

Description

The invention pertains to novel, nondigestible, solid fat-like compounds which are particularly useful as additives to liquid edible oils to form solid shortening compositions.

5 Conventional shortening compositions comprise a mixture of triglyceride materials which are respectively, liquids and solids at room temperature. Typically, the liquid triglyceride comprises about 85% of the shortening composition and the solid triglyceride about 15%. The compositions are prepared by hydrogenating a liquid triglyceride to the extent necessary to form the required amount of solid triglyceride within the mixture, or by hydrogenating a fraction of triglyceride to a high degree (Iodine Value from 0 to about 20) 10 to form a high melting solid, and then blending this with a liquid oil to form the solid shortening. In either case, the solid component traps relatively large amounts of the liquid component within its crystal structure, thereby forming a solid shortening, notwithstanding the fact that the amount of solid triglyceride in the shortening composition is relatively small. See U.S. Pat. No. 3,706,578, Bence, issued Dec. 19, 1972.

In recent years considerable attention has been focused on the amount of triglyceride fat in the diet 15 from the standpoint of health concerns about obesity and hypercholesterolemia. Numerous patents have been directed to providing materials which have the physical and gustatory characteristics of triglyceride fats, but which are absorbed to a low extent or not at all by the body. These materials are referred to variously as noncaloric fats, pseudofats, nondigestible fats and fat substitutes. Patents pertaining to such materials include U.S. Pat. Nos. 4,582,927, Fulcher, issued April 15, 1986, (fatty esters of malonic acid); 20 4,582,715, Volpenhein, Issued April 15, 1986, (alpha acetylated triglycerides); and 3,579,548, Whyte, issued May 18, 1981, (triglycerides of alpha-branched chain carboxylic acids).

One particular type of compound which has achieved considerable attention as a nondigestible fat is sucrose polyester (i.e., sucrose in which at least four of the eight hydroxyl groups are esterified with a fatty acid). U.S. Pats. 3,600,186, Mattson, issued Aug. 17, 1971; 4,368,213, Hollenbach et al. issued January 11, 25 1983; and 4,461,782, Robbins et al. issued July 24, 1984 describe the use of this material as a nondigestible fat in a variety of food compositions.

A problem associated with use of liquid nondigestible fats, i.e., those having a melting point below body temperature (about 37°C), is an undesired "laxative" effect, which is manifested in leakage of the liquid nondigested fat through the anal sphincter. U.S. Pat. No. 4,005,195, Jandacek, issued Jan. 25, 1977, 30 discloses the combining of higher melting fatty materials such as solid triglycerides and solid sucrose polyesters with the liquid sucrose polyesters in order to avoid the laxative effect.

An object of the present invention is to provide novel solid nondigestible materials which are suitable substitutes for solid fat in foods.

Other objects of the present invention are to provide improved solid nondigestible fat materials which 35 are useful in formulating solid shortenings from liquid edible oils, and to provide materials which can be formulated into food products with liquid nondigestible oils to prevent anal leakage caused by ingestion of the products containing such oils.

For purposes of describing this invention, the term "nondigestible" shall mean being absorbable to an extent of only 70% or less (especially 20% or less) by the human body through its digestive system.

40 All percentages and proportions herein are "by weight" unless otherwise specified.

The invention is directed to novel solid sucrose polyesters wherein the ester groups consist essentially of a mixture of short chain saturated fatty radicals (C_2 - C_{10}) and long chain saturated fatty acid radicals (C_{20} - C_{24}) in a molar ratio of short chain to long chain acid radicals of from about 3:5 to about 5:3, and wherein the degree of esterification is from about 7 to about 8.

45 It has now been found that certain sucrose polyesters (SPE's) which are solid at temperatures of about 40°C and higher, in addition to being suitable nondigestible substitutes for solid fat in the diet, have the ability to bind high levels of edible triglyceride oils and nondigestible oils such as liquid sucrose polyesters so as to form solid plastic compositions containing a high proportion of oil. Further, this high capacity of bind liquid oils makes these compounds particularly useful in the formulation of food products containing 50 the nondigestible oils so as to prevent the anal leakage problem associated with the ingestion of such oils.

