i.e., ‘hot dry’), samples maintained a favorable score of 1-4 for at least 9 weeks. Kinetic modeling, based on flavor loss and texture degradation, predicted an equivalent shelf life of 8-9 months under ambient storage conditions.

Similarly, under weather room conditions (i.e., ‘hot humid’), samples maintained a favorable score of 1-4 for at least 9 weeks, which was predicted to be equivalent to 8-9 months at ambient storage conditions per kinetic storage models.

Although various embodiments of the present disclosure have been disclosed here for purposes of illustration, it should be understood that a variety of changes, modifications and substitutions may be incorporated without departing from either the spirit or scope of the present disclosure.

CLAIMS

1. A shelf stable, baked, filled food product comprising:
 - a) a flour-based crust containing potassium sorbate, and
 - b) a fruit-based filling having water activity of about 0.5 to 0.7 and within 20% of the water activity of the crust, and having a pH of about 3 to 4.6;the baked product having a water activity of about 0.5 to 0.65 and a shelf life greater than about 3 months at ambient temperatures.
2. A baked product of claim 1 wherein:
 - a) the fruit-based filling has a water activity of about 0.6 to 0.65 and a pH of about 3.25 to about 4; and
 - b) the baked product has a water activity of about 0.52 to 0.65.
3. A baked product of claim 1 wherein the fruit-based filling has a water activity of about 0.6 to 0.63.
4. A baked product of claim 1 wherein the fruit-based filling has a pH of about 3.25 to about 3.4.
5. A baked product of claim 1 further comprising a topping.
6. A baked product of claim 5 wherein the topping is a glaze, a stringer, a crumble, or a streusel.
7. A baked product of claim 5 wherein the crust is about 50-85 wt% of the product, the filling is about 15-50 wt% of the product, and the topping is up to about 2 wt% of the product.
8. A baked product of claim 5 wherein the crust is about 60-75 wt% of the product, the filling is about 24-40 wt% of the product, and the topping is about 1 wt% of the product.

9. A baked product of claim 1 wherein the crust has a flour to water ratio of about 2:1 to 3.7:1 and a water activity before baking of less than about 0.85.
10. A baked product of claim 1 wherein the crust has a flour to water ratio of about 3:1 to 3.5:1 and a water activity before baking of about 0.65 to 0.85.
11. A baked product of claim 1 wherein the crust further comprises hydrocolloid(s).
12. A baked product of claim 11 wherein the hydrocolloid(s) comprise locust bean gum and xanthan gum.
13. A baked product of claim 1 wherein the crust has a pH less than about 4.6.
14. A baked product of claim 1 comprising about 10-18 wt% shortening.
15. A baked product of claim 1 comprising about 15 wt% shortening.
16. A baked product of claim 1 wherein the fruit-based filling comprises apples, blueberries, cherries, lemons, or strawberries.
17. A baked product of claim 1 having a shelf life greater than about 6 months at ambient temperatures.
18. A baked product of claim 1 wherein the crust envelops the filling.
19. A baked product of claim 1 wherein a portion of the filling is exposed.
20. A baked product of claim 1 comprising two crusts, wherein the filling is present between the two crusts.
21. A shelf stable, baked, filled food product comprising:
 - a) a flour-based crust containing shortening and potassium sorbate, the crust having a water activity of about 0.5 to 0.65; and

b) a fruit-based filling having water activity of about 0.5 to 0.7 and within 20% of the water activity of the crust, and having a pH of about 3 to 4.6;

the baked product having a shelf life greater than about 3 months at ambient temperatures.

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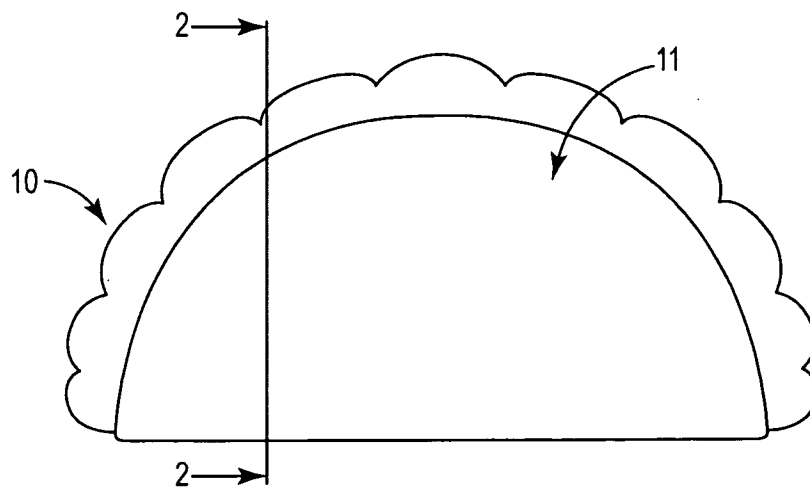


