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(54) **FOODSTUFF**

LEBENSMITTEL

PRODUIT ALIMENTAIRE

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**Description**

**[0001]** The present invention relates to a foodstuff. More particularly, the present invention relates to a foodstuff comprising at least one functional ingredient which has been generated *in situ* by a conversion agent wherein the conversion agent is a lipase.

**[0002]** Traditionally food was prepared in the private households and the constituents of the food or of the foodstuff were brought to the kitchen of the household where the food or foodstuff was prepared shortly before consumption.

**[0003]** Industrial development increased the demand for the reduction of the time and effort required to prepare food or foodstuffs. Thus there has been a massive expansion in the industrial preparation of food.

**[0004]** Recently, there has been increased demand for improvements in the quality of industrially prepared food. In particular there is demand for improved taste, eating quality and shelf life. In an attempt to address these demands for improved foodstuffs, industrial food producers have utilised and have relied upon functional ingredients to meet the demands for quality and shelf life. Functional ingredients such as emulsifiers, hydrocolloids, preservatives, antioxidants, colourings and flavourings are widely used in the food industry.

**[0005]** More recently, there has been demand from consumers to reduce the number of additives, such as functional ingredients, included in foodstuffs. Thus, there is a desire to prepare industrially foodstuffs meeting the quality requirements of consumers whilst minimising the number of additives in the final foodstuffs.

**[0006]** US-A-5,695,802 discloses flavouring compositions comprising hydrolysates or the diglyceride fraction of hydrolysates obtained by enzymatic hydrolysis of vegetable or animal fat. The enzymatic hydrolysis of the fat results in an enrichment of diglycerides.

**[0007]** Both Douglas B. Sarney et al., *Enzymatic Synthesis of Sorbitan Esters Using a Low-Boiling-Point Azeotrope as Reaction Solvent*, *Biotechnology and Bioengineering*, 1997 vol. 54(4) and J. A. Arcosm et al., *Quantitative Enzymatic Production of 6.O-Acylglucose Esters*, *Biotechnology and Bioengineering* 1998 57(5), teach the use lipase for the production of emulsifiers. The teachings require the synthesis of emulsifiers in an organic solvent system. The emulsifier is then isolated from the organic solvent system before use in food.

**[0008]** A. Coteron et al., *Reactions of Olive Oil and Glycerol over Immobilised Lipases*, *JAOCS*, Vol. 75, no. 5 (1998) reports the use of immobilised lipase in the reaction of olive oil and glycerol. Subsequent to the reaction the immobilised lipase is removed from the reaction mixture.

**[0009]** JP-A-90188214 reports the use of an immobilised lipase for the hydrolysis and ester exchange of triglyceride. In this process part of the triglyceride is partially hydrolysed to free fatty acid. The partially hydrolysed triglyceride product is used for production of margarine.

**[0010]** US-A-5,288,619 relates to enzymatic methods for the production of oils or fats having a specific fatty acid profile. In particular, US-A-5,288,619 discloses the use of a lipase to transesterification two oils or fats. A particularly preferred embodiment of this document uses an immobilised lipase. The resultant oils or fats, the required specific fatty acid profile, may subsequently be incorporated in a foodstuff or food material. For example the transesterified oils/fats may be incorporated in a margarine recipe.

**[0011]** US-A-4,865,866 teaches the use of a lipase to rearrange by transesterification the fatty acids components of a fat/oil. The disclosed lipases are immobilised, for example by support on Celite. The process is performed to provide a fat/oil composition having a specific fatty acid distribution. The fat/oil composition obtained by the transesterification may be incorporated in a foodstuff such as a plastic emulsion product e.g. a margarine or low fat spread.

**[0012]** JP-A-5211852 discloses the addition of a lipase to a mixture of water and less than 30% oil. The product prepared in this method may be used in the production of mayonnaise. The mayonnaise is prepared at a temperature such that the activity of lipase is not reduced. In the procedure of JP-A-5211852 the oil is degraded to free fatty acid or fatty acid salts(soap) and glycerol which may provide the emulsifying properties. However, this may be problematic as the emulsification properties of this reaction product will depend on the pH of the mixture. This is because the effect of fatty acid is pH dependent. At low pH free fatty acid is present in the acid form which has low emulsification properties. At alkaline pH however free fatty acid is available as a soap, which is known to have good emulsification properties. For the production of a creamy substance described in JP-A-5211852 this may not be a problem. However, for other foodstuffs this may be a problem. For example, in margarine production pH is adjusted to 4.5 or 5.5 or other pH values depending on the recipe. In this case the effect of free fatty acid formation by the lipase will impact on the emulsification of the foodstuff.

The present invention addresses the problem of the prior art

**[0013]** According to the present invention there is provided a process for preparing a foodstuff suitable for consumption comprising an emulsifier and a second functional ingredient, the process comprising the steps of

- (i) providing a food material containing a triglyceride and a second constituent, wherein the second constituent is glycerol or ascorbic acid;

(ii) contacting the food material with an enzyme, wherein the enzyme is a lipase, such that an emulsifier is generated by the enzyme from the triglyceride and a second functional ingredient is generated from the second constituent;  
 (iii) inactivating or denaturing the enzyme to provide the foodstuff wherein the foodstuff is selected from edible oils or fats comprising the emulsifier, the triglyceride, the second functional ingredient and the enzyme in an inactive form or a denatured form.

**[0014]** By the term "functional ingredient" we mean a constituent of the foodstuff which performs a specific function in the foodstuff. Preferably by the term "functional ingredient" we mean an emulsifier, hydrocolloid, preservative, anti-oxidant, colouring, flavouring, and/or viscosity modifier. Preferably by the term "functional ingredient" we mean a constituent of the foodstuff which has one or more of surface active properties, antioxidative effect, anti-bacterial effect including bacteriostatic effect and/or bactericidal effect and viscosity modifying effect, preferably viscosity improving effect.

**[0015]** By the term "foodstuff" we mean a substance which is suitable for human or animal consumption.

**[0016]** The present invention is advantageous as it overcomes the problems associated with the prior art.

**[0017]** The present invention utilises a lipase, during the production of a foodstuff to generate two or more functional ingredients, for example emulsifiers, antioxidants or preservatives, from two or more constituents of a food material (i.e. ingredients) from which the foodstuff is prepared. The constituent(s) may be a fat, for example. Thus, instead of adding food additives produced by traditional chemical synthesis, the present invention provides for the *in situ* synthesis of a required functional ingredient.

**[0018]** Traditional chemical synthesis of functional ingredients is problematic because syntheses are often carried out under extreme conditions, such as high temperatures (e.g. ~200°C). Under extreme conditions, side reactions may occur. Thus, although the resultant product may be substantially pure, it may contain undesirable components. To eliminate undesirable components, reactions must be closely controlled and/or the resultant product may require purification, adding to a production process. The present invention aims to overcome these disadvantages.

**[0019]** Moreover, by generating the functional ingredient from at least one constituent of the food material using a conversion agent, the foodstuff comprises at least one less "additive" material. This is advantageous because of the improvement in the ease of production. Moreover, the foodstuff may contain less "additives". The reduction or elimination of "additives" is desirable to consumers and inclusion of additives often must be declared to the consumer in the ingredients listing on the foodstuff. Thus, the present invention is further advantageous.