The novel solid compounds of the present invention are polyesters of sucrose wherein the ester groups are a combination of certain short chain and long chain saturated, straight chain fatty acid radicals. The short chain fatty acid radicals contain from 2 to 10 carbon atoms (preferably 6 to 10) and the long chain radicals contain from 20 to 24 (preferably 22) carbon atoms. The molar ratio of short chain to long chain 55 acid radicals in the polyester molecule is from 3:5 to 5:3, preferably from 3:5 to 4:4, and the average degree of esterification is from 7 to 8, i.e., from 7 to all 8 of the hydroxyl groups of sucrose are esterified.

Examples of short chain fatty acid radicals for use in the compounds of the invention are acetate, butyrate, hexanoate (caproate), octanoate (caprylate) and decanoate (caprate). Examples of suitable long

chain fatty acid radicals are eicosanoate (arachidoate), docosanoate (behenate), and tetracosanoate (lignocerate). The preferred short chain fatty acid radical is caprylate and the preferred long chain fatty acid radical is behenate. The more preferred ratio of short chain fatty acid to long chain fatty acid 3:5 and it is preferred that all of the hydroxyl groups of sucrose be esterified, i.e., that the compounds be the octaester.

5 The most preferred compound of the invention is sucrose tricaprylate pentabehenate.

The compounds of the present invention can be made according to prior known methods for preparing polyesters of sucrose. One such method is by reacting the acid chlorides of the fatty acids with sucrose. In this method a mixture of the long and short chain acid chlorides can be reacted in one step with sucrose or the long and short chain acid chlorides can be reacted sequentially with sucrose. Another preparation
10 method is by the process of reacting methyl esters of the fatty acids with sucrose in the presence of a fatty acid soap and a basic catalyst such as potassium carbonate. See, for example, U.S. Pat. Nos. 3,963,699, Rizzi et al., issued June 15, 1976; 4,518,772, Volpenhein, issued May 21, 1985; and 4,517,360, Volpenhein, issued May 14, 1985. When using the methyl ester route for preparing the compounds herein, the octaester of the short chain fatty acid is prepared first, then this product is partially interesterified with the methyl
15 ester of the long chain fatty acid in order to obtain the sucrose ester of mixed short chain/long chain fatty acids.

The solid SPE compounds of the present invention are all solids at temperatures below about 40°C. They have the ability to trap large amounts of oil within their crystal structure, and as a consequence, can be blended in relatively small amounts (on the order of about 10% to 20%) with liquid oils to convert the
20 oils to solid compositions. i.e., compositions which remain solid at temperatures below about 40°C. The oils can be conventional digestible triglyceride oils such as cottonseed and corn oils, or non-digestible, edible oils.

Some of the solid SPE compounds of the invention exhibit a beta prime-like crystal structure which is characteristic of triglycerides. However, not all compounds of the invention exhibit this structure and,
25 therefore, it is not a required characteristic of compounds of the invention.

Examples of nondigestible edible oils are liquid polyesters of sugars and sugar alcohols (U.S. Pat. No. 4,005,195, Jandacek, issued January 25, 1977); liquid esters of tricarballic acids (U.S. Pat. No. 4,508,746, Hamm, issued April 2, 1985); liquid diesters of dicarboxylic acids such as malonic and succinic acid (U.S. Pat. No. 4,582,927, Fulcher, issued April 15, 1986); liquid triglycerides of alpha-branched chain carboxylic
30 acids (U.S. Pat. No. 3,579,548, Whyte, issued May 18, 1971); ethers and ether esters containing the neopentyl moiety (U.S. Pat. No. 2,962,419 Minich, issued Nov. 29, 1960; fatty polyethers of polyglycerol (U.S. Pat. No. 3,932,532, Hunter et al., issued Jan. 13, 1976).

The nondigestible solid fat materials of the present invention (or blends of said materials with liquid triglyceride oils and nondigestible edible oils), are useful in a wide variety of food and beverage products.

35 For example, they can be used in the production of baked goods in any form, such as mixes, shelf-stable baked goods, and frozen baked goods. Possible applications include, but are not limited to, cakes, brownies, muffins, bar cookies, wafers, biscuits, pastries, pies, pie crusts, and cookies, including sandwich cookies and chocolate chip cookies, particularly the storage-stable dual-textured cookies described in U.S. Pat. No. 4,455,333 of Hong & Brabbs. The baked goods can contain fruit, cream, or other fillings. Other
40 baked good uses include breads and rolls, crackers, pretzels, pancakes, waffles, ice cream cones and cups, yeast-raised backed goods, pizzas and pizza crusts, and baked farinaceous snack foods, and other baked salted snacks.

