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(54) Title: PROCESS FOR PRODUCING A WATER-IN-OIL EMULSION

(57) Abstract: The present invention relates to a process for producing a water-in-oil emulsion, such as a margarine or a spread, and a bakery product having a layered structure, such as a croissant or a Danish pastry, made from a dough comprising the emulsion.

PROCESS FOR PRODUCING A WATER-IN-OIL EMULSION

FIELD OF INVENTION

The present invention relates to a process for producing a water-in-oil emulsion, such as a margarine or a spread, and a bakery product having a layered structure, such as a croissant or a Danish pastry, made from a dough comprising the emulsion.

BACKGROUND OF INVENTION

Water-in-oil emulsions have long been used in baking and as fillings and toppings. Examples include roll-in or laminating margarine-type compositions for making pastry and bread products such as those which are baked to exhibit a flaky consistency. Usually, they are formulated to have a spreadable consistency when used at room temperature and even when used at refrigerated temperatures. Examples of traditional spreads in this regard include spreadable margarine and the like. Margarine usually contains about 80% fat or oil (in the present specification there will be made no distinction between "fat" and "oil") mainly consisting of triglycerides, i.e. glycerol in which all three of the hydroxyl groups are esterified with fatty acids, which may be saturated or more or less unsaturated.

Edible oil based emulsions are well-known to provide consistency, texture and functional attributes that are very suitable for these types of applications. A typical edible oil based emulsion suitable for these types of uses, including roll-in or laminating spreads, have a fat content of at least 80 weight percent, based on the total weight of this type of spread.

Bakery products having a layered structure containing a roll-in spread may be broadly classified into those produced by using yeast, such as Danish pastry and croissant, and those produced without using yeast, such as pie. Each of these bakery products may be produced by sheeting and folding a dough, which has been prepared by kneading a mixture comprising, for example, wheat flour, salt, sugar and water, together with a plastic water-in-oil emulsion, such as butter or margarine several times, allowing the layered dough thus obtained for an appropriate retarding time, then subjecting it to the final sheeting, stamping out a suitable shape from the dough, moulding it into a desired shape, optionally effecting the final proofing, and then baking.

According to US patent 3505074 the emulsifying properties of phosphatides, for example as anti-spattering agent in margarine, can be improved by partial hydrolysis of the phosphatides. US patent 3652397 discloses the use of lipase and lecitinase A (aka phospholipase A2) treated phosphatides as anti-splattering agents in margarine. These patents do not mention margarines with improved baking properties.

CONFIRMATION COPY

US patents 5378623 and 5538874 are related and disclose a phospholipase A 1 which is capable of hydrolyzing a phospholipid to produce a 2-acyl lysophospholipid and is obtainable from species of the fungus Aspergillus.

US 20070009644 relates to a method for the enzymatic production of emulsifiers containing mono- and diacylglycerides by adding an aqueous solution of an enzyme (such as lipase) to a mixture of a phospholipid (such as lecithin) and a triacylglyceride (such as soy oil). The emulsifier is claimed to be usable for producing e.g. margarine.

There exists a commercial need for a margarine product which has improved spreading and baking properties, particularly for baking products with layered structure, such as of the croissant type or Danish pastry. The cited prior art is silent on how to solve this problem.

SUMMARY OF INVENTION

An object of the present invention was to provide edible oil based spreads having improved baking properties, especially when baking products with layered structure.

The present inventor has surprisingly found that addition of certain enzymes to a spread during its production results in a spread with advantageous properties. In accordance with this surprising finding, the present invention relates to a water-in-oil emulsion containing a phospholipase, preferable of the type A1. In addition, it has turned out that the enzyme can replace the hitherto used emulsifier (e.g. lecithin) partly or fully, without losing the water binding capacity of the spread.

The bakery product based on the emulsion of the invention has a uniform structure, especially when a phospholipase A1 enzyme is added to the emulsion.

DETAILED DISCLOSURE

An aspect of the present invention relates to a process for producing a water-in-oil emulsion (eg a margarine or a spread), characterized in that a composition comprising an oil, water, a phospholipase, and a phosphatide is mixed. The phospholipase may be selected from the group consisting of: an enzyme classified in EC 3.1.1.32; an enzyme classified in EC 3.1.1.4; an enzyme classified in EC 3.1.4.3; phospholipase A1; phospholipase A2; and phospholipase C. In an interesting embodiment, the phospholipase is selected from the group consisting of phospholipase A1 and phospholipase A2, and it is presently preferred that the phospholipase is phospholipase A1, especially YieldMAX®. Examples on phospholipases applicable in the present invention are disclosed in e.g. WO98/26057, WO00/32758, WO07/113257 and WO04/054377. The phospholipase may, for example, be added in an amount in the the range 0.01 to 1.0% (w/w).