**[0020]** As one of the advantages of the present invention is the possibility of providing a foodstuff prepared from a food material and comprising a functional ingredient which has been generated from a constituent of the food material, the following two aspects are preferred embodiments of the present invention

- in one preferred aspect the food material is substantially free of one of the at least one functional ingredients. In this aspect one of the functional ingredients must have been prepared at least in part in accordance with the present invention. By the term "substantially free" we mean the amount of the functional ingredient present in the food material is less than 10 % of the amount of the same functional ingredient present in the foodstuff, more preferably less than 5 %, more preferably less than 2 %, more preferably less than 1 %, yet more preferably less than 0.5 %
- in a further preferred aspect substantially all of at least one of the functional ingredients present in the foodstuff has been provided by conversion in accordance with the present invention, together optionally with any of the functional ingredient present in the food material. By the term "substantially all" we mean the amount of the functional ingredient present in the foodstuff provided by conversion in accordance with the present invention, together optionally with any of the functional ingredient present in the food material, is greater than 90 % of the total amount of the functional ingredient, more preferably greater than 95 %, more preferably greater than 98 %, more preferably greater than 99 %.

**[0021]** The food material may simply be added to the conversion agent or *vice versa*. The conversion agent remains in the food material/foodstuff.

**[0022]** Contact of the food material with the lipase thereby provides the foodstuff suitable for consumption. No further processing or addition of ingredients may be required; a foodstuff comprising a required functional ingredient is produced. Thus a foodstuff may be provided in which a required functional ingredient has been simply generated. Synthesis of the functional ingredient discretely from the foodstuff followed by subsequent addition is not required. Moreover, provided of course the conversion agent is suitably chosen so that it is compatible with a foodstuff i.e. it is edible, further processing of the foodstuff may not be necessary. However, the present invention encompasses foodstuffs which have been further processed.

**[0023]** The conversion agent is a lipase. Enzymes are readily available, may be chosen to convert a specific constituent of the food material and/or may be chosen to generate a specific functional ingredient. Yet further, enzymes may be denatured by heat. Thus in a further preferred aspect, the foodstuff/food material is heated after generation of the functional ingredient. The enzyme will be denatured and may then constitute protein. This is advantageous because the

denatured enzyme need not be declared on the foodstuff/food material ingredients.

**[0024]** The use of enzymes is advantageous because denatured enzymes are considered, particularly under food labelling regulations, to constitute a processing aid. Inactivated enzymes are not considered to be additives; the addition of additives to foodstuffs is undesirable to many consumers.

**[0025]** Inactivation of the lipase, in particular denaturation of the lipase, is advantageous because it allows one to control the amount of functional ingredient generated. For example, the generation of the functional ingredient may be monitored (for example by measurement of the functional properties of the food material) or the rate thereof determined. One may then terminate the generation of the functional ingredient, when a suitable amount of functional ingredient has been generated, by heating the food material. Thus the amount of the functional ingredient and the properties of the food material/foodstuff may easily be controlled.

**[0026]** Preferably, the enzyme is a lipase (EC 3.1.1.3). The enzyme may be used in a mixture with esterases, amylases, xylanases, proteases, lyases, including glucan lyases and  $\alpha$ -1,4-glucan lyase, and derivatives thereof.

**[0027]** Preferably the enzyme is an enzyme as described in and/or as claimed in Danish Patent Application No. 0400/97. In other words preferably the enzyme is a polypeptide in glycosylated or non-glycosylated form capable of exhibiting lipase activity wherein the polypeptide comprises at least one amino acid sequence selected from the group consisting of

(I) Ser-Val-Ser-Thr-Ser-Thr-Leu-Asp-Glu-Leu-Phe-Ala-Gln-Trp-Ser-Ala-Ala-Ala-Tyr-Xaa-Ser-Asn-Asn

(II) Val-His-Thr-Gly-Phe-Trp-Lys

(III) Ala-Trp-Glu-Ser-Ala-Ala-Asp-Glu-Leu-Thr-Ser-Lys-Ile-Lys

where Xaa represents an amino acid selected from the group consisting of Ala, Arg, Asn, Asp, Cys, Gln, Glu, Gly, His, Ile, Leu, Lys, Met, Phe, Pro, Ser, Thr, Trp, Tyr and Val.

**[0028]** In a further aspect the enzyme may be an enzyme as described in and/or as claimed in International Patent Application No. PCT/IB98/00708, filed 6 May 1998.

**[0029]** Preferably, the enzyme is isolated from a plant (preferably soy bean, rice bran, corn, rapeseed, peanut, pineapple, potato, oat, wheat and/or sunflower seed), an animal (preferably an animal pancreas) or a micro-organism. Preferably, the micro-organism selected from *Aspergillus niger*, *Rhizopus delemar*, *Rhizopus arrhizus*, *Mucor miehei*, *Pseudomonas sp.*, *Candida rugosa*, *Penicillium roqueforti*, *Penicillium cyclopium*, *Aspergillus tubingensis*, *Candida cylindracea*, *Thermomyces lanuginosus*, *Mucor javanicus*, *Candida antarctica*, *Chromobacterium viscosum*, *Pseudomonas fluorescens*, *Pseudomonas nitroreducans*, *Chromobacterium viscosum*, *Bacillus subtilis*, mutants and combinations thereof.

**[0030]** The conversion agent is present in an inactive form or in a denatured form in the foodstuff.

**[0031]** In one aspect of the present invention the at least one functional ingredient may be generated from the at least one constituent of the food material by two or more conversion agents. The at least one constituent may be contacted with the two or more conversion agents at the same time or in series or a combination thereof.

**[0032]** Preferably, the at least one constituent of the food material is selected from esters, monoglycerides, diglycerides, triglycerides, fats, including lard, tallow and butter fat; fatty acids, fatty acid esters, waxes, wax esters, oils including oils extracted from or derived from palm oil, sunflower oil, soya bean oil, safflower oil, cotton seed oil, ground nut oil, corn oil, olive oil, peanut oil, coconut oil and rape seed oil, proteins, amino acids, protein hydrolysates, peptides (partly hydrolysed protein), a constituent comprising a hydroxy group (-OH), polyvalent alcohols, including glycerol; water, ethanol, sugars including sucrose, fructose, glucose (dextrose), lactose, and galactose; dextrans including maltodextrin, sorbitol, mannitol, fruit acids and hydroxy acids including citric acid, tartaric acid, lactic acid and ascorbic acid; proteins, amino acids, protein hydrolysates, peptides (partly hydrolysed protein); mixtures and derivatives thereof.

**[0033]** Preferably, the at least one constituent of the food material is in liquid form.

**[0034]** The term "triglyceride" preferably means a triester of an alcohol, preferably glycerol, and a fatty acid. More preferably the triglyceride fatty acid is a triester of an alcohol, preferably glycerol, and a C4 to C24 fatty acid. Preferably the triglyceride fatty acid has an iodine value of from 0 to 125, preferably from 0 to 60.

