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CA 2241048 C 2005/02/22

(11)(21) **2 241 048**

(12) **BREVET CANADIEN
CANADIAN PATENT**

(13) **C**

(86) Date de dépôt PCT/PCT Filing Date: 1996/12/17
(87) Date publication PCT/PCT Publication Date: 1997/06/26
(45) Date de délivrance/Issue Date: 2005/02/22
(85) Entrée phase nationale/National Entry: 1998/06/19
(86) N° demande PCT/PCT Application No.: GB 1996/003107
(87) N° publication PCT/PCT Publication No.: 1997/022261
(30) Priorité/Priority: 1995/12/20 (08/575,711) US

(51) Cl.Int.⁶/Int.Cl.⁶ A23D 9/013, A23L 1/307, A23L 1/217,
A23L 1/164
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(54) Titre : GLYCERINE PROPOXYLEE, ESTERIFIEE A L'AIDE D'ACIDES GRAS ET UTILISEE DANS DES
COMPOSITIONS D'HUILE DE FRITURE

(54) Title: FATTY ACID ESTERIFIED PROPOXYLATED GLYCERIN AS FRYING OIL COMPOSITIONS

(57) **Abrégé/Abstract:**

Reduced calorie fried snacks are prepared by replacing a portion of the oil conventionally used in frying with a fat replacement composition comprised of a fatty acid-esterified propoxylated glycerin composition which has a solid fat index as measured by dilatometry of more than about 25 at 92 °F, preferably less than about 70 at 92 °F, and less than about 5 at 104 °F. Potato chips, corn chips and similar fried snacks prepared according to the invention exhibit excellent flavor and other organoleptic properties.



**PCT**WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : A23D 9/013, A23L 1/164, 1/217	A1	(11) International Publication Number: WO 97/22261 (43) International Publication Date: 26 June 1997 (26.06.97)
(21) International Application Number: PCT/GB96/03107 (22) International Filing Date: 17 December 1996 (17.12.96) (30) Priority Data: 08/575,711 20 December 1995 (20.12.95) US (71) Applicant: CPC INTERNATIONAL INC. [US/US]; International Plaza, P.O. Box 8000, Englewood Cliffs, NJ 07632 (US). (71) Applicant (for all designated States except CN KR SG): ARCO CHEMICAL TECHNOLOGY L.P. [US/US]; 3801 West Chester Pike, Newtown Square, PA 19073-2387 (US). (71) Applicant (for MG only): CPC (UNITED KINGDOM) LIMITED [GB/GB]; Claygate House, Littleworth Road, Esher, Surrey KT10 9PN (GB). (72) Inventors: SEKULA, Bernard, Charles; 743 Backhus Estate Road, Glen Gardner, NJ 08826 (US). GOLDEN, Rosemary, Antoinette; 304 S. Main Street, Milltown, NJ 08850 (US). (74) Agent: STEVENS, Ian, Edward; Stevens Hewlett & Perkins, 1 St Augustine's Place, Bristol BS1 4UD (GB).		(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>
(54) Title: FATTY ACID ESTERIFIED PROPOXYLATED GLYCERIN AS FRYING OIL COMPOSITIONS (57) Abstract Reduced calorie fried snacks are prepared by replacing a portion of the oil conventionally used in frying with a fat replacement composition comprised of a fatty acid-esterified propoxylated glycerin composition which has a solid fat index as measured by dilatometry of more than about 25 at 92 °F, preferably less than about 70 at 92 °F, and less than about 5 at 104 °F. Potato chips, corn chips and similar fried snacks prepared according to the invention exhibit excellent flavor and other organoleptic properties.		

5 FATTY ACID ESTERIFIED PROPOXYLATED GLYCERIN AS FRYING OIL COMPOSITIONS.

BACKGROUND OF THE INVENTION

Field of the Invention

10 The present invention has to do with reduced calorie snacks prepared by frying in an admixture of vegetable oil and a fat replacement composition. More specifically, the invention relates to fried snacks wherein some of the oil conventionally used in frying has been replaced by a fatty acid-esterified propoxylated
15 glycerin composition that is solid at ambient temperatures. The snacks are flavorful and do not have the waxy texture associated with previously employed fat replacement compositions.

Description of the Related Art

Snacks, such as potato and corn chips, are typically prepared
20 by frying in liquid or partially hydrogenated vegetable oils. These include soybean, canola, cottonseed, corn, sunflower, peanut, safflower and partially hydrogenated soybean, canola, cottonseed, corn and sunflower oils. The oils impart a pleasant fried flavor to snack products as well as an oily/greasy texture. Solid fats are
25 not used in the preparation of fried snacks because the high level of absorbed oil in the fried product, generally from about 25% to about 45% by weight, would result in a waxy mouthfeel upon consumption.