Fig. 1

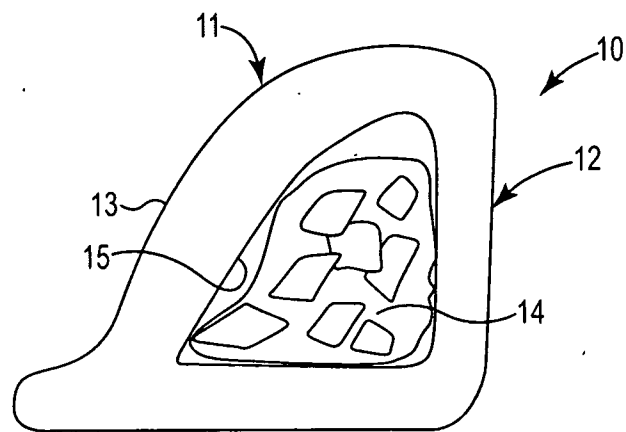


Fig. 2

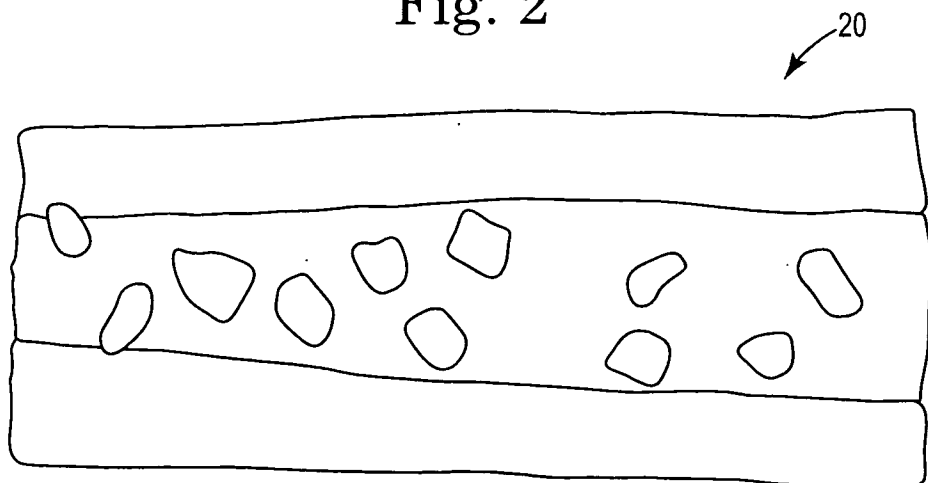


Fig. 3A

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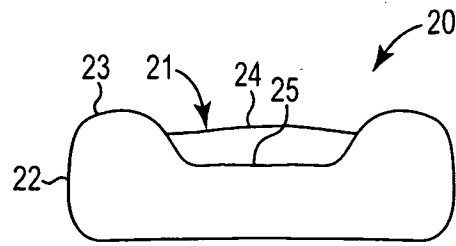