In addition to their uses in baked goods, the nondigestible solid fat materials herein can be used alone or in combination with other nondigestible or zero calorie fats to make shortening and oil products. The
45 other fats can be synthetic or derived from animal or vegetable sources, or combinations of these. Shortening and oil products include, but are not limited to shortenings, lards, cooking and frying oils, salad oils, popcorn oils, salad dressings mayonnaise, and other edible oils.

The present nondigestible solid fat materials can also be fortified with vitamins and minerals, particularly the fat-soluble vitamins. The fat-soluble vitamins include vitamin A, vitamin D, vitamin E, and vitamin K.
50 Vitamin A is a fat-soluble alcohol of the formula $C_{20}H_{29}OH$. Natural vitamin A is usually found esterified with a fatty acid; metabolically active forms of vitamin A also include the corresponding aldehyde and acid. Vitamin D is a fat-soluble vitamin well known for use in the treatment and prevention of rickets and other skeletal disorders. "Vitamin D" comprises sterols, and there are at least 11 sterols with vitamin D-type activity. Vitamin E (tocopherol) is a third fat-soluble vitamin which can be used in the present invention.
55 Four different tocopherols have been identified (alpha, beta, gamma and delta), all of which are oily, yellow liquids, insoluble in water but soluble in fats and oils. Vitamin K exists in at least three forms, all belonging to the group of chemical compounds known as quinones. The naturally occurring fat-soluble vitamins are K₁ (phyloquinone), K₂ (menaquinone), and K₃ (menadione). The amount of the fat-soluble vitamins employed

herein to fortify the present low calorie fat materials can vary. If desired, the fat materials can be fortified with a recommended daily allowance (RDA), or increment or multiple of an RDA, of any of the fat-soluble vitamins or combinations thereof. See U.S. Pat. No. 4,005,916, Jandacek et al., issued Jan. 25, 1977, incorporated herein by reference.

5 Vitamins that are nonsoluble in fat can similarly be included in the present nondigestible solid fat materials. Among these vitamins are the vitamin B complex vitamins, vitamin C, vitamin G, vitamin H, and vitamin P. The minerals include the wide variety of minerals known to be useful in the diet, such as calcium, magnesium, and zinc. Any combination of vitamins and minerals can be used in the present low-calorie fat materials.

10 The present nondigestible solid fat materials (or blends thereof with edible oils) are particularly useful in combination with particular classes of food and beverage ingredients. For example, an extra calorie reduction benefit is achieved when the fat materials are used with noncaloric or reduced calorie sweeteners alone or in combination with bulking agents. Noncaloric or reduced calorie sweeteners include, but are not limited to, aspartame, saccharin; alitame, thaumatin; dihydrochalcones; cyclamates; steviolides; glycyrrhizins, synthetic alkoxy aromatics, such as Dulcin and P-4000; sucrose, suosan; miraculin; monollin; 15 sorbitol; xylitol; talin; cyclohexylsulfamates; substituted imidazolines; synthetic sulfamic acids such as acesulfame, acesulfam-K and n-substituted sulfamic acids; oximes such as perilartine; rebaudioside-A; peptides such as aspartyl malonates and succinilic acids; dipeptides; amino acid based sweeteners such as gem-diaminoalkanes, meta-aminobenzoic acid, L-aminodicarboxylic acid alkanes, and amides of certain 20 alpha-aminodicarboxylic acids and gem-diamines; and 3-hydroxy-4-alkyloxyphenyl aliphatic carboxylates or heterocyclic aromatic carboxylates.

The nondigestible solid fat materials herein can be used in combination with other nondigestible fats, such as branched chain fatty acid triglycerides, triglycerol ethers, polycarboxylic acid esters, sucrose polyethers, neopentyl alcohol esters, silicone oils/siloxanes, and dicarboxylic acid esters. Other partial fat 25 replacements useful in combination with the materials herein are medium chain triglycerides, highly esterified polyglycerol esters, acetin fats, plant sterol esters, polyoxyethylene esters, jojoba esters, mono/diglycerides of fatty acids, and mono/diglycerides of short-chain dibasic acids.