Since fats make up approximately 40% of the diet and are
30 calorically dense, research efforts have focused on ways to produce low/no-fat foods that provide the same functional and organoleptic

properties as their full-fat counterparts, but not the calories. These efforts have led to the development of lipid-based fat replacers for both non-heated and heated applications. Examples of lipid-based fat replacers include the acylated glycerides described
5 in U.S. Patent No. 4,582,715, sucrose octaesters described in U.S. Patent No. 4,797,300, alkyl glycoside fatty acid polyesters described in U.S. Patent No. 4,840,815, polyoxyalkylene derivatives described in U.S. Patent No. 4,849,242, polymerized fatty acid esters described in U.S. Patent No. 4,980,191, polysiloxane oil
10 described in U.S. Patent No. 4,983,413, cyclohexyl diol diesters described in U.S. Patent No. 5,006,351, long chain diol diesters described in U.S. Patent No. 5,008,126, amide ether derivatives described in U.S. Patent No. 5,063,075, complex linked esters described in U.S. Patent No. 5,115,017, carboxy/carboxylate
15 disubstituted esters described in U.S. Patent No. 5,124,166, amide linked fat mimetics described in U.S. Patent No. 5,139,807, substituted succinate esters described in U.S. Patent No. 5,176,933, acylated amino acid ester derivatives described in U.S. Patent No. 5,190,782, primary amide esters described in U.S. Patent No. 5,190,783, 2,3-butane-diol diesters described in U.S. Patent No. 5,264,237, and extended ester derivatives described in U.S. Patent No. 5,266,346. Processes for the production of reduced-calorie low-fat potato chips are described in U.S. Patents Nos. 5,085,884, 5,100,684, 5,192,572 and 5,236,733.

25 Other fat replacement compositions which have been developed for use in low calorie fat-containing foods are described as useful

in heated environments. An early development employing sugar fatty acid ester compositions is described in U.S. Patent No. 3,600,186, and the compositions are said to be suitable for use in frying eggs, meat, fish, potatoes and the like.

5 The use of sucrose polyesters as fat replacement compositions is disclosed in U.S. Patent No. 4,789,664 in foods described as having blood cholesterol lowering properties but they are not suggested as a substitute for the oils normally used in frying.

10 In European Patent Application 0 236 288, low calorie fat materials are described which include sugar fatty acid polyesters, polyglycerol fatty acid esters and tricarboxylic acids esterified with fatty alcohols. The materials are said to be useful in a wide variety of food products, including fried snack foods such as potato chips, corn chips and the like. Polyol polyesters and their use in
15 shortenings and foods also are described in European Patent Specification 0 290 420. The polyesters are said to be useful to make foods which are fried in oil including fried and/or salted snack foods.

20 Feeding trials have shown that certain lipid-based fat replacers elicit undesirable gastrointestinal side effects such as passive oil leakage through the anal sphincter. These effects appear to correlate with the physical state of these fat replacers in the body, which, in turn, may be affected by their digestibility and/or absorbability.

25 All of the low calorie fat replacement compositions and low fat fried snacks discussed above have drawbacks either in the processes

which employ them or the flavor and mouthfeel characteristics of the finished reduced fat products. In particular, when such compositions are used in frying, the fat becomes visible when the product is cooled and/or the fat is detectable as a waxy mouthfeel.

5 Reduced calorie food compositions containing fat-type organoleptic ingredients are known wherein an esterified epoxide extended polyol is employed as a full or partial replacement for vegetable oils and fats. Fat substitutes of this type are disclosed in U. S. Patent No. 4,861,613 to White et al. (referred to herein as "White"). However, it has not heretofore been known
10 that such substances can be used in combination with the oils conventionally used in frying to make reduced calorie fried snack foods having superior flavor and mouthfeel properties.

 EP-A-0571219 discloses esterified propoxylated glycerin fat substitute compositions resistant to gastrointestinal side effects. The compositions have a
15 solid fat index at 27°C (80°F) of at least 30 as measured by dilatometry.

 It has now been found that certain fatty acid-esterified propoxylated glycerin compositions which are solid at ambient temperature can be employed as a substitute for some of the oil used to prepare fried snack foods such as potato chips and corn chips to make fried snacks having reduced calories and
20 excellent organoleptic properties.

 According to our invention, reduced-calorie fried snacks can be prepared without significantly modifying conventional processes. The snacks are neither oily nor greasy to the touch nor waxy in the mouth. The flavor of the snacks can be controlled to suit the desired taste by selecting the appropriate ratio of
25 fatty acid-esterified propoxylated glycerin to conventional vegetable oil and,

for example, potato chips can be made with exhibit more potato flavor and less oil flavor.

In the present specification and claims, all parts and percentages are by weight unless otherwise specified.

5

SUMMARY OF THE INVENTION

Reduced calorie fried snacks are prepared by frying in an admixture of the liquid or partially hydrogenated vegetable oils conventionally used in preparing fried snacks and certain fatty acid-esterified propoxylated glycerin compositions which function
10 as fat replacement compositions. Suitable fatty-acid esterified propoxylated glycerin compositions surprisingly are those which have a high solids content at about 92°F (33°C) and have a melting point as high as about 110°F. The fat replacement compositions surprisingly do not cause the reduced calorie fried snacks to have
15 a waxy mouthfeel even though the compositions exhibit a relatively high solids content at normal body temperature.