**[0035]** Preferably, the triglyceride is selected from triglycerides having a fatty acid chain length of no greater than 14 carbons, triglycerides having a fatty acid chain length of from 4 to 14 carbons, triglycerides having a fatty acid chain length of from 6 to 14 carbons, triglycerides having a fatty acid chain length of from 8 to 14 carbons, triglycerides having a fatty acid chain length of from 10 to 14 carbons, triglycerides having a fatty acid chain length of 12 carbons, triglycerides having a fatty acid chain length of from 16 to 24 carbons, triglycerides having a fatty acid chain length of from 16 to 22 carbons, triglycerides having a fatty acid chain length of from 18 to 22 carbons, triglycerides having a fatty acid chain length of from 18 to 20 carbons, mixtures and derivatives thereof.

**[0036]** Preferably, the first constituent and the second constituent are constituents of the foodstuff. In this aspect, the functional ingredient is generated from a first constituent and a second constituent of the food material and the first constituent and second constituent are also present in the foodstuff. Thus the functional ingredient may be generated from constituents/ingredients of the food material which are only partially used to generate the functional ingredient. The remainder of the constituents/ingredients may be present in the foodstuff.

**[0037]** The first constituent of the food material/foodstuff is hydrophobic and/or lipophilic.

**[0038]** The first constituent of the food material/foodstuff is a triglyceride.

**[0039]** The term "triglyceride" preferably has the meaning defined above.

**[0040]** Preferably, the triglyceride of the first constituent is selected from triglycerides having a fatty acid chain length of no greater than 14 carbons, triglycerides having a fatty acid chain length of from 4 to 14 carbons, triglycerides having a fatty acid chain length of from 6 to 14 carbons, triglycerides having a fatty acid chain length of from 8 to 14 carbons, triglycerides having a fatty acid chain length of from 10 to 14 carbons, triglycerides having a fatty acid chain length of 12 carbons, triglycerides having a fatty acid chain length of from 16 to 24 carbons, triglycerides having a fatty acid chain length of from 16 to 22 carbons, triglycerides having a fatty acid chain length of from 18 to 22 carbons, triglycerides having a fatty acid chain length of from 18 to 20 carbons, mixtures and derivatives thereof.

**[0041]** Preferably, the first constituent of the food material/foodstuff is in liquid form.

**[0042]** The second constituent of the food material/foodstuff is hydrophilic.

**[0043]** The second constituent of the food material/foodstuff is glycerol or ascorbic acid.

**[0044]** In a further preferred embodiment, the first constituent of the food material/foodstuff is a triglyceride and the second constituent of the food material/foodstuff is glycerol.

**[0045]** Preferably, the second constituent of the food material/foodstuff is in liquid form.

**[0046]** In a highly preferred embodiment, the first constituent of the food material/foodstuff is a triglyceride and the second constituent of the food material/foodstuff is the sugar or the sugar alcohol namely ascorbic acid or glycerol. In this highly preferred aspect the first constituent and the second constituent may interact on contact with the a conversion agent to generate an ester derived from the first constituent wherein the ester has a lower degree of esterification than the first constituent, and a sugar ester. This is extremely advantageous because the ester may act as a functional ingredient, such as an emulsifier, and the sugar ester may also act as a functional ingredient, such as an emulsifier or an anti-oxidant. Thus, two functional ingredients may be generated from two constituents of the food material/foodstuff by a conversion agent.

**[0047]** In the above highly preferred aspect the second constituent is preferably ascorbic acid. Ascorbic acid ester is an antioxidant.

**[0048]** Thus, in a further broad aspect of the present invention there is provided a foodstuff prepared from a food material, wherein the foodstuff comprises at least two functional ingredients, and wherein the at least two functional ingredients have been generated from a first constituent of the food material and a second constituent of the food material by a conversion agent. The first constituent is a triglyceride. Preferably, the second constituent is the sugar or the sugar alcohol, ascorbic acid.

**[0049]** In a preferred aspect, the first constituent of the food material/foodstuff and the first constituent of the food material/foodstuff are in liquid form.

**[0050]** In a further preferred aspect, the food material/foodstuff further comprises greater than two constituents. Preferably, the food material/foodstuff further comprises a third constituent. The third constituent may be selected from the constituents listed above in respect of the first and second constituents. Preferably, the third constituent is selected from a constituent comprising a hydroxy group (-OH), polyvalent alcohols, including glycerol; water, ethanol, sugars including sucrose, fructose, glucose (dextrose), lactose, and galactose; dextrans including maltodextrin, sorbitol, mannitol, fruit acids and hydroxy acids including citric acid, tartaric acid, lactic acid and ascorbic acid; mixtures and derivatives thereof.

**[0051]** Preferably, the third constituent of the food material/foodstuff is selected from sugars including sucrose, fructose, glucose (dextrose), lactose, and galactose; dextrans including maltodextrin, sorbitol, mannitol, fruit acids and hydroxy acids including citric acid, tartaric acid, lactic acid and ascorbic acid; mixtures and derivatives thereof.

**[0052]** In a highly preferred aspect of the present invention the second constituent of the food material/foodstuff is glycerol, and the third constituent of the food material/foodstuff is selected from sugars. In an alternative highly preferred aspect of the present invention the second constituent of the food material/foodstuff is glycerol, and the third constituent of the food material/foodstuff is selected from proteins, peptides and amino acids. These preferred aspects are advantageous because the third constituent may be soluble in the second constituent. Thus, the second constituent can readily react with the third constituent. Moreover, when the first constituent of the food material/foodstuff is in liquid form, the second constituent and/or the third constituent can readily react with the first constituent.

**[0053]** The provision of one or more constituents in liquid form as described above may significantly increase the reaction velocity of the generation of the least one functional ingredient.

**[0054]** The conversion agent may be contacted with the all of the food material or a portion thereof. In the former case, a portion of the food material is contacted with the conversion agent and the contacted material is subsequently contacted

with the further constituents of the food material. In the latter case, a portion of the food material may be removed from the total amount of food material. After contacting the conversion agent with the portion of food material, the portion may be returned to the remainder of food material. The portion of the food material may comprises from 0.1 to 10 wt % of the total food material, preferably from 0.1 to 5 wt % of the total food material, preferably from 0.1 to 2 wt % of the total food material, more preferably from 0.5 to 1 wt % of the total food material.

**[0055]** An Example of a portion of the food material being contacted with the conversion agent and the contacted material subsequently being contacted with the further constituents of the food material is exemplified in Figure 1 (Flow diagram for *in situ* production of emulsifier). Figure 1 illustrated the contact of an enzyme with an oil/fat to provide a composition comprising an emulsifier. The enzyme present in the contacted food material is then inactivated with heat. The emulsifier containing foodstuff is then mixed with a fat phase and a water phase and fed to tube chiller to provide a water-in-oil margarine.

**[0056]** The conversion agent may be contacted with a carrier prior to contact with the food material. Preferably, the carrier is a constituent of the food material. Preferably, the carrier is a first constituent or a second constituent of the food material as defined above. More preferably, the carrier is glycerol.

**[0057]** The conversion agent may be contacted with the food material under supercritical conditions. In this aspect the conversion agent may be contacted with the food material in a carbon dioxide solvent. Preferably, the carbon dioxide solvent comprises a mixture of carbon dioxide and an alcohol.