Bulking or bodying agents are useful in combination with the nondigestible solid fat materials herein in many food compositions. The bulking agents can be nondigestible carbohydrates, for example, polydex- 30 trose and cellulose or cellulose derivatives, such as carboxymethylcellulose, carboxyethylcellulose, hydroxypropylcellulose, methylcellulose and microcrystalline cellulose. Other suitable bulking agents include gums (hydrocolloids), starches, dextrans, fermented whey, tofu, maltodextrins, polyols, including sugar alcohols, e.g., sorbitol and mannitol, and carbohydrates, e.g., lactose.

Similarly, food and beverage compositions can be made that combine the present nondigestible solid 35 fat materials with dietary fibers to achieve the combined benefits of each. By "dietary fiber" is meant complex carbohydrates resistant to digestion by mammalian enzymes, such as the carbohydrates found in plant cell walls and seaweed, and those produced by microbial fermentation. Examples of these complex carbohydrates are brans, celluloses, hemicelluloses, pectins, gums and mucilages, seaweed extract, and biosynthetic gums. Sources of the cellulosic fiber include vegetables, fruits, seeds, cereals, and manmade 40 fibers (for example, by bacterial synthesis). Commercial fibers such as purified plant cellulose, or cellulose flour, can also be used. Naturally occurring fibers include fiber from whole citrus peel, citrus albedo, sugar beets, citrus pulp and vesicle solids, apples, apricots, and watermelon rinds.

These dietary fibers may be in a crude or purified form. The dietary fiber used may be of a single type (e.g., cellulose), a composite dietary fiber (e.g., citrus albedo fiber containing cellulose and pectin), or some 45 combination of fibers (e.g., cellulose and a gum). The fibers can be processed by methods known to the art.

Of course, judgment must be exercised to make use of the nondigestible solid fat materials and combinations thereof with other food ingredients. For example, a combination of sweetener and non- 50 digestible solid fat material would not be used where the specific benefits of the two are not desired. The nondigestible solid fat materials and nondigestible solid fat material/ingredient combinations are used where appropriate, and in appropriate amounts.

Many benefits are obtained from the use of the present nondigestible solid fat materials in food and beverage compositions, either when used alone or in combination with edible oils and/or other ingredients discussed above. A primary benefit is the calorie reduction achieved when nondigestible fat materials are used as a total or partial fat replacement. This calorie reduction can be increased by using combinations of 55 the present nondigestible solid fat materials with reduced calorie sweeteners, bulking agents, or other nondigestible fats and oils. Another benefit which follows from this use is a decrease in the total amount of fats in the diet. Foods or beverages made with the nondigestible solid fat materials instead of triglyceride fats will also contain less cholesterol, and the ingestion of these foods can lead to reduced serum

cholesterol and thus reduced risk of heart disease.

A related benefit is that the use of the nondigestible solid fat materials allows the production of foods and beverages that are stable in terms of shelf stability and penetration stability. Compositions made with these fat materials have acceptable organoleptic properties, particularly taste and texture.

5 Dietary foods can be made with the nondigestible solid fat materials, to meet special dietary needs, for example, of persons who are obese, diabetic, or hypercholesterolemic. The nondigestible solid fat materials can be a major part of a low-fat, low-calorie, low-cholesterol diet, and they can be used alone or in combination with drug therapy or other therapy. Combinations of food or beverage products made with the nondigestible solid fat materials can be used as part of a total dietary management regimen, based on one
10 or more of these products, containing the fat materials alone or in combination with one or more of the above-mentioned ingredients, to provide one or more of the above-mentioned benefits.

In formulating food products comprising fat and nonfat ingredients (e.g., shortenings, mayonnaise, baked goods, etc.) in which the fat component comprises a nondigestible oil (e.g., a liquid sucrose polyester such as sucrose octaoleate), the solid SPE's of the present invention can be included in said
15 products to prevent anal leakage of the nondigestible oil which would otherwise occur as a result of ingestion of the products. The solid SPE will generally be used in the food products at a level such that the ratio of the nondigestible oil to solid SPE is from about 9:1 to about 3:1.

In addition to food compositions, the compounds of the present invention can be used in formulating lubricants, skin creams, pharmaceutical ointments, and the like.