Suitable compositions for use according to the invention can be identified based on their solid fat index properties. The solid fat index (sometimes abbreviated herein as "SFI") referred to
20 throughout the present specification is determined in accordance with AOCS Official Method Cd 10-57 (available from American Oil Chemists' Society, 1608 Broadmoor Dr., Champaign, IL 61821-5930 USA). The fatty-acid esterified propoxylated glycerin compositions meeting the following SFI specifications are suitable for use
25 according to the invention:

SFI > about 25 at 92°F;

SFI < about 70 at 92°F; more preferably

< about 60; most preferably < about 50; and

SFI < about 5 at 104°F.

5 The fatty acid-esterified propoxylated glycerin compositions (sometimes referred to herein as "EPG" in the singular form and as "EPGs" in the plural form) are made by incorporating propylene oxide (sometimes referred to herein as "oxypropylene" or "PO") groups into a typical triglyceride fat as described in White. The triglyceride
10 fat can contain one fatty acid or a blend of fatty acids. The average number of PO groups which are incorporated into a triglyceride is called the propoxylation number. The melting properties and other characteristics of the composition can be modified by adjusting the propoxylation number, fatty acid chain
15 length or unsaturation level.

In the present invention, a preferred embodiment of the reduced-calorie fried snacks employ as a partial substitute for the oils conventionally used to prepare fried snacks an EPG which is prepared by the propoxylation of glycerol to a propoxylation number
20 of 5 followed by esterification with a blend of nine parts fully hydrogenated rapeseed oil fatty acids and one part liquid soybean oil fatty acids and hydrogenation to a final IV of $\leq$ about 10, referred to herein as EPG-05 9HR/1LS(IV $\leq$ 10), preferably to a final IV of from about 2-6, referred to herein as EPG-05 9HR/1LS(IV=2-6).
25 This composition has a dropping point of 109.9°F according to AOCS method Cc 18-80 (93) and yet the fried snacks prepared using the

composition do not have a waxy mouthfeel. This is surprising because the dropping point is higher than body temperature (about 98.6°F). The reduced calorie snacks of the invention also exhibit a high anal leakage tolerance.

DETAILED DESCRIPTION OF THE INVENTION

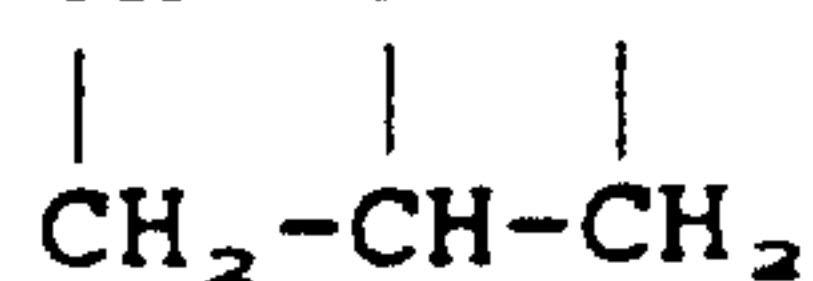
In order for the fatty acid-esterified propoxylated glycerin compositions of this invention to function effectively as partial substitutes for the liquid or partially hydrogenated vegetable oils conventionally used in frying farinaceous snack foods, the replacement compositions have a high solids content at about 92°F (33°C). Thus, mixtures of two or more EPGs (i.e., having different propoxylation numbers) of the same fatty acid composition can be used, mixtures of two or more EPGs of different fatty acid compositions having the same or different propoxylation numbers can be used, and any combination thereof can be used as long as the desired melting profile characteristics are obtained.

The fatty acid-esterified propoxylated glycerin compositions of this invention contain glyceryl residues, oxypropylene units, and fatty acid acyl

$$\begin{array}{c} \text{O} \\ | \\ \text{-CR} \end{array}$$
 groups. Typically, the compositions are mixtures of individual fatty acid-esterified propoxylated glycerin compounds which may differ from each other in degree of propoxylation and acyl group composition. The glyceryl residue may have the generic structure

$$\begin{array}{c} \text{O} \quad \text{O} \quad \text{O} \\ | \quad | \quad | \\ \text{CH}_2\text{-CH-CH}_2 \end{array}$$
 and is derived from glycerin

OH OH OH



or a glycerin equivalent. The oxypropylene units are

5 generally interspersed between glyceryl residues and the acyl

groups and have the structure $-\text{CH}_2 - \overset{\text{CH}_3}{\underset{|}{\text{CH}}} - \text{O}-$ or $-\overset{\text{CH}_3}{\underset{|}{\text{CH}}} - \text{CH}_2 - \text{O}-$. Typically,

10 more than one oxypropylene unit may be present between an oxygen of an individual glyceryl residue and an acyl group such that a polyoxypropylene unit is created. However, a single "branch" or "arm" of the fatty acid-esterified propoxylated glycerin may contain only one oxypropylene unit. Certain of the acyl groups may be
15 attached directly to the glyceryl residue, without any intervening oxypropylene units, although an average of at least about 3 oxypropylene units per glyceryl residue must be present in the overall composition. The average number of oxypropylene units in the fatty acid-esterified propoxylated glycerin composition is from
20 about 3 to about 10. The presence of oxypropylene units is critical, as the oxypropylene units help to lower the melting point of the compositions thereby improving the mouthfeel and melting characteristics as compared to analogous compositions not containing oxypropylene units.