The phosphatide source is not important, and it is presently preferred to use a phosphatide selected from the group consisting of phosphatidylcholine (lecithin), plant phosphatide, egg yolk phosphatide, phosphatidylethanolamine (cephalin), and fish oil lecithin. The phosphatide may, for example, be added in an amount in the the range 0.1 to 5.0% (w/w).

The reaction time of the process seems not to be critical, but in an embodiment of the invention the process is allowed to proceed until the phospholipids in the water in oil emulsion is consisting of more than 20% lyso-phospholipids (w/w), preferably at least 35% lyso-phospholipids, most preferably at least 50% lyso-phospholipids. After the desired amount has been reached, the process may be stopped by e.g. heat treatment.

The oil is preferably an edible oil and/or an vegetable oil, such as an oil selected from the group consisting of: butter oil, lard, sunflower oil, rapeseed oil, coconut oil, soybean oil, canola oil, cottonseed oil, corn oil, palm oil, palm kernel oil, rice bran oil, cocoa butter fat, and combinations thereof.

In a further embodiment of the process of the invention, the composition may comprise a further component selected from the group consisting of: an emulsifier, and a milk protein. The further component may, for example, be added in an amount in the the range 0.1 to 5.0% (w/w).

In a last embodiment the process of the invention may comprise a further step selected from the group consisting of: packing, crystallization, filtration, heating, cooling, pasteurizing, flavoring and coloring.

In a second aspect, the present invention relates to a water-in-oil emulsion obtainable by the process of the invention, such as a water-in-oil emulsion, which is obtainable by mixing a composition comprising an edible oil, a phosphatide, a phospholipase, and water. The emulsion may further comprise an additional emulsifier, and/or milk protein. A presently preferred emulsion is obtained using phospholipase A1, especially YieldMAX®.

The amount of oil in the emulsion is dependent on the oil used, and of the desired plasticity. It is presently preferred that the emulsion consists of at least 35% oil, such as at least 55% oil, or at least 75% oil, said oil may for example be selected from the group consisting of: butter oil, lard, sunflower oil, rapeseed oil, coconut oil, soybean oil, canola oil, cottonseed oil, corn oil, palm oil, palm kernel oil, rice bran oil, cocoa butter fat, and combinations thereof.

In interesting embodiments, a mixture/combination of different oils are used for preparation of the emulsion, and/or the emulsion contains 75-90% oils and 10-25% water (w/w). It is

presently preferred that the obtained emulsion has a plasticity suitable for laminating dough, especially at ambient temperature, such as at a temperature in the range 10-30 degrees C.

In a further aspect, the present invention relates to a dough which comprises a water-in-oil emulsion of the invention, preferably a laminated dough, such as a pastry dough, a croissant dough and a pie dough.

The invention also relates to a process for producing a laminated dough, which comprises surrounding a layer of the emulsion of the invention with a dough, and optionally flatten and folding the resulting dough. The surrounding may be partially, but it is presently preferred that both sides of the layer are contacted with dough.

In a last aspect, the invention relates to a bakery product obtainable by baking the dough of the invention, e.g. a bakery product selected from the group consisting of a croissant, a Danish pastry, a pie and a pastry.

DEFINITIONS

In the present context, the term "oil" comprises refined or unrefined vegetable oil, partially or completely hardened (hydrogenated) vegetable oil/fat or animal oil/fat, all of the main components of which are triacylglycerides. Mono-, di- and triacylglycerides have one, two or three acyl groups which are derived from a long-chain saturated or monounsaturated or polyunsaturated fatty acid. Preferably, the acyl groups have 6 to 35 carbon atoms, in particular 10 to 30 carbon atoms, and still more preferably 12 to 26 carbon atoms. Monoacylglycerides can be 1- or 2-monoacylglycerides, di-glycerides can be 1,2- or 1,3-diacylglycerides.

The term "edible oil" refers to oils that can be consumed of humans without adverse effects. Edible oils may include canola oil, coconut oil, corn oil, cottonseed oil, grape seed oil, olive oil, palm oil, peanut oil, rapeseed oil, safflower oil, sesame oil, soybean oil, sunflower oil, and walnut oil.