20 A listing of representative solid sucrose polyesters of the present invention is shown in the following table.

TABLE 1

Solid Sucrose Polyesters						
	Short Chain Acid*	Long Chain Acid*	Ratio of Short:Long Chain**	Average Degree of Esterification	Melting Point-°C	Hydroxyl Value
25						
30	1 C ₄	C ₂₂	4:4	7.99	49	0.22
	2 C ₆	C ₂₂	4:4	7.97	44	0.65
	3 C ₈	C ₂₂	4:4	7.88	48	3.1
	4 C ₁₀	C ₂₂	4:4	7.87	47	3.2
35	5 C ₈	C ₂₄	4:4	7.81	52	5.5
	6 C ₂	C ₂₂	4:4	7.87	58	4.2
Note: Compounds 1 through 5 have a beta prime-like crystal structure.						

*Straight chain saturated monocarboxylic acids.

40 **Ratio of moles of short chain:long chain acid chlorides used in the reaction to prepare the desired products.

The invention will be illustrated by the following examples.

EXAMPLE I**Preparation of Tetrabehenyl Tetracaprylyl Sucrose (Acid Chloride Route)****Chemicals:**

A. Reaction	Mol. Wt.	Wt. (g)	Moles	Mole Ratio
1. Sucrose	342.3	7	0.0204	1
2. Behenyl Chloride (Docosanoyl Chloride)	358.6	30	0.0836	4.09
3. Caprylyl Chloride (Octanoyl Chloride)	162	15	0.0925	4.53

B. Solvents

1. Pyridine
2. Dimethylformamide
3. Dichloromethane
4. Methanol

Procedure

Seven grams of sucrose (anhydrous) were dissolved by warming in a mixture of 150 ml pyridine and 75 ml of dimethylformamide (DMF). Both solvents had been dried over 4A molecular sieves.

Thirty grams of the acid chloride of behenic (C₂₂) acid were dissolved in 100 ml of dichloromethane and the acid chloride solution added dropwise to the sucrose solution. The reaction temperature was held at 32°C by use of a cold water bath. Addition time was 30 minutes.

After addition of the C₂₂ acid chloride, the reaction mixture was warmed to 40°C, removed from the water bath and allowed to stir at ambient temperature for four additional hours.

After four hours of reaction time, 15 grams of caprylyl chloride in 50 ml of dichloromethane were added. Addition time was 30 minutes and the reaction temperature was maintained at 30-35°C. After addition of the caprylyl chloride, the reaction mixture was allowed to stir overnight.

After stirring overnight, the reaction mixture was diluted with 30 ml of methanol to convert excess acid chlorides to their methyl esters. The reaction mixture was then diluted with 300 ml of dichloromethane and combined in a separatory funnel with 300 ml of a dilute salt (NaCl) solution. The mixture was shaken then allowed to separate.

The organic (dichloromethane) layer was washed a second time with a dilute salt solution followed by washing with dilute HCl (to remove residual pyridine), then with water until the last wash was neutral to pH paper.

The dichloromethane solution was dried over anhydrous sodium sulfate then stripped under vacuum with heating to a liquid residue. The product solidified on standing. The solid product was melted in a hot water bath then extracted three times with methanol (the methanol layers were removed by decantation). The reaction product was stripped again under vacuum and the residue dissolved in 80 ml of dichloromethane. The solution was stirred and 80 ml of methanol were slowly added to induce crystallation. The mixture was again vacuum distilled to displace the dichloromethane with additional methanol added during distillation. A white precipitate (crystalline) formed and the suspension was cooled in a water bath then filtered to give 40.5 grams of dried product.

Yield - 93% of theoretical

Analytical

1. Hydroxyl value - 3.1
2. Average degree of esterification - 7.88 (calculated from hydroxyl value as an approximation)
3. Estimated % octaester - 90.6

EXAMPLE IIPreparation of Tetrabehenyl Tetracaprylyl Sucrose (Methyl Ester Route)

An alternative method for preparation of C₈-C₂₂ sucrose polyesters is by a modification of the process described in U.S. Pat. Nos. 4,518,772, *supra*, and 4,517,360, *supra*. Sucrose is reacted with methyl caprylate in the presence of a potassium soap and a basic catalyst such as K₂CO₃ to form sucrose octacaprylate. The octacaprylate is then reacted with methyl behenate in the presence of sodium methoxide for an interesterification to the C₈-C₂₂ product of interest.