25 In order to maximize the resistance of the fatty acid-esterified propoxylated glycerin composition towards pancreatic lipase enzyme-catalyzed hydrolysis, the oxypropylene units adjacent to the acyl groups should be oriented such that secondary rather than primary ester linkages are created. That is, the methyl group
30 should be located on the carbon atom attached to the oxygen atom

forming part of the ester linkage as follows:

$$\begin{array}{c} \text{CH}_3\text{O} \\ | \\ -\text{CH}_2-\text{CHOCR} \end{array}$$
 Preferably, at least about 80% of the ester linkages
 5 in the overall composition are secondary. Most preferably, at least
 about 95% of the ester linkages are secondary. However, the
 secondary ester content can be less than about 80% without adversely
 affecting the fat replacement properties of the EPGs of the
 invention.

10 It is desirable for the fatty acid-esterified propoxylated
 glycerin composition to be substantially esterified such that it has
 an average of at least about 2.5 (more preferably, at least about
 2.9) fatty acid acyl groups per equivalent of glycerin. The extent
 of esterification may be readily determined by conventional
 15 analytical methods such as hydroxyl number.

The structure of the composition preferably is such that the
 composition has a porcine pancreatic lipase hydrolysis rate of less
 than about 10% as compared to an olive oil standard. Preferably,
 the relative hydrolysis rate is less than about 1% of the olive oil
 20 rate. Methods of measuring porcine pancreatic lipase hydrolysis
 rate are described in White.

The average number of oxypropylene units in the EPG must not
 be so low as to result in a high proportion of the acyl groups being
 attached directly to glyceryl residues since such directly attached
 25 acyl groups will be nearly as susceptible to enzymatic cleavage as
 the acyl groups in a conventional fully digestible triglyceride,
 thus reducing the usefulness of the composition as a low calorie fat

substitute. At the same time the average number of oxypropylene units should not exceed about 10 since the resulting compounds may be substantially lower in melting point or higher in melt viscosity than is needed to meet the requirements of the invention.

5 The solid fat index for a given EPG may be adjusted as needed by varying the average number of oxypropylene units per glycerin (propoxylation number) present in the composition. At a constant fatty acid acyl group content (i.e., if the relative proportions of the different acyl groups present are fixed), the solid fat index
10 at a particular temperature will increase as the propoxylation number is decreased and will decrease as the propoxylation number is increased. As the average number of fatty acid acyl group carbons per equivalent of glycerin decreases or as the iodine number of the composition increases (as a result of increasing the
15 proportion of unsaturated fatty acid acyl groups present), the average number of oxypropylene units per glycerin will need to be decreased to maintain the solid fat index at a given temperature above a predetermined target value. If a particular fatty acid-esterified propoxylated glycerin composition has an undesirably high
20 solid fat index at a given temperature the index may be brought below a predetermined target value by increasing the propoxylation number. By so adjusting the average number of oxypropylene units per equivalent of glycerin, the melting properties of each EPG may be controlled to obtain a fat replacement composition having a solid
25 fat index which meets the requirements of the invention.

Suitable EPGs may be prepared using either fatty acids or fatty

acid derivatives such as fatty acid esters, fatty acid halides, or fatty acid anhydrides. Generally speaking, C_{12} - C_{24} saturated linear fatty acids and their derivatives can be used as starting materials for preparing the EPGs of the invention.

5 In addition, the iodine number (which reflects the proportion of unsaturated fatty acid acyl groups in the composition) must be less than about 30, more preferably is less than about 20, and most preferably is less than about 10 centigrams I_2 per gram of the composition. A relatively minor proportion of unsaturated fatty
10 acid acyl groups may be advantageous, however, in order to ensure that the composition does not melt over an excessively narrow range. Iodine number (also referred to as iodine value) may be measured by AOCS Official Method Cd 1-25.

The C_{12} - C_{24} saturated fatty acid is linear (i.e., nonbranched)
15 and preferably contains only one carboxylic acid functionality. The acyl group may thus correspond to the general structure

$$\begin{array}{c} O \\ || \\ -CCH_2 \end{array})_n CH_3$$
 wherein n is an integer of from 10 to 22. The value
20 of n is most conveniently an even number (e.g., 10, 12, 14, 16, 18, 20, or 22) since the corresponding fatty acids are readily available at low cost from natural sources such as edible triglycerides. Specific illustrative fatty acids suitable for use as this component of the fatty acid-esterified propoxylated glycerin compositions
25 include, but are not limited to lauric acid, myristic acid, stearic acid, palmitic acid, eicosanoic (arachidic) acid, heneicosanoic acid, docosanoic (behenic) acid, tricosanoic acid, and tetracosanoic

(lignoceric) acid. Mixtures of these C_{12} - C_{24} saturated linear fatty acids may also be utilized to advantage, as discussed above.

While all of the acyl groups in the fatty acid-esterified propoxylated glycerin composition may be derived from C_{12} - C_{24} saturated linear fatty acid, the compositions may contain minor amounts of acyl groups derived from other C_8 - C_{24} fatty acids. Preferably, the proportion of such other acyl groups is less than 40%. Generally speaking, the incorporation of acyl groups which are relatively short in length (C_8 - C_{18}), unsaturated, and/or branched will tend to decrease the melting point of the resulting EPG.