**[0058]** Preferably, the functional ingredient of the present invention is generated by a reaction selected from alcoholysis, preferably glycerolysis, hydrolysis, interesterification, and combinations thereof. More preferably the functional ingredient is generated by a alcoholysis reaction, preferably a glycerolysis reaction.

**[0059]** Preferably, the functional ingredient comprises less than 5 wt % of the foodstuff. Preferably, the functional ingredient comprises from 0.01 to 4 wt % of the foodstuff. Preferably, the functional ingredient comprises from 0.01 to 2 wt % of the foodstuff. Preferably, the functional ingredient comprises from 0.01 to 1 wt % of the foodstuff. Preferably, the functional ingredient comprises from 0.01 to 0.5 wt % of the foodstuff. Preferably, the functional ingredient comprises from 0.01 to 0.3 wt % of the foodstuff.

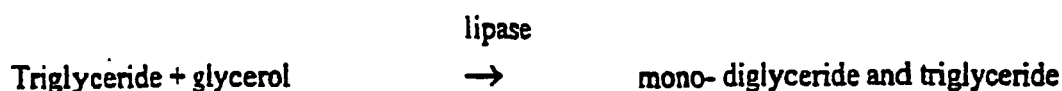
**[0060]** Preferably, the at least one functional ingredient comprises or is a functional ingredient selected from emulsifiers, hydrocolloids, preservatives, antioxidants, colourings and flavourings. More preferably, the at least one functional ingredient comprises or is an emulsifier. In this aspect, preferably the emulsifier comprises from 0.1 to 0.3 wt % of the foodstuff.

**[0061]** The emulsifier may comprise or may be selected from monoglycerides, diglycerides, derivatives and mixtures thereof.

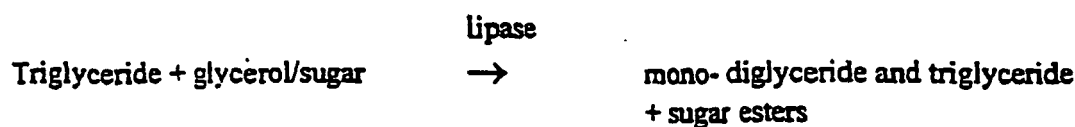
**[0062]** In one aspect of the present invention the at least one functional ingredient is other than an antioxidant. In a further aspect of the present invention the foodstuff does not contain an antioxidant generated in accordance with the present invention. In a further aspect of the present invention the foodstuff does not contain an antioxidant.

**[0063]** In a further aspect of the present invention the food material and/or the food material contacted with the conversion agent and/or the conversion material is substantially free of water. In this aspect, the creation of free fatty acids and there presence in the foodstuff may be reduced or avoided when the food material is contacted with the conversion agent.

**[0064]** An example of the is aspect of the invention is provided wherein a lipase carried in glycerol, preferably in a glycerol/sugar mixture is contacted with a triglyceride. In this aspect advantageous mono-diglycerides and, preferable, sugar esters are generated as functional ingredients.



or:



**[0065]** A person skilled in the art will appreciate that the at least one constituent of the food material from which the

functional ingredient is generated may be selected to provide a required functional ingredient. Thus in the above aspect wherein the functional ingredient is an emulsifier, preferably an emulsifier selected from monoglycerides, diglycerides, derivatives and mixtures thereof, the at least one constituent may be, for example, a triglyceride and a polyvalent alcohol.

**[0066]** In a preferred aspect the present invention provides foodstuff as defined above wherein the foodstuff is selected from oil-in-water emulsions, water-in-oil emulsions, margarine, shortening.

**[0067]** In one aspect of the present invention the foodstuff is a foodstuff other than mayonnaise.

**[0068]** The claims of the present application are to be construed to include each of the foodstuffs listed above.

**[0069]** In a preferred embodiment the foodstuff of the present invention is a margarine.

**[0070]** Thus in a preferred aspect the present invention provides a margarine prepared from a food material. wherein the foodstuff comprises at least one functional ingredient, and wherein the at least one functional ingredient has been generated from at least one constituent of the food material by a conversion agent.

**[0071]** In a further preferred embodiment the foodstuff comprises greater than 30 wt % fat (i.e. triglycerides), more preferably greater than 40 wt % fat, yet more preferably greater than 50 wt % fat.

**[0072]** The foodstuff may comprise an emulsion of oil and water. The emulsion may be an oil-in-water emulsion. The emulsion may be an water-in-oil emulsion.

**[0073]** The invention will now be described, by way of example only, with reference to the following examples.

## EXAMPLES

### Example 1 - Full-fat Table Margarine

**[0074]** Full-fat table margarine is used for spreading on bread and household baking.

**[0075]** Each of fat blends A, B and C listed in Table 1 were treated with lipase as follows, 1 part of the fat blend is heated to 50°C during stirring 0.2 part of lipase (obtained from *Aspergillus tubingensis*) dispersed in glycerol is added.

The fat blend is reacted for 12 hours at 50 °C and then shortly heated to 100 °C to denature the enzyme.

Table 1

Fat blends	A	B	C
Margarine used at approx.	5-10°C	20-25°C	25-30°C
Soya 41°C	20	-	-
Soya 35°C	20	-	-
Soya oil	60	25	20
Palm 43°C	-	25	30
Palm oil	-	50	50
SFC* values of fat blends (IUPAC method)	A	B	C
5°C	34	47	54
10°C	28	45	50
20°C	14	26	30
30°C	3	10	12
35°C	0	5	7
40°C	0	1	2
Slip melting point °C (AOCS 3-25 method)	26.3	36.9	36.8
* Solid fat content			

**[0076]** The treated fat blends were then processed in accordance with the following steps to prepare a recipe shown in Table 2

1. Blend the water phase ingredients. (If required, pasteurise the water phase by heating to approx. 80°C). Adjust pH with Ferment Flavouring 4646.
2. Melt the fat phase, and temper to approx. 40-45°C. Add the  $\beta$ -carotene.

3. Add the flavouring.
4. Add the water phase to the fat phase, stirring continuously.
5. Cool in a tube chiller (normal capacity, normal cooling) to an outlet temp of 8-10°C.

Table 2

Water phase:	Water	16.0%
	Skimmed milk powder or whey powder	1.0%
	Salt	1.0%
	pH 5.0-5.5 with Ferment Flavouring 4646*	
Fat phase:	Lipase treated fat	1.2%
	Soya lecithin	0.2%
	$\beta$ -carotene	4 ppm
	Fat blend	80.6%
	Butter Flavouring 3559**	0.01%
<p>* Ferment Flavouring 4646 - a nature-identical, water-soluble flavouring which ensures a good, lactic and fermented taste. Used for direct acidification of the water phase to ensure the taste similar to that obtained by microbial fermentation of the milk</p> <p>** Butter Flavouring 3559 - a nature-identical, fat-soluble flavouring which provides a rich, fermented butter taste.</p>		

**[0077]** The fat contacted with lipase generated an emulsifier, a functional ingredient which is important in the preparation of margarine. Each of the margarines prepared from fat blends A, B and C was visually inspected and found to substantially identical in appearance to conventionally prepared margarine. No separation of the oil and water phases was observed. Each of the margarines prepared from fat blends A, B and C was also spread on bread and tasted. The organoleptic properties of each margarine was pleasant and were felt by the taster to be substantially identical to those of conventionally prepared margarine.