The term 'lecithin' is a generic word used to refer to either phosphatidylcholine (PC) or a group of phosphate acids. Soya lecithin is typically the commercial kind, which consists of three types of phospholipids: phosphatidylcholine (PC), phosphatidylethanolamine (PE), and phosphatidylinositol (PI). All of these phospholipids are a major component in the formation of cell membranes, along with cholesterol and glycerides.

The use of the terms "a" and "an" and "the" and similar referents in the context of describing the invention (especially in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by

context. The terms "comprising", "having", "including" and "containing" are to be construed as open-ended terms (i.e., meaning "including, but not limited to,") unless otherwise noted. Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention.

EXAMPLES

Example 1 Production of margarines for the baking trials.

Three margarines were produced in pilot plant scale, 40 kg per batch. The recipes are shown in the table below.

	Reference margarine, % (weight)	**Reference + YieldMAX, %**	**Reference without emulsifier + YieldMAX, %**
Palm oil (refined, bleached, deodorized)	20.0	20.0	20.0
Palm stearin	52.0	52.0	52.0
Liquid oil (soy)	7.8	7.8	7.8
Water	16.6	16.4	16.4
Salt (NaCl)	1.5	1.5	1.5
K-sorbate	0.1	0.1	0.1
YieldMAX ® Novozymes A/S	0	0.2	0.2
Soy lecithin	1.0	1.0	1.0
Emulsifier Grindsted PS404 from Danisco	1.0	1.0	0
Procedure	Lecithin, emulsifier and oil are mixed at 60°C for 10 minutes, cooled to 45°C, mixed for 10 minutes with water	Lecithin, emulsifier and oil are mixed at 60°C for 10 minutes, cooled to 45°C, mixed for 20 minutes	Lecithin and oil are mixed at 60°C for 10 minutes, cooled to 45°C, mixed for 20 minutes with water

	phase (water, salt + sorbate) at 45°C before processing in the margarine unit	with water phase (water, salt + sorbate+ YieldMAX) at 45°C before processing in the margarine unit	phase (water, salt + sorbate+ YieldMAX) at 45°C before processing in the margarine unit

Example 2 Baking trials

An intercontinental pastry (Danish type) recipe was used for making croissants and lift rings. The dough is made according to the following recipe:

Ingredients	Recipe in %	Recipe in kg	Bakers %
Flour* (kept at -18°C)	57.23	0.835	100
Water (as cold as possible)	27.41	0.400	47.9
Eggs (hole eggs)	5.83	0.085	10.1
Yeast	2.40	0.035	4.2
Salt	0.27	0.004	0.48
Sugar	3.43	0.050	6.0
Cake margarine	3.43	0.050	6.0
Total yield	100.00	1.459	
Pastry fat** (or margarine tempered for at least 12 hours until the desired temperature has been reached)	57.23	0.835	100

Flour*: Meneba Pelicaan pastry flour used, protein content about 13.6 %

Margarine**: three types made at Chr. Hansen pilot plant and one from Vejle Margarine fabrik, Denmark (VM-standard 16 or VM-16: "Eminent 16 rullemargarine").

All ingredients are kneaded at the low speed (78 rpm) for 1 minute & 3 minute high (138 rpm) in the pin mixer with water-jacket. Dough temp. 15°C. 3 minutes floor time.

The tempered margarine is pre-kneaded. The margarine is pounded into a square; plasticity is determined when performing this. Afterwards the dough is outstretched to approx. 25 x 25 cm, the pastry margarine is placed on the surface and immediately surrounded by the dough.

The incorporated margarine is laminated 3 x 3 on the laminate table sheeter, ie laminated 3 x 3 half fold (27 layers of margarine). The dough/margarine is drawn to 12 mm prior to each folding, the laminator is to be moved 1 streak at the time. The pastry dough is drawn to 15 mm at the last folding. Cover the dough completely with plastic. Place the pastry dough in the

freezer (-18°C) for 30 min. After sheeting rings 79 mm outer and 38 mm inner diameter were cut for baking.

The laminating process ends with a dough of 15 mm thickness. After that follows a preparation of the products before the baking. This preparation consists of a rolling out at dough thickness of 7.0mm which is the "Height before baking" mentioned in the tables below. These tables also include a "Max height" and a "Min height" column with measurements of ring heights (maximum and minimum on each ring) on 10 rings after the baking, measured in cm.