The fatty acids which optionally may be used in combination with the required C_{12} - C_{24} saturated linear fatty acids may be any of the known fatty acids such as caprylic acid, pelargonic acid, capric acid, oleic acid, cetoleic acid, palmitoleic acid, gadoleic acid, erucic acid, rincinoleic acid, linoleic acid, linolenic acid, myristoleic acid, eleostearic acid, arachidonic acid, or mixtures of these acids. Preferably, linear monocarboxylic acids containing from 0 to 5 double bonds are employed.

The proportions and chemical structures of the fatty acid acyl groups in the fat replacement compositions of this invention should be selected such that the solid fat indices as determined by dilatometry (AOCS Official Method Cd 10-57) will meet the following specifications:

SFI > about 25 at 92°F;

SFI < about 70 at 92°F; more preferably

< about 60; most preferably < about 50; and

SFI < about 5 at 104°F.

Increasing the ratio of average number of fatty acid acyl group carbons per equivalent of glycerin will shift the melting range of an EPG to a higher average temperature while decreasing the ratio will shift the melting range to a lower average temperature. The melting profile of the fat replacement composition can thus be conveniently made to meet the requirements of the invention by adjusting this ratio.

The average number of fatty acid acyl group carbons per equivalent of glycerin in the fatty acid-esterified propoxylated glycerin compositions of the invention may be readily calculated from a knowledge of the fatty acid acyl group content (i.e., the chemical structures and relative proportions of the fatty acids used to prepare the compositions). The following formula may be used to calculate this average number (N_a) for a fatty acid-esterified propoxylated glycerin composition prepared using fatty acids A and B:

$$N_a = \frac{\text{moles A} \times \text{no. carbons in A}}{\text{moles propoxylated glycerin}} + \frac{\text{moles B} \times \text{no. carbons in B}}{\text{moles propoxylated glycerin}}$$

For example, a composition prepared by reacting a mixture of 1.5 moles of stearic acid (a C_{18} fatty acid) and 1.5 moles of eicosanoic acid (a C_{20} fatty acid) with 1 mole of propoxylated glycerin containing an average of 7 oxypropylene units per glycerin will have an average of 57 fatty acid acyl carbons per equivalent of glycerin.

To minimize the available caloric content of the fatty acid-esterified propoxylated glycerin fat replacement compositions of this invention, the chemical composition should be selected such that the number average molecular weight is at least about 800. More preferably, the minimum molecular weight is about 1000. In order for the fatty acid-esterified propoxylated glycerin composition to mimic the viscosity, heat transfer properties and other properties of a frying oil, it is also desirable that the average molecular weight not exceed about 2200. Preferably, the molecular weight is below about 2000.

In a preferred embodiment of the invention, behenic (i.e. saturated C_{22}) acid-containing fatty acid compositions are employed. Fatty acid compositions which are relatively high in behenic acid content, having at least about 30% and preferably at least about 35% by weight of C_{22} saturated fatty acid, are most preferred. It is also preferred that the behenic acid content of such compositions not exceed about 60% by weight; more preferably, the behenic acid content is not in excess of about 50% by weight. The balance of the fatty acids may be any of the fatty acids previously discussed. In a preferred embodiment of the invention, however, the balance of the fatty acids are predominately stearic (C_{18} saturated) fatty acid. The fatty acid composition thus may comprise as much as about 70% by weight stearic acid.

Sources of behenic acid and stearic acid are well-known. For example, the fatty acids derived from rapeseed oil contain a relatively high proportion (typically about 30 to about 50 weight

%) of C_{22} fatty acids. The erucic acid present may be readily converted by hydrogenation to behenic acid, either before or after incorporation into the fatty acid-esterified propoxylated glycerin composition. A number of vegetable oils are known which contain high proportions (typically about 70 to about 95 weight %) of C_{18} fatty acids. The unsaturated C_{18} fatty acids present may be hydrogenated before or after incorporation into the fatty acid-esterified propoxylated glycerin composition. Illustrative vegetable oils of this type include, but are not limited to, soybean oil, corn oil, cottonseed oil, olive oil, peanut oil, canola oil, safflower oil, sesame oil, sunflower oil, and the like. Fatty acids derived from mixtures of such oils may also be utilized to advantage.

One specific type of EPG suitable for use in accordance with the present invention is a fatty acid-esterified propoxylated glycerin composition having an average number of oxypropylene units of from about 4 to about 6 and an iodine value (also referred to herein as "IV") of from about 2 to about 6, wherein the fatty acids are comprised of about 35 to about 45% by weight behenic acid and about 35 to about 45% by weight stearic acid (the balance of the fatty acids being any of the other known fatty acids).

In another desirable embodiment, the fatty acid-esterified propoxylated glycerin composition has an iodine value less than or equal to about 10 (i.e., 0-10) and is obtainable by esterifying a propoxylated glycerin having an average number of oxypropylene units of from about 4 to about 6 with a fatty acid mixture wherein from

about 80 to about 95 weight % of the fatty acid mixture are derived from rapeseed oil and the balance of said fatty acids are derived from a vegetable oil selected from the group consisting of soybean oil, corn oil, cottonseed oil, olive oil, peanut oil, canola oil, 5 safflower oil, sesame oil, sunflower oil, and mixtures thereof.

