

Title: Low Calorie Fat Substitute5 Technical field

The present invention relates to a fat substitute comprising at least one n-alkenyl succinate starch and at least one polyol for use in bakery products.

10 Background of the invention

In the food processing industry, including that of baked goods, it has, for a long time, been desirable to develop high quality, convenient foods, having ever longer shelf-lives, easier storage conditions, reduced calorie content and high appeal to sight,
15 touch, taste and smell.

New trends such as more natural, healthier, more nutritious foods, reduced fat content, environmental friendliness, freshness and clean label are also in demand.

One particular focus has been the replacement of fat. High intake of fat is associated
20 with increased risk for obesity, some types of cancer. Studies also show strong evidence of a relationship between a high saturated fat intake and a high blood cholesterol level, which is a risk factor for coronary heart disease.

A number of fat substitutes or fat replacers have therefore been developed. Food technologists are investigating a wide range of ingredients and processes to replace fat
25 in foods and beverages.

For example, fats have been replaced by protein-based fat replacers, fat-based fat replacers, or carbohydrate-based fat replacers.

For example US 6,838,107 relates to a method for preparing an improved low-calorie, low-fat foodstuff wherein the improvement includes the partial or total replacement of
30 the fat by a taste effective amount of maltitol.

US 5,409,726 relates to a method of preparing reduced fat foods employing a fragmented starch hydrolysate and a minor amount of a hydrophilic agent.

CA 2,228,805 relates to a high fibre, low fat, low calorie, food formulation comprising an edible cellulose compound and an edible polyhydric alcohol.

Nevertheless there are fat replacers on the market which do not satisfy the needs. Fat cannot be taken out of food without compensating for its various properties.

5 It is all about texture, flavour development and in order to mimic fat, fat replacers have been mixed and matched into "systems" because each fat replacer only mimics one or two functions of fat.

Thus, there exists a need for an improved fat substitute, which acts in itself as a system and mimics of several or preferably all functions of fat. Such a "system" is suitable for
10 entire or partial fat content replacement, for use in the preparation of high quality bakery products, but which can be extended to diverse food applications. The present invention provides such a fat substitute.

Summary of the invention

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The current invention relates to a fat substitute comprising at least one n-alkenyl succinate starch and at least one polyol. Preferably, at least one n-alkenyl succinate starch is an n-alkenyl succinate waxy starch. More preferably, the n-alkenyl succinate starch is n-octenyl succinate starch (n-OSA). The n-octenyl succinate starch is
20 preferably selected from thinned n-octenyl succinate starch.

In addition, the current invention relates to a fat substitute wherein the fat substitute comprises a) from 20 to 60% w/w polyols, preferably from 30 to 60%, more preferably from 45 to 55%, and b) from 1% to 50% w/w n-alkenyl succinate starch, preferably from 20 to 40%, more preferably from 25 to 35%. In a preferred embodiment, the fat
25 substitute further comprises a thickener. The thickener is selected from starches, flours, hydrocolloids and mixtures thereof, preferably starches, more preferably corn starches. In a more preferred embodiment, the fat substitute comprises a) from 20 to 60% w/w polyols, preferably from 30 to 60%, more preferably from 45 to 55%, b) from 1% to 50% w/w n-alkenyl succinate starch, preferably from 20 to 40%, more preferably from
30 25 to 35%, and c) from 1% to 35% w/w thickener, preferably from 15 to 30%.

Furthermore, the current invention relates to a dry fat substitute comprising a blend of the fat substitute according to the current invention. In addition, it relates to a semi-

liquid fat substitute comprising an edible liquid and a fat substitute according to the current invention. Preferably, the consistency of the semi-liquid fat substitute at 20°C is in the range from 50 to 400 loadgram, preferably from 100 to 300, more preferably from 100 to 250. More preferably, said semi-liquid fat substitute comprises from 5 to 30% edible liquid based on the dry weight of the fat substitute, even more preferably 15 to 25%.

The current invention further relates to a dough comprising dough ingredients and the fat substitute of the current invention.

The current invention further relates to a dressing comprising dressing ingredients and the fat substitute of the current invention. Preferably, the dressing comprises from 1 to 15% w/w of fat substitute, preferably 1 to 7%.

The current invention further relates to a bakery product comprising bakery ingredients and the fat substitute of the current invention. Said bakery product is selected from cakes, biscuits, cookies, waffles, donuts, muffins, yeast leavened dough based bakery products, fat-filling and bakery cream.