Lift calculation:

Lift (volume) Ref

Dough	Max height	Min height	Heights before baking
1	2,0	1,9	7,0
2	2,1	1,7	7,0
3	1,9	1,8	7,0
4	2,4	1,6	7,0
5	2,1	1,8	7,0
6	2,4	1,5	7,0
7	2,1	1,8	7,0
8	2,6	1,8	7,0
9	2,1	1,6	7,0
10	2,4	1,4	7,0
Average	2,2	1,7	**2,2+1,7/2= 1,95**

Lift (volume) Yieldmax-emulg

Dough	Max height	Min height	Heights before baking
1	2,2	1,8	7,0
2	2,6	2,2	7,0
3	2,4	1,6	7,0
4	2,4	1,8	7,0
5	2,4	1,6	7,0
6	2,2	1,8	7,0
7	2,4	1,6	7,0
8	2	1,9	7,0
9	2,3	1,8	7,0
10	2	1,8	7,0
Average	2,29	1,79	**2,29+1,79/2= 2,04**

Lift (volume) Yieldmax

Dough	Max height	Min height	Heights before baking
1	2,10	2,10	7,0
2	2,30	2,00	7,0
3	2,40	1,90	7,0
4	2,30	2,10	7,0
5	2,30	1,90	7,0
6	2,20	2,00	7,0
7	2,40	1,60	7,0
8	2,20	2,00	7,0
9	2,10	2,00	7,0
10	2,20	1,80	7,0
Average	2,25	1,94	**2,25+1,94/2= 2,10**

Lift (volume) VM-standard 16

Dough	Max height	Min height	Heights before baking
1	2,20	2,40	7,0
2	2,30	2,00	7,0
3	2,40	2,20	7,0
4	2,40	2,00	7,0
5	2,40	2,00	7,0
6	2,40	2,10	7,0
7	2,30	1,90	7,0
8	2,30	1,90	7,0
9	2,10	1,90	7,0
10	2,10	1,60	7,0
Average	2,29	2,00	**2,29+2,0/2=2,14**

Lift	Average heights		lift from start heights 7 mm dough %
	Ref	1,95	278
	Yieldmax	2,10	300
	Yieldmax/emulg	2,04	291
	VM-16	2,19	305

Expansion of rings:

Exspansion Ref

Dough	Max diameter	Min diameter	Diameter before baking mm
1	8,0	4,5	7,9
2	8,1	8,1	7,9
3	8,4	8,0	7,9
4	8,1	7,9	7,9
5	8,2	8,2	7,9
6	8,3	8,1	7,9
7	8,4	8,2	7,9
8	8,5	8,2	7,9
9	8,0	8,2	7,9
10	8,4	8,2	7,9
Average	8,2	7,8	8,2+7,8/2= 8,0

Exspansion Yieldmax

Dough	Max diameter	Min diameter	Diameter before baking mm
1	8,60	8,10	7,9
2	8,50	8,10	7,9
3	8,50	8,30	7,9
4	8,40	8,10	7,9
5	8,50	8,20	7,9
6	8,60	8,00	7,9
7	8,40	8,30	7,9
8	8,50	8,20	7,9
9	8,30	8,30	7,9
10	8,30	8,10	
Average	8,46	8,17	8,30+8,17/2=8,31

Exspansion Yieldmax-emulg

Dough	Max diameter	Min diameter	Diameter before baking
1	8,60	8,40	7,9
2	8,70	8,00	7,9
3	9,00	8,20	7,9
4	8,90	8,50	7,9
5	9,00	8,00	7,9
6	9,30	8,40	7,9
7	9,00	8,20	7,9
8	8,50	8,20	7,9
9	9,20	8,00	7,9
10	9,00	8,40	7,9
Average	8,92	8,23	8,92+8,23/2=8,5

Exspansion VM 16

Dough	Max diameter	Min diameter	Diameter before baking
1	8,7	8,5	7,9
2	8,5	8,2	7,9
3	8,4	8,2	7,9
4	8,8	8,7	7,9
5	8,8	8,3	7,9
6	8,9	8,7	7,9
7	8,8	8,2	7,9
8	9,0	8,5	7,9
9	8,8	7,8	7,9
10	9,3	8,7	7,9
Average	8,8	8,38	8,8+8,38/2=8,59

Exspansion radio of dough	start radio 7,9 mm	%
Ref	8,00	101,2
Yieldmax	8,32	105,2
Yieldmax/emulg	8,58	108,6
VM-16	8,59	108,7

Baked products:
Croissants was made and cut over horizontal and vertical for evaluation of the layers uniformity and thickness. Lift rings were made mainly for heights (volume) determination.