A particularly preferred EPG of the invention is made by preparing a mixture of about 90% by weight hydrogenated rapeseed fatty acid and about 10% by weight soya fatty acid and esterifying the mixture with propoxylated glycerol to synthesize a crude EPG. 10 The product is a fatty acid-esterified propoxylated glycerin composition having an average number of oxypropylene units per equivalent of glycerin (propoxylation number) of about 5, an iodine number less than about 5, an average number of fatty acid acyl group carbons per equivalent of glycerin of from about 54 to about 60, and 15 a drop melting point (also called a dropping point as measured by the Mettler Dropping Point method, AOCS Official Method Cc 18-80(93)) of from about 102 to about 110°F.

The fatty acid-esterified propoxylated glycerin fat replacement compositions of this invention may be prepared using any suitable 20 method. In general, the procedures described in the prior art for synthesizing other fatty acid-esterified propoxylated glycerin compositions will be appropriate for use provided that the necessary C_{12} - C_{24} saturated linear fatty acids or fatty acid derivatives are employed in the esterification step. Such procedures are described, 25 for example, in U.S. Patents Nos. 4,861,613 (the White patent, referenced above) and 4,983,329 and in European Patent Publication

No. 353,928. As is explained in more detail in the above-mentioned publications, either fatty acids or fatty acid equivalents such as fatty acid esters, fatty acid halides, or fatty acid anhydrides may actually be employed in the esterification. The C₁₂-C₂₄ saturated linear fatty acid acyl groups may also be
5 introduced by using C₁₂-C₂₄ unsaturated fatty acids in the esterification step and then hydrogenating the esterified propoxylated glycerin composition to increase the proportion of C₁₂-C₂₄ saturated linear fatty acid acyl groups to the desired level. Any residual free fatty acid remaining in the composition after esterification should preferably be removed or reduced as much as possible to
10 minimize problems with off flavor, off-odor, or storage stability.

The fatty acid-esterified propoxylated glycerin compositions of the present invention are particularly suitable for use as partial replacements for the liquid or partially hydrogenated vegetable oils of the type conventionally used in preparing fried snacks. These conventional vegetable oils are selected from the
15 group consisting of soybean, canola, cottonseed, corn, sunflower, peanut, safflower and partially hydrogenated soybean, canola, cottonseed, corn and sunflower oils.

Typically, fried snacks are comprised of 25 to 45 weight percent of a fat component. To achieve a significant reduction in
20 available caloric content while maintaining desirable flavor and other organoleptic properties, it will generally be desirable for

at least about 30 weight percent and preferably at least about 40 weight percent of the fat component to be a suitable fatty-acid esterified propoxylated glycerin composition. The balance of the fat component may be a liquid and/or partially hydrogenated vegetable oil or a different fat substitute, equivalent or mimetic which is capable of being used in frying. The amount of the fat replacement composition may, if desired, constitute up to about 70% of the total fat in the frying oil composition, and preferably will be from about 40% to about 60% of the total fat in the product. More than about 70% can be employed provided that the product does not have a waxy mouthfeel, the objective of the invention being to use as much of the fat replacement composition as possible while avoiding a waxy mouthfeel.

In addition to the fat component comprised of the fatty acid-esterified propoxylated glycerin composition, the fried snack of the invention may further comprise one or more conventional ingredients such as sugars (e.g., sucrose, fructose, glucose and maltose), water, flavorings such as jalapeno, cheese, sour cream, or nut flavorings, seasonings such as salt or pepper, milk solids (non-fat, skimmed, or whole), emulsifiers such as lecithin, antioxidants, dietary fibers, vitamins, bulking or bodying agents such as polydextrose or modified starch, salt, and the like. A sugar alcohol such as sorbitol, xylitol, or mannitol or a reduced calorie sweetener such as saccharine, aspartame, cyclamates, sucralose, acesulfame, acesulfam-K, or the like may also be employed in combination with the fatty acid-esterified propoxylated glycerin

compositions of the invention.

Snack food products in accordance with the invention may be readily prepared by replacing a portion of the oil component of a standard frying oil formulation with the fatty acid-esterified propoxylated glycerin fat replacement compositions described hereinabove using known processing methods and techniques as will be apparent to those skilled in the art.

EXAMPLES

The EPGs utilized in the examples of the invention were synthesized from rapeseed and soybean fatty acids and physically refined. The resulting materials were hydrogenated to saturation IV<4), bleached and deodorized. The deodorized products were fortified with a mixed tocopherol blend of 50% Covi-ox T70 and 50% Covitol F1300 (both available from Henkel Corp., La Grange, Illinois, U.S.A.) to a level of 0.16%. The finished products were characterized using analytical methods commonly used by the industry to evaluate oils and fats. These methods included Wijs iodine value (AOCS Cd 1-25), dropping point (AOCS Cc 18-80 (93)) and solid fat index (AOCS Cd 10-57).