Furthermore, it relates to a cake, which comprises from 1 to 20% of fat substitute by weight on the dry substance of the baked product, preferably 1 to 15%, more preferably 3 to 13%, and a fat-filling that comprises from 1 to 10% of fat substitute by weight of the fat-filling, preferably 1 to 5%, a biscuit that comprises from 1 to 8% of fat substitute by weight on the dry substance of the baked product, preferably 2 to 5%, and a yeast leavened dough based bakery product that comprises from 1 to 10% of fat substitute by weight on the dry substance of the yeast leavened dough based bakery product, preferably 1 to 5%.

Finally, the current invention relates to the use of a composition comprising at least one n-alkenyl succinate starch and at least one polyol for the preparation of a fat substitute. Preferably said fat substitute is applied in bakery products, in mayonnaise, in sauces, in dressings, in ice cream, in frozen desserts, in chocolate based drinks, and for the preparation of margarine.

Detailed description of the invention

The fat substitute of the current invention is set-up such that the ingredients mimic as a whole the function of fat. Without limiting ourselves to an explanation of the set-up of the system, it might well be that microparticles are formed between the ingredients of the system, which can be seen from the aerated structure, the glossy surface, such that the function of fat is fulfilled. Functions, like bulk, creamy structure, mouthfeel, moisture holding capacity, adhesiveness and shelf stability are fulfilled by the fat substitute of the current invention.

The current invention relates to a fat substitute comprising at least an n-alkenyl succinate starch and at least a polyol. The n-alkenyl succinate starch may be thinned (by acid or enzymatic thinning), undextrinised, dextrinised, granular, pregelatinised and/or stabilised. Alternatively, it may be a mixture of two or more of such n-alkenyl succinate starches. Preferably, at least one n-alkenyl succinate starch is an n-alkenyl succinate waxy starch. More preferably, the n-alkenyl succinate starch is n-octenyl succinate starch (n-OSA). Preferably, the n-OSA starch is selected from thinned starches. The degree of substitution of the n-OSA starch will preferably vary between 0.2 to 3%, even more preferably between 0.5 to 2.5%. The degree of substitution can be determined by HPLC. The starch obtainable according to the process disclosed in EP 0811633 is also a suitable n-alkenyl succinate starch.

The polyol in the fat substitute is having the following chemical formula $C_nH_{2n+2}O_n$.

This chemical formula is typical for hydrogenated carbohydrates but the polyol of the current invention is not necessarily obtained by hydrogenation of the carbohydrate. Some of these polyols (e.g. erythritol) are obtainable via other chemical processes and/or microbial processes or fermentation. Typically, the polyol is selected among the triitols, tetritols, pentitols, hexitols, hydrogenated disaccharides, hydrogenated trisaccharides, hydrogenated tetrasaccharides, hydrogenated maltodextrins and mixtures thereof. More specifically the polyol can be selected from the group consisting of glycerol, erythritol, threitol, arabinitol, xylitol, ribitol, allitol, altritol, gulitol, galactitol, mannitol, sorbitol, talitol, maltitol, isomaltitol, isomalt, lactitol, and mixtures thereof. Preferably, sorbitol is selected as a suitable polyol for the fat substitute. Suitable polyols for use in the current invention can be without limitation for example in dry form such as a powder or liquid form such as a syrup.

Furthermore, the current invention relates to a fat substitute wherein the fat substitute comprises a) from 20 to 60% w/w polyols, more preferably 30 to 60%, even more preferably 45 to 55%, and b) from 1% to 50% w/w n-alkenyl succinate starch, more preferably 20 to 40%, even more preferably 25 to 35%. The invention preferably relates to a fat substitute wherein the fat substitute comprises a) from 20 to 60% w/w sorbitol, more preferably 30 to 60%, even more preferably 45 to 55%, and b) from 1% to 50% w/w n-alkenyl succinate starch, more preferably 20 to 40%, even more preferably 25 to 35%.