#### Example 2 - 60% Fat Spread with Protein

**[0078]** 60% fat spread with protein is used for spreading on bread and open pan frying instead of full-fat products.

**[0079]** Each of fat blends A and B listed in Table 3 were treated with lipase as follows. 1 part of the fat blend is heated to 50°C during stirring 0.2 part of lipase (obtained from *Rhizopus arrhizus*) dispersed in glycerol is added. The fat blend is reacted for 12 hours at 50 °C and then shortly heated to 100 °C to denature the enzyme.

Table 3

Fat blends	A	B
Spread used at approx.	5-10°C	20-25°C
Soya 41°C	25	20
Soya 35°C	-	45
Soya oil	75	35
SFC values of fat blends (IUPAC method)	A	B
5°C	23	48
10°C	19	46
20°C	9	28
30°C	2	8
35°C	0	2



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(continued)

Fat blends	A	B
40°C	0	0
Slip melting point °C (AOCS 3-25 method)	26.6	31.7

The treated fat blends were then processed in accordance with the following steps to prepare a recipe shown in Table 4

1. Blend the water phase ingredients. (If required, pasteurise the water phase by heating to approx. 80°C). Adjust pH.
2. Melt the fat phase, and temper to approx. 40-45°C. Add the  $\beta$ -carotene.
3. Add the flavouring.
4. Add the water phase to the fat phase, stirring vigorously.
5. Crystallise and knead vigorously in a tube chiller (80% of normal capacity,  $\text{NH}_3$  - 15°C, 2 tubes) to an outlet temperature of 8-10°C

Table 4

Water phase at pH 5.5:	Water	37.9%
	Whey powder	1.0%
	Salt	1.0%
	K-sorbate	0.1%
Fat phase:	Lipase treated fat	1.4%
	$\beta$ -carotene	4 ppm
	Fat blend	58.6%
	Butter Flavouring 3559	0.01%

**[0080]** The fat contacted with lipase generated an emulsifier. Both of the margarines prepared from fat blends A and B was visually inspected and found to substantially identical in appearance to conventionally prepared margarine. No separation of the oil and water phases was observed. Both of the margarines prepared from fat blends A and B was also spread on bread and tasted. The organoleptic properties of each margarine was pleasant and were felt by the taster to be substantially identical to those of conventionally prepared margarine.

### Example 3 - 40% Fat Spread with Whey Powder

**[0081]** Fat blend A listed in Table 3 above was treated with lipase as follows. 1 part of the fat blend is heated to 50°C during stirring 0.2 part of lipase (obtained from *Candida rugosa*) dispersed in glycerol is added. The fat blend is reacted for 12 hours at 50 °C and then shortly heated to 100 °C to denature the enzyme and used for 40% fat spread production. The spread had a composition shown in Table 5 below.

Table 5

Water phase at pH 5.5	Water	55.16%
	Salt	1.2%
	K-sorbate	0.1%
	Whey powder	1.0%
	GRINDSTED™ Pectin LFS 100	1.0%
Fat phase	Fat blend - 25 parts soya 41° - 75 parts liquid oil	39.5%
	$\beta$ -carotene	4ppm

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(continued)

	Butter Flavouring 2873	0.01%
	Butter Flavouring 3507	0.01%
	Lipase treated fat	2.0%

**[0082]** The fat contacted with lipase generated an emulsifier. The low-fat spread was stable and had good water dispersion. Sensory evaluation of the sample showed that they had a very good flavour release and colour.

### Example 4 - Filling Cream.

**[0083]** Each of fat blends A and B listed in Table 3 above were treated with lipase as follows. 1 part of the fat blend is heated to 45°C during stirring 0.2 part of lipase (obtained from *Rhizopus delemar*) dispersed in glycerol is added. The fat blend is reacted for 12 hours at 45 °C and then shortly heated to 100 °C to denature the enzyme and used for filling cream production.

**[0084]** Filling cream was made in a ice cream freezer with mono-pump (capacity 27 kg/hr). Nitrogen blown in after the pump and before the cooling cylinder. Outlet temperature: 15-17°C.

**[0085]** The filling cream spread had a composition shown in Table 6 below.

Table 6

Water phase	Water	12.5%
	GRINDSTED™ Pectin LFS 100	0.5%
	SMP	8.0%
	Sucrose	9.9%
	Invert sugar	9.0%
	Sorbitol 70%	8.0%
	Glucose syrup	14.0%
	Glycerol	7.0%
	K-sorbate	0.1%
Fat phase	Lipase treated fat	3,0%
	Lecithin	0,4%
	Fat blend (100% coconut 31 °C)	27.6%
	Butter flavouring 2598	0.03%

**[0086]** The fat contacted with lipase generated an emulsifier. The filling cream was smooth with good flavour release. Specific gravity of the cream: 0.8 g/ml.

### Example 5 - Ice cream

**[0087]** 1 part of soya fat 41 ° is heated to 45 °C during stirring 0.2 part of lipase (obtained from *Aspergillus niger*) dispersed in glycerol is added. The fat blend is reacted for 12 hours at 45 °C and then shortly heated to 100 °C to denature the enzyme and used for ice cream production.

**[0088]** The treated fat was then processed in accordance with the following steps to prepare a recipes shown in Table 7

1. Heat all liquid ingredients to approx. 40 °C

2. Add dry ingredients, (stabiliser blend is mixed with sugar before addition)

3. If butter/butter oil or veg. fat is used it must be melted separately and added to the mix at 40 °C, or via a static mixer at the entrance to the homogeniser by means of a dosing pump.

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4. Pasteurise at 80 -85 °C/20-40 seconds
5. Homogenise at 80 °C (190 bar for recipe 1 and 175 bar for recipe 2)
6. Cool to ageing temperature , 4 °C
7. Freeze in continuous freezer to desired overrun (100% recommended)
8. Harden in tunnel at -40 °C
9. Store below -25 °C

Table 7

Recipe	1 Milk fat	2 Veg. fat
Dairy cream, 38%	23.65	
Skimmed milk	53.30	
Skimmed milk powder	4.90	11.30
Vegetable fat (HCO)		8.00
Sugar	12.00	12.00
Glucose syrup, DE 42, 75% TS	5.25	5.25
Stabiliser blend	0.2	0.2
Lipase treated fat	0.6	0.6
Grindsted Flavouring 2976	0.1	0.1
Colour	+	+
Water		62.55

**[0089]** The fat contacted with lipase generated an emulsifier. Ice cream of both recipes had a good taste and excellent creamy mouthfeel.

### Example 6 -Margarine

**[0090]** In a vessel 0.6 part of sun flower oil and 0.4 part of palm oil and 0.15 part of lipase from *Rhizopus arrhizus* dissolved glycerol/water is added. The reaction is continued for 20 hours at 45°C and then shortly treated by 100°C in order to inactivate the enzyme.

**[0091]** Two recipes were prepared. These recipes are shown in Table 8 below. Recipe 1 was in accordance with a prior art method - a previously prepared mono/di glyceride emulsifier (DIMODAN® CP available from Danisco Ingredients, Denmark) was added. Recipe 2 was in accordance with the present invention. In recipe 2, 1.7% of the fat phase was provided by the above lipase treated fat. The lipase treated fat was added to the fat blend for margarine production and the margarine is produced by standard procedures for margarine production.