20 Example 1

To illustrate the effect of the average number of oxypropylene units per equivalent of glycerin on the melting characteristics of fatty acid-esterified propoxylated glycerin compositions, the following series of such compositions were synthesized using the procedures described in U. S. Patent No. 4,983,329. The average number of oxypropylene units per equivalent of glycerin was varied

from 3 to 12 and various types and ratios of fatty acid were employed. In each case, the reaction was carried out until essentially all of the hydroxyl groups of the propoxylated glycerin had been esterified. The EPGs were physically refined, bleached and
5 deodorized. The deodorized products were fortified with a mixed tocopherol blend of 50% Covi-ox T70 and 50% Covitol F1300 (both available from Henkel Corp., La Grange, Illinois, U.S.A.) to a level of 0.16%. The finished products were characterized using analytical
10 methods commonly used by the industry to evaluate oils and fats. These methods included Wijs iodine value (AOCS Cd 1-25), dropping point (AOCS Cc 18-80 (93)) and solid fat index (AOCS Cd 10-57). The solid fat index of each composition at certain temperatures is shown in Table I.

TABLE I
SFI DATA AT °F

5	<u>COMPOSITION</u>	<u>50</u>	<u>70</u>	<u>80</u>	<u>92</u>	<u>98.6</u>	<u>104</u>
	EPG-03 ST	82.3	81.4	80.2	74.1	ND	0.1
	EPG-04 ST	79.6	78	76.2	60.5	ND	0.1
	EPG-05 HS	71.9	64.8	53.9	<0.1	<0.1	<0.1
	EPG-05 ST	75	72	67.5	0.1	ND	<0.1
10	EPG-05 HR/ST (2/1)	75.5	70.2	66.2	38.7	4.7	<0.1
	EPG-05 HR/ST (75/25)	O/S	68.6	63.4	36.9	6.9	<0.1
	EPG-05 HR/ST (8/2)	76.7	70.4	65.4	40.8	10.8	<0.1
	EPG-05 HR/ST (85/15)	O/S	86.3	66.9	45.5	17.5	<0.1
	EPG-05 HR/ST (6/4)	O/S	71.5	67.3	44	8.4	0.5
15	EPG-05 HR/ST (7/3)	O/S	64.7	58.2	28.1	1.1	<0.1
	EPG-05 HR/ST (45/55)	O/S	67.5	62.9	30.6	<0.1	<0.1
	EPG-05 HR/LS (7/3)	50.4	29.9	18.4	5.5	0.4	0.2
	EPG-05 HR/LS (9/1)	74.4	65.8	59.8	43.0	ND	2.8
	EPG-08 B/ST (1/1)	74.2	68.3	60.6	28.2	ND	<0.1
20	EPG-08 HR	70.0	66	60.9	25.1	ND	<0.1
	EPG-08 HR/ST (45/55)	73.7	67.8	62.7	24.8	<0.1	<0.1
	EPG-08 B/ST (1/3)	69.4	61.6	38.2	<0.1	ND	<0.1
25	EPG-08 B/Coco (3/1)	65.9	59	54.4	48.4	ND	29.3
	EPG-12 HR	53	21.2	5.9	<0.1	<0.1	<0.1

KEY

HS = Fully hydrogenated soybean oil fatty acids

HR = Fully hydrogenated rapeseed oil fatty acids

5 ST = Contains 95% stearic (C18:0) and 5% palmitic (C16:0) acids

B = Contains 85% behenic (C22:0) and 15% stearic acids

LS = Liquid soybean oil fatty acids

Coco - coconut oil fatty acids

Fatty acid blend ratios are shown in parentheses.

10 O/S means

The compositions EPG-03 ST, EPG-05 HS, EPG-05 ST, EPG-05 HR/LS (7/3), EPG-08 B/Coco (3/1) and EPG-12 HR were found to be unsuitable for use according to the invention either because the SFI at 92°F was too low or the SFI at 92°F was too high or the SFI at 104°F was too high and as a consequence they were not characterized by the sharp melt required according to the present invention.

In contrast, the melting behavior of the remaining compositions were suitable. In each case, the melting range was desirably sharp.

20 Example 2

Hydrogenated rapeseed fatty acid (1423kg) was blended with soybean fatty acid (140kg) to make a free fatty acid blend. The blend was reacted with propoxylated glycerin having a propoxylation number of 5 using the procedures described in U. S. Patent No. 4,983,329. The esterified product was physically refined, hydrogenated, bleached and deodorized. The hydrogenated product was fortified by blending with 0.15% tocopherol blend (50% Covi-ox T70

and 50% Covitol F1300) for 30 minutes at 60°C in a nitrogen atmosphere. The product was transferred to a belt dryer, grated and packaged.