In a further embodiment of the invention, the fat substitute further comprises a thickener. A thickener in this context means edible ingredients which contribute substantially to the overall viscosity at temperatures above 60°C. The thickener is selected from the group consisting of starches, flours and hydrocolloids, and mixtures thereof. The thickener can be polydextrose, arabinogalactan, chitosan, chitin, gelatine, xanthan, pectin, cellulose, konjac, gum arabic, soy fiber, inulin, hydrolysed guar, guar gum, beta-glucan, carrageenan, locust bean gum, alginate, polyglycol alginate, starch or mixtures thereof. Preferably starch is applied. The starch used for the current invention is obtained from a source selected from the group consisting of native leguminous starch, native cereal starch, native root starch, native tuber starch, native fruit starch modified leguminous starch, modified cereal starch, modified root starch, modified tuber starch, modified fruit starch, waxy type starches, high amylose starches and mixtures thereof. Actually, the starches and flours which are still containing proteins, such as wheat gluten (hereinafter "starch"), can be derived from any native source, wherein native relates to the fact that said starch is found in nature. Typical sources for the starches are cereals, tubers, roots, legumes, fruit starches and hybrid starches. Suitable sources include corn, pea, potato, sweet potato, sorghum, banana, barley, wheat, rice, sago, amaranth, tapioca, arrowroot, canna, and waxy (containing at least about 95% by weight amylopectin) or high amylose (containing at least 40% by weight amylose) varieties thereof. Also suitable are starches derived from a plant obtained by breeding techniques including crossbreeding, translocation, inversion, transformation or any other method of gene or chromosome engineering to include variations thereof. In addition, starch derived from a plant grown from artificial mutations and variations of the above generic composition, which may be produced by,

known standard methods of mutation breeding are also suitable herein. Modifications are intended to include chemical modifications and physical modifications. The chemical modifications are intended to include without limitation crosslinked starches, acetylated starches, hydroxyethylated and hydroxypropylated starches, inorganically esterified starches, cationic, anionic, oxidized starches, zwitterionic starches, and combinations thereof. Physically modified starches such as thermally inhibited starches may also be suitable for use herein, as base material. In a preferred embodiment the thickener of the current invention is a native starch, more preferably corn starch, tapioca starch, and mixtures thereof.

10 Preferably, the fat substitute comprises a) from 20 to 60% w/w polyols, more preferably 30 to 60%, even more preferably 45 to 55%, and b) from 1% to 50% w/w n-alkenyl succinate starch, more preferably 20 to 40%, even more preferably 25 to 35%, and c) from 1 to 35% w/w thickener, more preferably 15 to 30%. More preferably, the polyol in above fat substitute is sorbitol and/or at least one n-alkenyl succinate starch is an n-alkenyl waxy starch. Even more preferably, the n-alkenyl succinate starch is an n-octenyl succinate starch.

Furthermore, the current invention relates to a dry fat substitute comprising a blend of at least one n-alkenyl succinate starch and at least one polyol. In addition, it relates to a semi-liquid fat substitute comprising an edible liquid and a fat substitute according to the current invention. The edible liquid such as water and/or a water-miscible liquid (such as milk, buttermilk, or to a lesser extent alcohol for example) may be added to the dry fat substitute.

20 Preferably, the semi-liquid fat substitute according to the current invention has a consistency at 20°C in the range from 50 to 400 loadgram, preferably from 100 to 300, more preferably from 100 to 250. The consistency of the semi-liquid fat substitute is measured on a Stevens Texture Analyzer QTS 25 using a cone as penetration tool. The speed of penetration is 50 mm/minute and the distance of penetration is 25 mm. Preferably, said semi-liquid fat substitute comprises from 5 to 30% edible liquid based on the dry weight of the fat substitute, preferably 10 to 20%. The semi-liquid fat substitute may further comprise one or more flavouring(s), colorant(s), vitamin(s) and/or mineral(s) and the like, depending upon the subsequent application.

The term "fat substitute", as used herein, is referring to the dry as well as the semi-liquid fat substitute of the present invention, unless it is specifically mentioned.

In its final form, the (dry or semi-liquid) fat substitute of the present invention is an effective fat substitute for use in bakery products, margarine, mayonnaise, sauces, dressings, chocolate based drinks, ice cream and frozen desserts.

Furthermore, the current invention refers to a dough comprising the fat substitute of the current invention and dough ingredients. The current invention further relates to a bakery product comprising bakery ingredients and the fat substitute of the current invention. Dough in this context means the paste prepared from the fat substitute of the current invention and dough ingredients before any further processing, whereas bakery products mean the end products of the baking process.