Table 8

Recipe	1	2
<b>WATER PHASE</b>		
Water	480	480
Salt	30	30
Skim Milk Powder	30	30
Potassium Sorbate	3	3
EDTA	0.45	0.45

(continued)

Recipe	1	2
WATER PHASE		
pH	5.5	5.5
FAT PHASE		
Soya 41°	490	481
Soya 35°	490	481
Soya oil	1471	1444
DIMODAN® CP	6.0	-
Lipase	-	51.0
PPM $\beta$ -carotene	0.5	0.5
Flavourings	0.6	0.6

**[0092]** The fat contacted with lipase generated an emulsifier. The margarine in accordance with the present invention was visually inspected and found to substantially identical in appearance to the conventionally prepared margarine. No separation of the oil and water phases was observed. The margarine in accordance with the present invention was also spread on bread and tasted. The organoleptic properties of the margarine was pleasant and were felt by the taster to be substantially identical to those of the conventionally prepared margarine.

#### Example 7-Margarine

**[0093]** In a vessel 1 part of palm oil and 0.15 part of lipase from *Candida* dissolved citric acid/glycerol/water is added. The reaction is continued for 20 hours at 55°C and then shortly treated by 100°C in order to inactivate the enzyme.

**[0094]** 1% of this reaction mixture is added to a fat blend for margarine production and the margarine is produced by standard procedures for margarine production.

**[0095]** The reaction mixture gives good water in oil emulsification and also contributes to reduce spattering when the margarine is used for frying.

#### Example 8- Soft table margarine

**[0096]**

Materials	
Palm oil:	Palmotex from Aarhus Oil, Denmark
Glycerol:	Food grade 99.5%
Lipase #1920:	Lipase PS "Amano" from <i>Pseudomonas cepacia</i> , available from Amano, Japan
DIMODAN® BP:	Distilled monoglyceride from Danisco Ingredients, Denmark

**[0097]** Palm oil was reacted with a solution of lipase in glycerol according to the following recipe Table 9 and Table 10

Table 9

1		2	3	4	5
Palmotex, palm oil	g	100	100	100	100
Glycerol-lipase solution	g	32	21	11	32
				11	

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Table 10

Glycerol-lipase solution		1	2	3	4	5
Glycerol		90	90	90	95	95
Lipase #1920, solution in water	5100 LUT/g	10	10	10	5	5

Procedure:

**[0098]** 2.5 gram of lipase #1920 was dissolved in 15ml of water whilst being stirred at ambient temperature. A glycerol-lipase solution was prepared as disclosed in Table 10. The glycerol lipase solutions were added to the palm oil in accordance with the recipes of Table 9 and incubated at 45 °C for 20 hours.

**[0099]** The samples were then heated to 90 °C for 10 minutes and the upper oil phase was isolated. The isolated oil phases were analysed by GLC. The results obtained are given in Table 11.

Table 11

		1	2	3	4	5
Glycerol	%	2.3	2.1	2	2.2	1.4
Free fatty acid	%	5.7	4.8	4.3	3	2.4
Monoglyceride	%	24.5	24.6	24	25	19.7
Diglyceride	%	47.3	48	47.7	48.2	47.6
Triglyceride	%	20.2	20.5	21.9	21.7	28.8

**[0100]** Table 11 indicates that 20-25% monoglyceride was formed during this enzymatic reaction. These samples were used to prepare a soft table margarine according to the recipe given in Table 12 below

Table 12

	Margarine No.						
	1	2	3	4	5	6	7
<b>Water phase</b>							
water phase	16	16	16	16	16	16	16
Salt	1	1	1	1	1	1	1
Skim milk powder	1	1	1	1	1	1	1
Potassium sorbate	0.1	0.1	0.1	0.1	0.1	0.1	0.1
EDTA	0.015	0.015	0.015	0.015	0.015	0.015	0.015
pH	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Water phase total	18.1	18.1	18.1	18.1	18.1	18.1	18.1
<b>Fat phase</b>							
Soya, 41 °C	20	20	20	20	20	20	20
Soya, 35 °C	20	20	20	20	20	20	20
Soya oil	60	60	60	60	60	60	60
Fat phase total	81.7	81.02	81.02	81.03	81.08	80.88	81.6
Dimodan BP	0.2						

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(continued)

Fat phase							
Sample 1		0.88					
Sample 2			0.88				
Sample 3				0.87			
Sample 4					0.82		
Sample 5						1.02	
Soya lecithin							0.3
β-carotene, ppm	3	3	3	3	3	3	3
Fat phase total	81.9	81.9	81.9	81.9	81.9	81.9	81.9
Flavorings:							
Flavouring 2565*, %	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Flavouring 2712*, %	0.01	0.01	0.01	0.01	0.01	0.01	0.01
* Butter Flavouring 2565 and Butter Flavouring 2712 are available from Danisco Ingredients, Denmark.							

### Evaluation

**[0101]** Margarine numbers 1 to 7 were evaluated after 4 days storage at 5°C.

Visual:

**[0102]** Margarines 1 to 7 all produced fine and stable margarine.  
Margarines 2 to 6 were slightly more firm than 1 and 7.

Organoleptic:

**[0103]** Each of margarines 1 to 7 gave very good melting properties on the tongue.

Microscopy:

**[0104]** Margarines 1, 5, 6 and 7 gave very good dispersions of water particles in the fat phase, with an average diameter of 4-5 µm.

Margarines 2,3 and 4 also produced a fine dispersion with water particles approx. 5µm, but a few water particles of 10 µm were observed.

**[0105]** From the experiment with margarine it can be concluded that the enzymatic interesterification of palm oil (Margarine Nos. 1 to 5) can be used to produce margarine which is equal in quality to commercial products. Furthermore, it is shown that these samples can substitute distilled monoglyceride or lecithin for the production of a soft table margarine. The change in firmness observed using interesterified palm oil in place of lecithin can be adjusted by changing the fat composition of the fat phase in the margarine.

### Example 9 - Puff pastry margarine

**[0106]**

Materials	
Palm oil	
Palm stearin	Melting point 55 °C
Palm	Melting point 43 °C

(continued)

Rape seed oil	
Glycerol	Food grade 99.5%
Lipase #1920	Lipase PS "Amano" from <i>Pseudomonas cepacia</i>
DIMODAN® BP	Distilled monoglyceride from Danisco Ingredients, Denmark
DIMODAM® PVP	Distilled monoglyceride from Danisco Ingredients, Denmark
Flavouring O2986	Butter flavouring available from Danisco Ingredients, Denmark

**[0107]** Palm oil and palm stearin were reacted with a solution of lipase in glycerol according to the following recipe Table 13 and Table 14.

Table 13

		Sample 1	Sample 2
Palmotex, palm oil	g	300	
Palm stearin	g		200
Glycerol-lipase solution 1	g	33	22

Table 14

Glycerol-lipase solution		
Glycerol		90
Lipase #1920, solution in water	5100 LUT/g	10

Procedure:

**[0108]** 2.5 g lipase #1920 were dissolved in 15 ml water during stirring at ambient temperature. Glycerol-lipase solution was made as mentioned in Table 14.