Fig. 3B

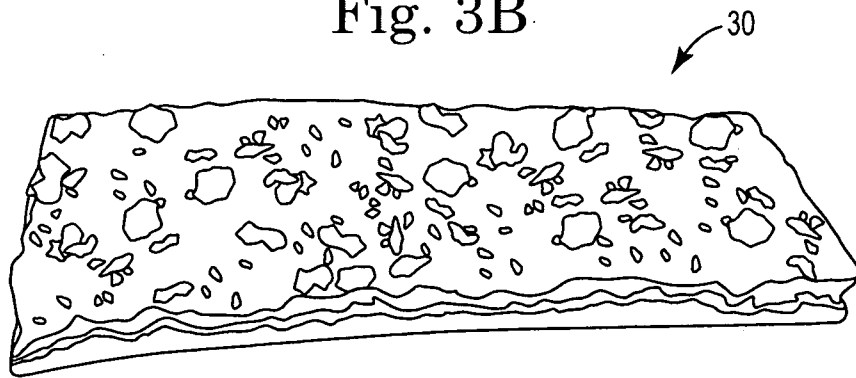


Fig. 4A

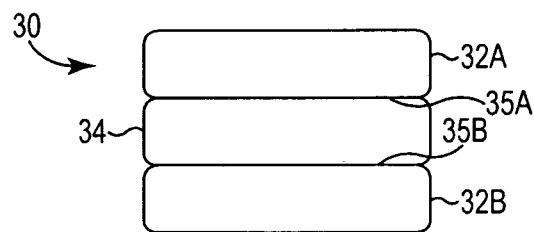


Fig. 4B

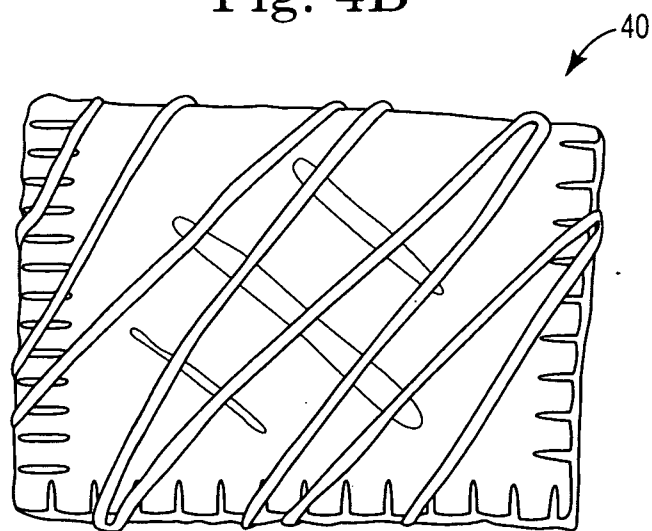


Fig. 5A

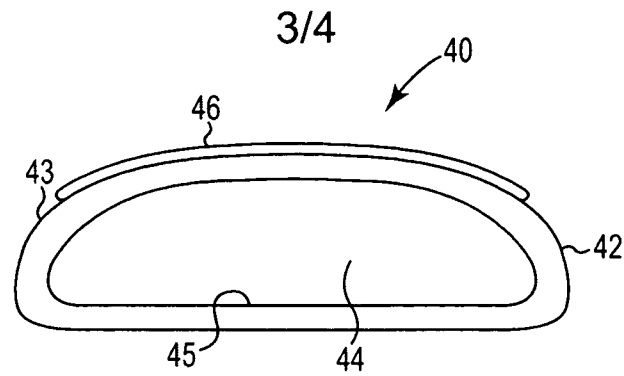


Fig. 5B

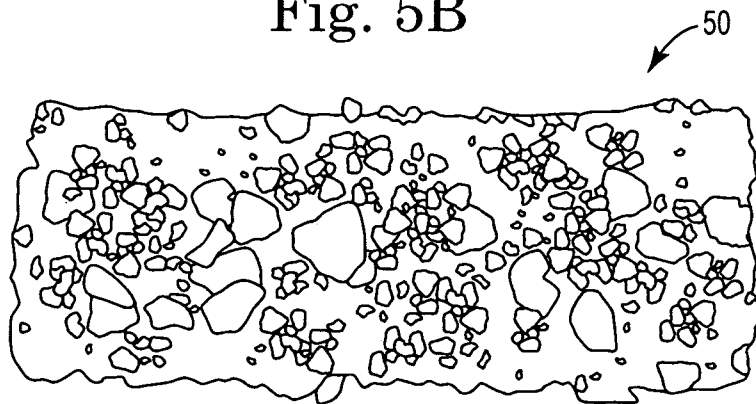


Fig. 6A

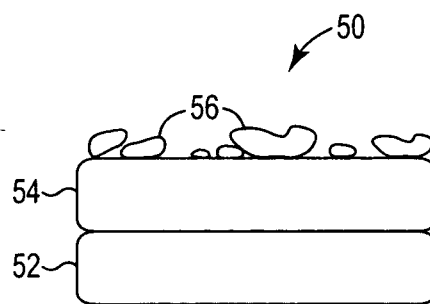


Fig. 6B

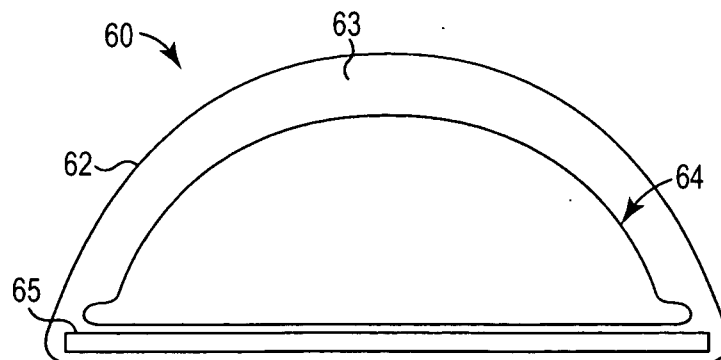


Fig. 7

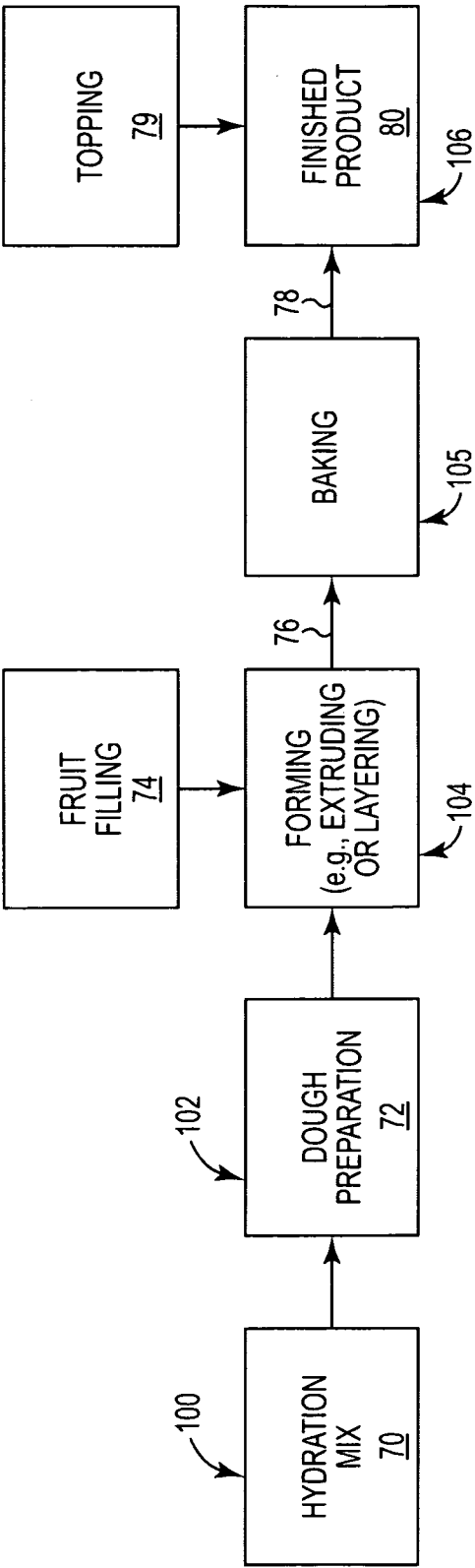


Fig. 8

INTERNATIONAL SEARCH REPORT

13/043212-23-11-2013
International application No.

PCT/US2013/043212

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A21D 13/08 (2013.01)

USPC - 426/89

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - A21D 10/02, 10/04, 13/00, 13/04, 13/08; A23L 1/00, 1/164; A23P 1/08 (2013.01)

USPC - 426/89, 94, 128, 275, 283, 284, 449, 496, 549, 556

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

CPC - A21D 10/025, 13/0019, 13/0022, 13/0041, 13/0045, 13/0067, 13/04, 13/08; A23L 1/00, 1/0014, 1/0044, 1/0067, 1/007, 1/1641; A23P1/086, 1/087 (2013.01)

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

PatBase, Google Patents, Google Scholar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/0220654 A1 (KINO et al) 03 September 2009 (03.09.2009) entire document	1-21
Y	US 6,299,916 B1 (DALLY et al) 09 October 2001 (09.10.2001) entire document	1-21
Y	US 5,340,598 A (HAY JR et al) 23 August 1994 (23.08.1994) entire document	7, 8
Y	WO 2011/109300 A1 (COLEMAN et al) 09 September 2011 (09.09.2011) entire document	8-12
Y	US 2004/0219272 A1 (KRAKLOW et al) 04 November 2004 (04.11.2004) entire document	13

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"P" document published prior to the international filing date but later than the priority date claimed

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

04 November 2013

Date of mailing of the international search report

29 NOV 2013

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