The additional dough and bakery ingredients will be apparent to a person skilled in the art. They may include, for instance: flour, raising agents (such as baking powder and/or yeast), water and/or water miscible liquids (such as milk, alcohols, etc.), sweeteners (e.g. sugar or artificial sweeteners), flavourings (e.g. synthetic or natural flavourings such as vanilla, caramel and/or almond flavourings; fruit juices such as orange, grapefruit, pear, cherry, raspberry and/or blackcurrant juices; vegetable extracts such as tomato, carrot, onion and/or garlic extracts; spices; herbs; etc.) and/or one or more natural or synthetic colorants and the like. Optionally, vitamins (such as vitamins A, D3, E, K1, C, B1, B2, B5, B6, B12 and PP, folic acid and biotin) and minerals (such as sodium, potassium, calcium, phosphorus, magnesium, chloride, iron, zinc, copper, manganese, fluorine, chromium, molybdenum, selenium and iodine) can also be added.

The flour used for the dough and bakery products of the current invention may be from any source (e.g. corn flour, soy flour or wheat flour). Most preferably, however, it will be wheat flour. It is the protein of wheat flour, gluten, which distinguishes it from other flours and makes it of particular value in the baking industry. In hard, high-protein wheats, there is more gluten in the endosperm and the starch cells are firmly cemented together. In soft, low-protein wheats the bonding is not so firm. For most cakes a soft, low-protein flour is needed for obtaining a tender cake. Flours used for pan bread production will generally be milled from hard wheats of high protein content, although soft wheats can give optimum quality in the type of bread that is most popular in some countries. Ideally, the flour will be non-chlorinated. It has indeed been found that

certain starches – such as those used in the present invention (i.e. n-OSA starch) – can be used to supplement non-chlorinated flour whilst maintaining characteristics such as dough volume, crumb hardness and bakery product volume comparable to those of products prepared with chlorinated flour (the use of which is now banned in many countries).

The choice of additional ingredients will depend, of course, on the dough and bakery product being produced. Indeed, the fat substitute according to the present invention can be used in the manufacture of bakery products such as cakes, biscuits, cookies, waffles, donuts, muffins, yeast leavened dough based bakery products, fat-filling and bakery cream.

More specifically it can be used in cakes such as pound cake, sponge cake, chiffon cake, cheesecake, fruitcake, layer cake and gingerbread.

Furthermore, it relates to a cake, which comprises from 1 to 20% of fat substitute of the current invention by weight on the dry substance of the baked product, preferably 1 to 15%, more preferably 3 to 13%.

The cake dough prepared with the fat substitute is good aerated and smooth. The cakes have a regular and fine crumb structure. For example, a high quality pound cake is obtained. The water activities (a_w) of the cakes obtained employing the fat substitute of the current invention imply a shelf life similar to standard cakes. Actually, the fat substitute concept creates the possibility to decrease the amount of energy in cakes resulting in an application with acceptable sensorial properties and good shelf-life. The product containing the fat substitute provides softness and melting effect of crumb which facilitates its consumption.

Furthermore, it also relates to biscuits comprising 1 to 8% of fat substitute of the current invention by weight on the dry substance of the baked product, preferably 2 to 5%. Biscuits with 1 to 20% reduction of fat by replacing it with the fat substitute of the current invention are high quality products.

Thus, the present invention further relates to the use of this fat substitute in bakery products in which it is desired to reduce cholesterol levels and/or calorie content. In fact, the fat substitute of the current invention can further be used in sugar-reduced products, wherein the sugar is for instance replaced fully or partially by polyols or sugar substitutes either alone or in combination with intense sweeteners.

The current invention further relates to a fat-filling that comprises from 1 to 10% of fat substitute of the current invention by weight of the fat-filling, preferably 1 to 5%, and further ingredients. Suitable further ingredients are without any limitation, sugar, milk powder, chocolate powder and eventually fat, depending upon partial or full fat substitution. Products including the fat substitute of the current invention, show a long shelf life.

The current invention further relates to a yeast leavened dough based bakery product comprising 1 to 10% of fat substitute of the current invention by weight on the dry substance of the yeast leavened dough based bakery product, preferably 1 to 5%. Yeast leavened dough based bakery products are for example Brioche style and toast breads. Concerning colour, shape, crumb colour and texture is the Brioche bread wherein one third of the butter was replaced by the fat substitute according to the current invention equal or even superior than the bread without fat substitute.