**[0109]** The glycerol-lipase solutions were added to the palm oil or palm stearin as shown in Table 13 and incubated at 45°C for 20 hours.

**[0110]** The samples were heated to 90°C for 10 min and the upper oil phase isolated.

Table 15

		Sample 1	Sample 2
Glycerol	%	1.3	2.9
Free fatty acid	%	7.2	6.5
Monoglyceride	%	19.2	16.1
Diglyceride	%	42.3	42.9
Triglyceride	%	29.8	31.5

**[0111]** Table 15 indicates that 15-20 % monoglyceride was formed during this enzymatic reaction.

**[0112]** These samples were used to produce a puff pastry margarine according to the recipe of Table 16.

Table 16

Margarine				
	1	2	3	4
Water phase				
Water phase	36.9	36.9	36.9	36.9
Salt	2	2	2	2
Sugar	1	1	1	1
Potassium sorbate	0.1	0.1	0.1	0.1
EDTA	0.015	0.015	0.015	0.015
pH	3	3	3	3
Water phase total, %	40	40	40	40
Fat phase				
Palm stearin 55	20	20	20	20
Palm 43	25	25	25	25
Palm oil	45	45	45	45
Rape seed oil	10	10	10	10
Fat total,%	58.8	58.8	54.8	54.8
Dimodan PVP,%	1			
Dimodan BP,%		1		
Sample 1,%			5	
Sample 2,%				5
Lecithin, %	0.2	0.2	0.2	0.2
$\beta$ -carotene, ppm				
Fat phase total, %	60	60	60	60
Flavouring O2986,%	0.03	0.03	0.03	0.03

**Evaluation**

**[0113]** Margarines 1 to 4 were evaluated after 2 days storage at 5 °C.

Visual:

**[0114]** Margarines 1 to 4 all produced fine and stable puff pastry margarine

Margarine 1: Soft plastic

Margarine 2: Soft plastic was more soft than Margarine 1

Margarine 3: Soft plastic slightly more soft than Margarine 1

Margarine 4: Soft plastic better than Margarine 1

**[0115]** Microscopy:



Margarine 1 gave very nice dispersions of water particles in the fat phase,  
Margarine 2 and Margarine 3 were evaluated equal fine water particles.  
Margarine 4 was evaluated slightly better than 1.

Microscopic pictures of the samples is shown in Figures 2 and 3. Margarines 1 to 4 are shown as 1863-1 to 4, respectively.

Conclusion:

**[0116]** From the experiment with puff pastry margarine it can be concluded that the enzymatic interesterification of palm oil or palm stearin can be used to produce margarine which are fully on level with the quality of commercial products.

**[0117]** It has been shown that these samples made by enzymatic interesterification can substitute distilled monoglyceride for the production of a puff pastry margarine.

**[0118]** All publications mentioned in the above specification are herein incorporated by reference. Various modifications and variations of the described methods and system of the invention will be apparent to those skilled in the art without departing from the scope and spirit of the invention. Although the invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiments. Indeed, various modifications of the described modes for carrying out the invention which are obvious to those skilled in chemistry or related fields are intended to be within the scope of the following claims.

## Claims

1. A process for preparing a foodstuff suitable for consumption comprising an emulsifier and a second functional ingredient, the process comprising the steps of

- (i) providing a food material containing a triglyceride and a second constituent, wherein the second constituent is glycerol or ascorbic acid;
- (ii) contacting the food material with an enzyme, wherein the enzyme is a lipase, such that an emulsifier is generated by the enzyme from the triglyceride and a second functional ingredient is generated from the second constituent;
- (iii) inactivating or denaturing the enzyme to provide the foodstuff wherein the foodstuff is selected from edible oils or fats comprising the emulsifier, the triglyceride, the second functional ingredient and the enzyme in an inactive form or a denatured form.

2. A process according to any one of the preceding claims wherein the enzyme is isolated from a plant, an animal or a micro-organism.

3. A process according to claim 2, wherein the micro-organism is selected from *Aspergillus niger*, *Rhizopus delemar*, *Rhizopus arrhizus*, *Mucor miehei*, *Pseudomonas sp.*, *Candida rugosa*, *Pencilium roqueforti*, *Pencilium cyclopium*, *Aspergillus tubingensis*, *Candida cylindracea*, *Thermomyces lanuginosus*, *Mucor javanicus*, *Candida antarctica*, *Chromobacterium viscosum*, *Pseudomonas fluorescens*, *Pseudomonas nitroreducans*, *Chromobacterium viscosum*, *Bacillus subtilis* mutants and combinations thereof.

4. A process according to any one of the preceding claims wherein the second constituent is glycerol.

5. A process according to any one of claims 1-3 wherein the second constituent is ascorbic acid.

6. A process according to any one of the preceding claims wherein the foodstuff is selected from w/o emulsions, o/w emulsions, margarine, and shortening.

## Patentansprüche

1. Verfahren zur Herstellung eines für den Verzehr geeigneten Nahrungsmittels, das einen Emulgator und einen zweiten funktionalen Inhaltsstoff enthält, wobei das Verfahren die Stufen umfaßt, in denen man

- (i) ein Nahrungsmittelmateriale bereitstellt, das ein Triglycerid und einen zweiten Bestandteil enthält, wobei der zweite Bestandteil Glycerin oder Ascorbinsäure ist,

(ii) das Nahrungsmittelmateriel mit einem Enzym in Kontakt bringt, wobei das Enzym eine Lipase ist, so daß von dem Enzym aus dem Triglycerid ein Emulgator erzeugt wird und ein zweiter funktionaler Inhaltsstoff aus dem zweiten Bestandteil erzeugt wird,  
 (iii) das Enzym inaktiviert oder denaturiert, um das Nahrungsmittel bereitzustellen, wobei das Nahrungsmittel unter Speiseölen oder Fetten ausgewählt ist, welche den Emulgator, das Triglycerid, den zweiten funktionalen Inhaltsstoff und das Enzym in einer inaktiven Form oder einer denaturierten Form enthalten.

2. Verfahren nach einem der vorangegangenen Ansprüche, wobei das Enzym aus einer Pflanze, einem Tier oder einem Mikroorganismus isoliert ist.
3. Verfahren nach Anspruch 2, wobei der Mikroorganismus unter *Aspergillus niger*, *Rhizopus delemar*, *Rhizopus arrhizus*, *Mucor miehei*, *Pseudomonas sp.*, *Candida rugosa*, *Penicillium roqueforti*, *Penicillium cyclopium*, *Aspergillus tubingensis*, *Candida cylindracea*, *Thermomyces lanuginosus*, *Mucor javanicus*, *Candida antarctica*, *Chromobacterium viscosum*, *Pseudomonas fluorescens*, *Pseudomonas nitroreducans*, *Chromobacterium viscosum*, *Bacillus subtilis*, Mutanten und Kombinationen davon ausgewählt ist.
4. Verfahren nach einem der vorangegangenen Ansprüche, wobei der zweite Bestandteil Glycerin ist.
5. Verfahren nach einem der Ansprüche 1 bis 3, wobei der zweite Bestandteil Ascorbinsäure ist.
6. Verfahren nach einem der vorangegangenen Ansprüche, wobei das Nahrungsmittel unter Wasser-in-Öl-Emulsionen, Öl-in-Wasser-Emulsionen, Margarine und Backfett ausgewählt ist.