Visual inspection of croissants, see figure:

Reference:
Thick layers were seen on the reference (control), the dough was very greasy after baking, properly because of the thick layers and the uneven layer distribution compared to Yieldmax.

Yieldmax/emulgator:
Smooth and uniform layers compared to reference.

Yieldmax:
Very thin layers and good uniformity compared to reference. Absolutely the best laminated dough compared to doughs prepared with reference margarine and margarine with Yieldmax/emulgator.

Preferred embodiments of this invention are described herein, including the best mode known to the inventors for carrying out the invention. Variations of those preferred embodiments may become apparent to those of ordinary skill in the art upon reading the foregoing description. The inventors expect skilled artisans to employ such variations as appropriate, and the inventors intend for the invention to be practiced otherwise than as specifically described herein. Accordingly, this invention includes all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.

REFERENCES

US patents 5378623, 3505074, 3652397 and 5538874
US 20070009644
GB patent 1215868
EP0253429B1
WO 98/26057, WO 98/26057, WO 00/32758, WO07/113257, WO04/054377

All references cited in this patent document are hereby incorporated herein in their entirety by reference.

CLAIMS

1. A process for producing a water-in-oil emulsion, characterized in that a composition comprising an oil, water, a phospholipase, and a phosphatide is mixed.

2. The process of any preceding claim, wherein the phospholipase is selected from the group consisting of: an enzyme classified in EC 3.1.1.32, an enzyme classified in EC 3.1.1.4, an enzyme classified in EC 3.1.4.3, phospholipase A1, phospholipase A2, and phospholipase C.

3. The process of any preceding claim, wherein the phospholipase is selected from the group consisting of phospholipase A1 and phospholipase A2.

4. The process of any preceding claim, wherein the phospholipase is phospholipase A1.

5. The process of any preceding claim, wherein the phosphatide is selected from the group consisting of phosphatidylcholine (lecithin), plant phosphatide, egg yolk phosphatide, phosphatidylethanolamine (cephalin), and fish oil lecithin.

6. A process of any preceeding claim where the process is allowed to proceed until the phospholipids in the water in oil emulsion is consisting of more than 20% lyso-phospholipids (w/w), preferably at least 35% lyso-phospholipids, most preferably at least 50% lyso-phospholipids.

7. The process of any preceding claim, wherein the produced emulsion is selected from the group consisting of: a margarine and a spread.

8. The process of any preceding claim, wherein the oil is an edible oil and/or an vegetable oil.

9. The process of any preceding claim, wherein the oil is selected from the group consisting of: butter oil, lard, sunflower oil, rapeseed oil, coconut oil, soybean oil, canola oil, cottonseed oil, corn oil, palm oil, palm kernel oil, rice bran oil, cocoa butter fat, and combinations thereof.

10. The process of any preceding claim, wherein the composition comprises a further component selected from the group consisting of: an emulsifier, and a milk protein.

11. The process of any preceding claim, which comprises a further step selected from the group consisting of: packing, crystallization, filtration, heating, cooling, pasteurizing, flavoring and coloring.

12. A water-in-oil emulsion obtainable by the process of any preceding claim.

13. A water-in-oil emulsion, which is obtainable by mixing a composition comprising an edible oil, a phosphatide, a phospholipase, and water.

14. The emulsion of the preceding claim, wherein the composition further comprises an additional emulsifier, and/or milk protein.

15. The emulsion of any preceding claim, wherein the phospholipase is phospholipase A1.

16. The emulsion of any preceding claim, which consists of at least 35% oil, such as at least 55% oil, or at least 75% oil.

17. The emulsion of any preceding claim, wherein the oil is selected from the group consisting of: butter oil, lard, sunflower oil, rapeseed oil, coconut oil, soybean oil, canola oil, cottonseed oil, corn oil, palm oil, palm kernel oil, rice bran oil, cocoa butter fat, and combinations thereof.

18. The emulsion of any preceding claim, which is selected from the group consisting of: a margarine and a spread.

19. A dough which comprises a water-in-oil emulsion of any preceding claim.

20. The dough of any preceding claim, which is a laminated dough, such as a pastry dough, a croissant dough and a pie dough.

21. A process for producing a laminated dough, which comprises surrounding a layer of the emulsion of any preceding claim with a dough, and optionally flatten and folding the resulting dough.

22. A bakery product obtainable by baking the dough of any preceding claim.

23. The bakery product of any preceding claim, which is selected from the group consisting of a croissant, a Danish pastry, a pie and a pastry.

Fig. 1