The current invention further relates to a dressing comprising dressing ingredients and the fat substitute according to the current invention. Preferably, the dressing comprises from 1 to 15% of fat substitute of the current invention by weight of the dressing, more preferably from 1 to 7%. This percentage is based upon the total weight of the dressing. The additional dressing ingredients will be apparent to a person skilled in the art. They may include, but are not limited to, all kinds of vegetable oils, egg yolk, edible liquids (such as water), all kinds of vinegars, mustards, sugars, salts, starches and other hydrocolloids including but not limited to polydextrose, arabinogalactan, chitosan, chitin, gelatine, xanthan, pectin, celluloses, konjac, gum arabic, soy fiber, inulin, hydrolysed guar, guar gum, beta-glucan, carrageenan, locust bean gum, alginate, polyglycol alginate.

Finally, the current invention relates to the use of a composition comprising at least one n-alkenyl succinate starch and at least one polyol for the preparation of a fat substitute. Preferably said fat substitute is applied in bakery products, in mayonnaise, in sauces, in dressings, in ice cream, frozen desserts, in chocolate based drinks, and for the preparation of margarine.

A preferred method for preparing the fat substitute according to the current invention is by application of a fluidized bed reactor. For example, the polyol can be sprayed as a liquid (e.g. syrup) into the other ingredients of the fat substitute of the current

invention or water can be sprayed into the ingredients of the fat substitute of the current invention. This leads to a fat substitute with desired moisture content and high porosity that can then further be employed in applications as mentioned previously.

The current invention has also the following advantages: The fat substitute of the current invention is spoonable and has a white opaque and glossy surface; there is no separation occurring during storage; while fat has an energy of 9 kcal/g, the fat substitute of the current invention has a reduced energy value of 3.1 kcal/g for the dry fat substitute and 2.6 kcal/g for a semi-liquid fat substitute containing 22% water based on the dry weight of the fat substitute, therefore the products prepared with this fat substitute exhibit a significant reduction of the caloric value and yet the perception of fat is obtained; the water activity values (a_w) of products prepared using the fat substitute of the current invention indicate a long shelf life.

The current invention is illustrated in the following example.

Example 1

Preparation of semi-liquid fat substitute

Ingredients:

- 1) 288 g (n-alkenyl succinate starch, 12635, Cargill)
- 2) 472 g (Polyol, 16656, Cargill)
- 3) 240 g (Thickener, 03401, Cargill)
- 4) 220 g water.

The three first ingredients were thoroughly dry blended and the fourth ingredient, water, was slowly added to the first blend, at a temperature between 20 and 40°C. Everything was mixed in the Hobart mix for 8 minutes.

Example 2

Preparation of biscuits with 20% fat reduction

The biscuits were prepared according to a reference recipe and a recipe including the fat substitute of example 1.

Recipe: The quantities are expressed in grams.

Refined palm oil	15	12
Semi-liquid fat substitute of example 1	0	3
Sucrose (S1)	15.3	15.3
Whole milk solids	0.6	0.6
Salt	0.5	0.5
Water	7.9	7.9
Flour (Duo from Ceras)	60	60
Baking powder	0.7	0.7
Total	100	100

All the ingredients (except the flour, baking powder and water) were mixed during 5 minutes (at medium speed of mixer). Water was then added and mixed in during 1 minute. Flour and baking powder were then added and the whole was further mixed for 2.5 minutes. The dough was laminated until a thickness of 3.5 mm was reached. These laminates were cut in round pieces by applying a round plug.

The biscuits were baked at 210°C for 12 minutes.

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Results:

The dough with fat substitute exhibited the same properties as the reference dough. No shrinking effect was observed. The colour (light brown), the crumb colour (pale yellow), the crumb structure (open and round pores), the bottom structure (somewhat open) as well as taste, and edibility (short, crumbly and dry) were identical for the reference material and the biscuits comprising the fat substitute of example 1. After 5 weeks of storage, no cracks within the biscuits were observed. A 20% fat reduced biscuit prepared according this recipe is a high quality biscuit.

20 Example 3

Preparation of fat-filling with 10% fat reduction

Recipe: The quantities are expressed in grams.

The fat-filling was prepared according to a reference recipe and a recipe including the fat substitute of example 1.

	Reference recipe	Recipe including fat substitute of example 1
Fat	330	297
Semi-liquid fat substitute of example 1	0	33
Icing sugar	300	300
Dextrose	220	220
Cocoa (10% fat)	100	100
Skimmed milk powder	50	50
Total	1000	1000

- 5 The fat substitute and the remaining fat were creamed into a Hobart mixer until smooth mixture. The cocoa powder was added, followed by the icing sugar and the dextrose. Everything was mixed for 5 minutes at medium speed of the Hobart mixer. Afterwards the fat filling is packed.
- 10 The characteristics of the fat-filling are displayed in Table 1.