## Revendications

1. Procédé pour la préparation d'un produit alimentaire apte à la consommation, comprenant un émulsionnant et un second ingrédient fonctionnel, procédé qui comprend les étapes consistant à :
  - (i) prendre une denrée alimentaire contenant un triglycéride et un second constituant, le second constituant étant le glycérol ou l'acide ascorbique ;
  - (ii) mettre en contact la denrée alimentaire avec une enzyme, l'enzyme étant une lipase, de telle sorte qu'un émulsionnant soit engendré par l'enzyme à partir du triglycéride et un second ingrédient fonctionnel soit engendré à partir du second constituant ;
  - (iii) inactiver ou dénaturer l'enzyme pour obtenir le produit alimentaire, le produit alimentaire étant choisi parmi des huiles ou graisses comestibles comprenant l'émulsionnant, le triglycéride, le second ingrédient fonctionnel et l'enzyme sous une forme inactive ou une forme dénaturée.
2. Procédé suivant l'une quelconque des revendications précédentes, dans lequel l'enzyme est isolée d'une plante, d'un animal ou d'un micro-organisme.
3. Procédé suivant la revendication 2, dans lequel le micro-organisme est choisi entre *Aspergillus niger*, *Rhizopus delemar*, *Rhizopus arrhizus*, *Mucor miehei*, *Pseudomonas sp.*, *Candida rugosa*, *Penicillium roqueforti*, *Penicillium cyclopium*, *Aspergillus tubingensis*, *Candida cylindracea*, *Thermomyces lanuginosus*, *Mucor javanicus*, *Candida antarctica*, *Chromobacterium viscosum*, *Pseudomonas fluorescens*, *Pseudomonas nitroreductans*, *Chromobacterium viscosum*, *Bacillus subtilis*, leurs mutants et leurs associations.
4. Procédé suivant l'une quelconque des revendications précédentes, dans lequel le second constituant est le glycérol.
5. Procédé suivant l'une quelconque des revendications 1 à 3, dans lequel le second constituant est l'acide ascorbique.
6. Procédé suivant l'une quelconque des revendications précédentes, dans lequel le produit alimentaire est choisi entre des émulsions eau/huile, des émulsions huile/eau, la margarine et des matières grasses.

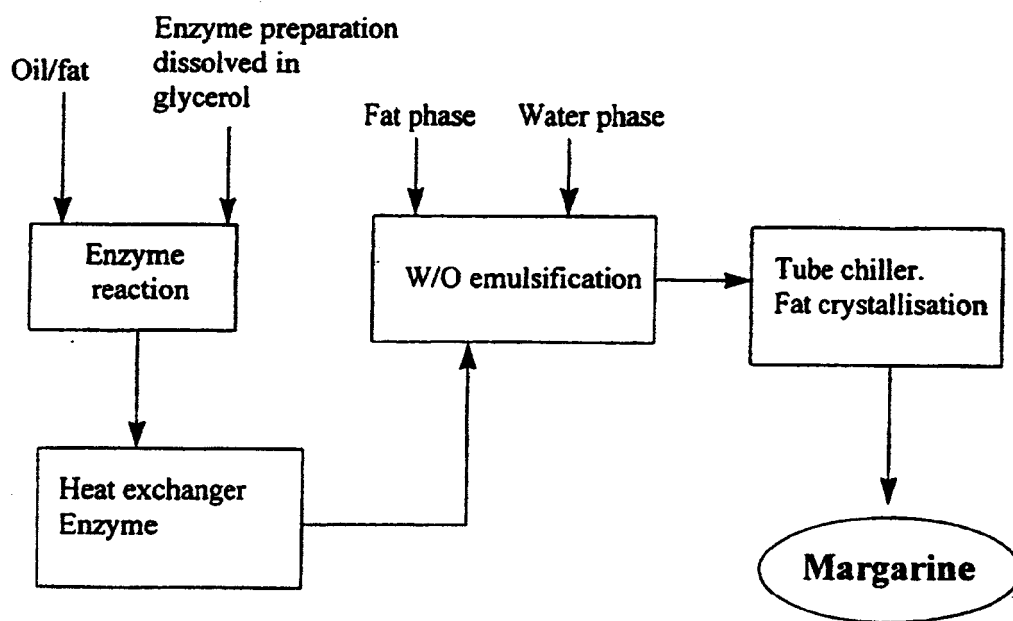


Figure 1

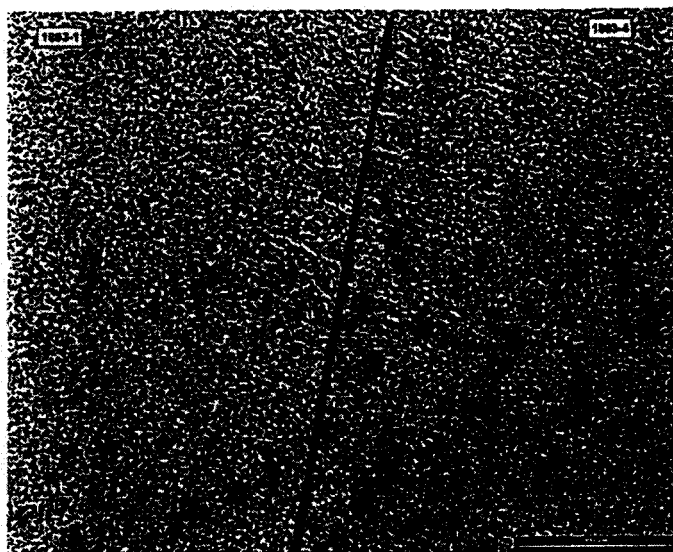


Fig. 2

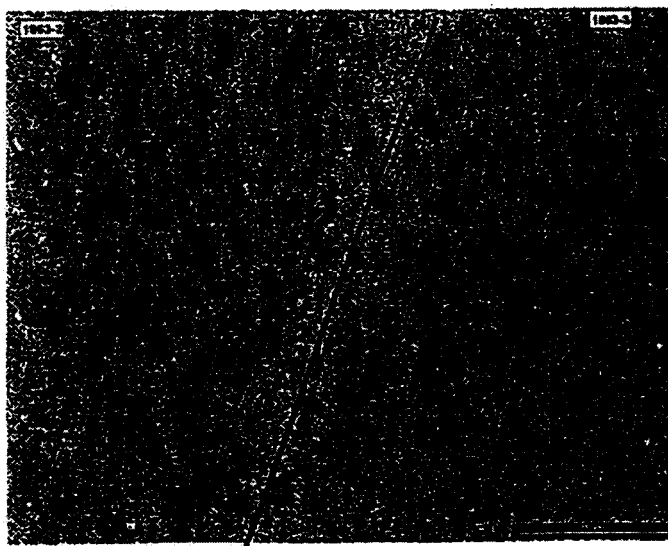


Fig. 3

## REFERENCES CITED IN THE DESCRIPTION

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