Example 3

5 The grated product of Example 2 was analyzed and found to have an iodine value of 3.9 and a dropping point of 109.9°F. The solid fat index ("SFI") was as follows:

	<u>TEMP °F</u>	<u>SFI</u>
	50	74.3
10	70	67.4
	80	62.4
	92	45.9
	104	2.6

15 Example 4

The EPG product of Example 2 was blended in various ratios with WESSON vegetable oil (100% soybean oil). Idaho potato slices were freshly prepared and submerged in cold water prior to their use. For each blend ratio, a five quart deep frier was charged with 2,000
20 grams of the EPG/soybean oil blend. Two hundred grams of sliced potatoes were fried per batch (and four batches were prepared at each blend level) for about 4 minutes or until bubbling in the frier ceased. The remaining process details and sensory results are set forth in Table II and analytical results for used oil and potato
25 chips are shown in Table III. Each "x" in Table II represents a panelist who picked up the attribute. On the acceptable/un-

acceptable scale, "a" represents acceptable, "u" represents unacceptable and the numbers represent the number of panelists reporting an acceptable or unacceptable perception.

The sensory data indicated that waxiness is not perceived in
5 chips fried in EPG/oil blends containing up to 60% EPG. Additionally the chips were noted as having a potato flavor with little or no off-flavors. It should be noted that a rancid flavor can be an oil note and a fishy flavor is an oil note. No selective absorption of oil into the potato chips was observed.

10 The perceptible potato flavor was unexpected because conventionally prepared potato chips have only an oil taste and no potato taste. The potato flavor and hint of oil or an oil flavor can be optimized according to desired taste by adjusting the EPG/oil ratio.

TABLE II

PROCESS DETAILS & SENSORY PANEL RESULTS

5

		EPG/OIL BLEND RATIO				
<u>Process Conditions</u>		<u>70/30</u>	<u>65/35</u>	<u>60/40</u>	<u>55/45</u>	<u>40/60</u>
10	Starting Temperature (°C)	190	190	190	190	190
	Low Temperature (°C)	145	143	146	145	143
	Final Temperature (°C)	151	147	150	153	152
	Frying Time (min.)	4.17	4.12	4.12	4.08	4.08
<u>Sensory Panel Results</u>						
Flavor Descriptors						
15	- Corny	x	x			x
	- Metallic			x	x	
	- Potato	xxx	xxx	xx	xx	xxx
	- Rancid			sl.	sl.	
	- Other: Fishy		x		x	
Textural Descriptors						
20	- Crisp	xxxx	x	xx	xx	xxx
	- Soggy	x	xx, sl.	xx	x	xxx
	- Stale		xx			
	- Waxy	sl., sl., coating	xx, sl.		x, sl.	
Flavor Scale (4 pt. scale)						
25	- Clean	xxxx	xx	xx	x	xxxx
	- Slight Off-Flavor		xx	xx	xxx	
30	Acceptable/Unacceptable	a (3) a/u (2)	a, u (2) a/u (2)	a (5)	a (3) u (2)	a (4) a/u

TABLE III**ANALYTICAL RESULTS**

	<u>EPG/OIL BLEND RATIO</u>				
<u>Used Oil Analyses</u>	<u>70/30</u>	<u>65/35</u>	<u>60/40</u>	<u>55/45</u>	<u>40/60</u>
Lovibond Color, 1"cell (AOCS scale)	2.2 R/14 Y	3.4 R/26 Y	3.4 R/24 Y	1.6 R/9.6 Y	1.5 R/9.1 Y
Free Fatty Acids (%)	0.33	0.33	0.33	0.28	0.23
Peroxide Value	4.2	4.2	5.6	5.6	4.8
Anisidine Value	72.6	71.7	75.2	74.1	80.6
<u>Potato Chip Analysis</u>					
Fat Content (%) - Soxhlet Extraction	37.7	38.1	37.9	39.2	38.5

CLAIMS:

1. The use of a fat component comprising
 - a) from 40% to 60% by weight of a fatty acid-esterified propoxylated glycerin composition which is at solid state at ambient temperature having a solid fat index at 33°C (92°F) of more than 25 but less than 70, wherein the solid fat index of said fatty acid-esterified propoxylated glycerin composition at 40°C (104°F) is less than 5, said composition having an average number of oxypropylene units of from 3 to 10, a porcine pancreatic lipase hydrolysis rate of less than 1% compared to an olive oil standard and an iodine number of less than 30; and
 - b) a liquid or partially hydrogenated vegetable oil selected from the group consisting of soybean, canola, cottonseed, corn, sunflower, peanut and safflower and partially hydrogenated soybean, canola, cottonseed, corn and sunflower oils,
- for frying a reduced calorie fried snack product that does not impart a waxy mouthfeel sensation.
2. The use of claim 1 wherein the fatty-acid esterified propoxylated glycerin composition has a solid fat index at 33°C (92°F) of less than 60.
3. The use of claim 1 wherein the fatty-acid esterified propoxylated glycerin composition has a solid fat index at 33°C (92°F) of less than 50.
4. The use of claim 1 wherein the snack product comprises a potato chip or corn chip.
5. The use of claim 1 wherein the fatty acid-esterified propoxylated glycerin composition has esterified linkages and at least 80% of the linkages are secondary.
6. The use of claim 1 the fatty acid-esterified

propoxylated glycerin composition has an average of at least 2.5 fatty acid acyl groups per equivalent of glycerin.

7. The use of claim 1 wherein the fatty acid-esterified propoxylated glycerin composition has a number average molecular weight of at least 800 and not exceeding 2200.

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