Table 1

<u>Characteristics</u>	<u>Reference</u>	<u>Fat filling containing Fat substitute of example 1</u>
a_w	0.419	0.449
Hardness measured on Stable Micro Systems with a penetration depth of 20 mm employing plastic tube P4 (4 mm diameter)		
after 48 hours, at 20°C,	100 grams	122 grams

after 8 weeks at 20°C	100 grams	118 grams
Specific volume cm ³ /g	1.52	1.49

- Biscuits were filled with the fat-fillings and stored at 35°C. After 2 weeks of storage, none of the trials showed leaking problems and the taste was still good. The fat-fillings containing the fat substitute of example 1 are somewhat harder but exhibit a less fatty mouth feel compared to the reference fat-filling. The water activity value (a_w) of the fat-filling containing the fat substitute of example 1 signifies a long shelf life.

Example 4

Preparation of cake with 25% fat reduction

10 Recipe:

The cake was prepared according to a reference recipe and a recipe including the fat substitute of example 1. The quantities are expressed in grams.

	Reference recipe	Recipe including fat substitute of example 1
Cake mix	1100	1100
Whole eggs	550	550
Semi-liquid fat substitute of example 1		138
Margarine	550	412
Total	2200	2200

- 15 All the ingredients were mixed during 5 minutes in a Hobart mixer. 400 g of the dough was transferred into a tin, and baked for 55 minutes at 175°C. The results of the dough characteristics and the baked product (cake) are displayed in Table 2.

Table 2

Characteristics Dough	Reference	Product containing fat substitute of example 1
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Temperature dough (°C)	24.5	24.5
Consistency measured by Stevens Texture Analyzer QTS 25, penetration depth 25 mm with cone (loadgram)	58	57
Specific volume (cm ³ /g)	3.27	3.24
Characteristics of cakes	Reference	Product containing fat substitute of example 1
Weight (g)	367	368
Volume (cm ³)	1825	1850
Specific volume (cm ³ /g)	4.97	5.02
Hardness measured on Stable Micro Systems, cone P5, 5 mm diameter, penetration 20 mm (g)		
Day 21	4926	3397
Day 40	5688	4317
a _w changes with time:		
Day 21	0.794	0.811
Day 40	0.800	0.816

The cake dough was good aerated and smooth (applicable for reference and dough containing the fat substitute according to example 1). The cakes containing the fat substitute according to example 1 had a regular and fine crumb structure. They were also somewhat softer than the reference cake without the fat substitute which is very positive. The water activity (a_w) values indicated a similar shelf life for cakes containing the fat substitute according to example 1 and the reference cake. A pound cake of particular high quality was obtained using the fat substitute according to example 1).

Example 5:

Preparation of Brioche style bread.

The breads were prepared according to a reference recipe and a recipe including the fat substitute of example 1. The quantities are expressed in grams.

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	Reference	Product containing fat substitute of example 1
Flour Edelweiss Meneba	2000	2000
Water (10°C.)	750	750
Eggs	360	360
Butter	240	160
Sugar	100	100
Semi-liquid fat substitute of example 1	0	80
Milk powder (24% fat)	60	60
Yeast	75	75
Glucose syrup (fructose content: 30% by weight on dry substance)	60	60
ImproverS500 (Puratos) emulsifier	40	40
Salt	40	40
Lecimulthin 150 IP (Cargill)	10	10
Total	3735	3735

The dough was kneaded including all ingredients, except salt, using a Kemper, type SP15, kneader during 16 minutes at speed I. The salt was added after 10 minutes of kneading. The conditions during preparation of the dough are shown in Table 3.

10

Table 3.

Temperature in the bakery (°C)	24
Relative humidity in the bakery (%)	60
Water temperature (°C)	10

Temperature in the proofing cabinet (final fermentation) (°C)	33
Relative humidity in the proofing cabinet (%)	80
Temperature of the dough before baking (°C)	26-26,3

The preparation was as follows. After kneading, the dough was left (relaxing time) for 30 minutes. The dough was then punched and scaled to 450 grams of dough. After rounding, the dough was left for fermentation time of 20 minutes. It was further
5 moulded and panned and then left in the proofing cabinet for 65 minutes. After that, it was baked for 28 minutes at 220°C and then cooled for one hour. At the end, the bread was packaged.

Results dough:

10 The consistency measured on a farinograph (standard AACC method, 30°C) was similar for both doughs produced. The fat reduced dough was dry, not sticky and had excellent film forming capacities. The fat replacement using the fat substitute according to example 1 did not lead to a weakening effect of the dough compared with
15 fermentation time compared with reference.

Results baked product:

<u>external</u>	reference	fat reduced
Colour	brown	brown
Shape	regular	regular
Ovenspring (increase of volume during baking)	standard	10 to 15% increased compared to standard
<u>internal</u>	reference	fat reduced
Crumb colour	yellow	less yellow
Texture	soft	soft

Crumb structure	fine pores	finer pores (thinner cellwalls)
Distribution of pores	regular	regular
Chewability	soft	soft
Feel	somewhat sticky	somewhat sticky
Feel after 4 days	less soft	less soft
	somewhat crumbly	smoother than reference
Taste	fatty	less fatty
Specific volume (cm ³ /g)	5,54	5,57
Hardness measured on Stable Micro Systems, cone P45 (4.5 mm diameter), penetration 25 mm:		
Day 2	469	481
Day 5	621	635

The value for hardness is the mean value of 10 measurements carried out.

5 Example 6:

Reduction of fat from 70% oil to 30% w/w oil in dressings.

Preparation of fat substitute

Ingredients:

- 10 1) 24% w/w (n-alkenyl succinate starch, 12635, Cargill)
- 2) 47% w/w (Polyol, 16616, Cargill)
- 3) 29% w/w (Thickener 06748, Cargill)

- The dressings were prepared according to the reference recipe with 70% oil and a 30 %
- 15 w/w oil recipe with the above fat compound. The quantities are expressed as percentages of the total weight of the dressing.

	Reference: 70% w/w oil dressing	30% w/w oil dressing + fat substitute	Phases
Fat substitute	0.0	3.0	Water phase
C*PolarTex 06748 (Cargill)	0.0	3.4	
Sugar	3.0	3.0	
Salt	2.0	2.0	
Potassium sorbate	0.1	0.1	
Water	14.2	49.8	
Sunflower oil	5.0	5.0	Dispersion phase
Egg yolk powder	3.5	1.5	
Guar gum/xanthan gum (2/3 by weight)	0.2	0.2	
Sunflower oil	65.0	25.0	Oil phase
Vinegar	5.0	5.0	Acid phase
Mustard	2.0	2.0	
Total	100	100	

- The preparation of the dressing was carried out as follows on a MaxxD lab colloid mill. The colloid mill was put under vacuum (700mbar). The water phase of the dressing was put into the vessel and the MaxxD lab colloid mill was switched on homogenization mode (30 seconds on 1200 rpm and 60 seconds at 0 rpm). The pressure in the vessel was restored to atmospheric pressure by opening the air-inlet valve of the vessel. Then, it was heated up to 95°C and the homogenization mode was stopped when 95°C was reached.
- 10 The Maxx D lab colloid mill was put under vacuum (700mbar) and cooled down to 35°C. When 35°C was reached the homogenizer was switched on at 3000 rpm. The dispersion phase was added into the Maxx D lab colloid mill and the mixture homogenized continuously for 30 seconds. Then, the oil phase was added within a time

of 60 seconds. After 2/3 of the amount of the oil phase was added, the acid phase was added. The homogenization was continued for 30 seconds.

The pressure in the vessel was restored to atmospheric pressure by opening the air-inlet valve of the vessel.

- 5 The two prepared dressings have comparable properties. Sensory evaluation showed similar results for both: mouthfeel, body, color, shortness, smoothness and gloss are comparable for both. Both dressings were of equally excellent quality.

10 Example 7:

Reduction of fat from 30% oil to 10% w/w oil in a dressing with and without egg yolk.

Preparation of fat substitute

Ingredients:

- 15 1) 24% w/w (n-alkenyl succinate starch, 12635, Cargill)
2) 47% w/w (Polyol, 16616, Cargill)
3) 29% w/w (Thickener 12748, Cargill)

- 20 The dressings were prepared according to the reference recipe with 70% oil and a 30 % w/w oil recipe with the above fat compound. The quantities are expressed as percentages of the total weight of the dressing.

	Reference: 30% oil dressing	10% oil with egg yolk – 3% fat substitute	10% oil dressing without egg yolk – 3% fat substitute	Phases
Fat substitute	0.0	3.0	3.0	Water phase
Sugar	3.0	2.1	2.1	
Salt	2.0	2.0	2.0	
Potassium sorbate	0.1	0.1	0.1	

Water	53.2	69.1	68.9	
C*HiForm 12748 (Cargill)	3.0	5.0	6.7	Dispersion phase
Sunflower oil	5.0	5.0	5.0	
Egg yolk powder	1.5	1.5	0.0	
Guar gum/xanthan gum (2/3 by weight)	0.2	0.2	0.2	
Sunflower oil	25.0	5.0	5.0	Oil phase
Vinegar	5.0	5.0	5.0	Acid phase
Mustard	2.0	2.0	2.0	
Total	100.0	100.0	100.0	

- The preparation of the dressing was carried out as follows on a MaxxD lab colloid mill. The colloid mill was put under vacuum (700mbar). The water phase of the dressing was put into the vessel and the MaxxD lab colloid mill was switched on
- 5 homogenization mode at 3000 rpm. The dispersion phase was added into the Maxx D lab colloid mill and the mixture homogenized continuously for 30 seconds. Then, the colloid mill was stopped and the mixture was left for 5 minutes. The colloid mill was switched on again at 3000 rpm. Then, the oil phase was added within a time of 60
- 10 seconds. After 2/3 of the amount of the oil phase was added, the acid phase was added. The homogenization was continued for 30 seconds.
- The pressure in the vessel was restored to atmospheric pressure by opening the air-inlet valve of the vessel.
- The two prepared dressings have comparable properties. Sensory evaluation gave
- 15 similar dressings of excellent quality: mouthfeel, body, color, shortness, smoothness and gloss are comparable for the reference sample, the sample with fat compound and the sample with fat compound and no egg yolk.

Claims

1. A fat substitute comprising
 - a) from 30 to 60% w/w polyols, preferably 45 to 55%, and
 - b) from 20 to 40% w/w n-alkenyl succinate starch, preferably 25 to 35%.
2. The fat substitute according to claim 1, wherein at least one n-alkenyl succinate starch is an n-alkenyl succinate waxy starch.
3. The fat substitute according to either claim 1 or claim 2, wherein the n-alkenyl succinate starch is n-octenyl succinate starch.
4. The fat substitute according to anyone of claims 1 to 3, wherein the polyol is selected from the group consisting of glycerol, erythritol, threitol, arabinitol, xylitol, ribitol, allitol, altritol, gulitol, galactitol, mannitol, sorbitol, talitol, maltitol, isomaltitol, Isomalt, lactitol, and mixtures thereof, preferably sorbitol.
5. The fat substitute according to anyone of claims 1 to 4, wherein the fat substitute further comprises a thickener.
6. The fat substitute according to claim 5, wherein the thickener is selected from the group consisting of starches, flours, hydrocolloids and mixtures thereof, preferably starches.
7. The fat substitute according to either claim 5 or claim 6, wherein the system comprises
 - a) from 30 to 60% w/w polyols, preferably 45 to 55%,
 - b) from 20 to 40% w/w n-alkenyl succinate starch, preferably 25 to 35%,
 - c) from 1% to 35% w/w thickener, preferably 15 to 30%.
8. The fat substitute according to claim 7, wherein the polyol is sorbitol.
9. The fat substitute according to either claim 7 or claim 8, wherein at least one n-alkenyl succinate starch is an n-alkenyl succinate waxy starch.

10. The fat substitute according to anyone of claims 7 to 9, wherein n-alkenyl succinate starch is n-octenyl succinate starch.
11. The fat substitute according to anyone of claims 1 to 10, wherein the fat substitute is in the form of a blend.
12. A semi-liquid fat substitute comprising an edible liquid and a fat substitute according to any one of claims 1 to 11, wherein the semi-liquid fat substitute comprises 5 to 30% edible liquid based on the dry weight of the fat substitute, preferably 15 to 25%.
13. The semi-liquid fat substitute according to claim 12, wherein the consistency of the semi-liquid fat substitute at 20°C is in the range from 50 to 400 loadgram, preferably from 100 to 300, more preferably from 100 to 250.
14. Use of a fat substitute according to any one of claims 1 to 13 in bakery products, margarine, mayonnaise, sauces, dressings, ice cream or frozen desserts.