Chemicals:A. Reactions

	<u>Mol.Wt.</u>	<u>Wt.(g)</u>	<u>Moles</u>	<u>Mole Ratio</u>
1. Sucrose	342.30	300.00	0.876	1.000
2. Potassium Behenate	378.60	124.10	0.328	0.375
3. Methyl Caprylate	158.24	1663.40	10.512	12.000
4. Methyl Behenate	354.60	2174.40	6.132	7.000
5. Potassium Carbonate	138.21	12.107	0.0876	0.100
6. Sodium Methoxide	54.00	(1% by wt. of mixture)		

B. Solvents

1. Methanol
2. Hexane

Procedure:Step A - Preparation of Potassium Behenate

Methyl behenate (0.375 moles/mole of sucrose to be used in Step B) is saponified by stirring at reflux in methanol containing an equivalent amount of KOH. The reaction is stirred with heating until all methyl ester has been converted to soap as indicated by infrared analysis. The soap solution is used, as is in the next reaction step.

Step B - Preparation of Sucrose Octacaprylate

Methyl caprylate (12 moles/mole of sucrose) is added directly to the potassium behenate-methyl alcohol solution from Step A above. The mixture is stripped under vacuum to remove the methanol. Sucrose and potassium carbonate are then added to the soap-methyl caprylate mixture and the reaction mixture heated to 135°C and placed under a partial vacuum.

The reaction is allowed to proceed until the sucrose is converted to its octacaprylate. The endpoint is determined by liquid or super critical fluid chromatography.

The reaction mixture is cooled to 95°C and 7% H₂O is added to form the hydrate of the soap.

The soap separates as a sludge and is removed by centrifugation, filtration and/or decantation. The oil layer (sucrose octacaprylate/methyl ester layer) is washed several times with hot water, separated and the residual water removed by N₂ sparging at 110°C.

The crude octacaprylate is then decolorized with a mixture of fittrol and celite and the bleaching earths removed by vacuum filtration. The excess methyl esters are removed by distillation at 130°C and 1 mm

Hg.

Step C - Preparation of C₈-C₂₂ Sucrose Polyesters

Sucrose octacaprylate (from Step B above) and 7 moles of methyl behenate are combined with sodium methoxide in a reactor. While stirring, the temperature is raised to 120 °C and the reactor placed under vacuum.

The methyl caprylate formed during interesterification is distilled from the reaction mixture and collected. The reaction is continued until 4-5 moles of methyl caprylate are collected (the ratio of C₈-C₂₂ on the sucrose may be adjusted by the amount of methyl caprylate removed).

The reaction mixture is then cooled to 90 °C and neutralized with glacial acetic acid.

The product is diluted with hexane and the hexane solution washed several times with hot water.

The water washes are separated and the hexane, along with any residual water, is removed via N₂ sparging at 110 °C. The product is then rediluted with hexane and is decolorized with a mixture of charcoal and filter.

The charcoal/filter is removed by vacuum filtration and the solvent removed by vacuum distillation. Excess and/or residual methyl esters are removed by thin film evaporation and the product crystallized from a hexane/methanol solution.

(Steam stripping at 210 °C and 1 mm Hg is an optional final step.)

EXAMPLE III

Preparation of a Reduced Calorie Shortening from a Compound of Example I and a Liquid Triglyceride

Six grams of a solid C₈-C₂₂ sucrose polyester, prepared as in Example I, and 24 grams of Crisco Oil (A liquid triglyceride oil marketed by the Procter & Gamble Company.) are weighed into a sample vial. The mixture is heated on a steam bath and mixed by shaking. The mixture is then allowed to cool back to room temperature to form the plastic gel consisting of 20% of the sucrose polyester and 80% triglyceride oil.

The shortening composition can be treated in the conventional manner with air or nitrogen to form an "aerated" shortening.

EXAMPLE IV

Preparation of Nondigestible Shortening from a Compound of Example I and a Liquid Sucrose Polyester

Procedure

Six grams of a solid C₈-C₂₂ sucrose polyester prepared as in Example I, and 24 grams of a liquid sucrose polyester are combined and heated until all solids are dissolved. The mixture is allowed to cool back to room temperature to form a plastic gel consisting of 20% solid sucrose polyester of Example I and 80% liquid sucrose polyester. The composition is suitable for use as a food fat and does not produce the anal leakage problem which would otherwise result if only the liquid sucrose polyester is used as a food fat.

The shortening composition can be treated in the conventional manner with air or nitrogen to form an "aerated" shortening.

Claims

1. A fatty acid ester of sucrose, the fatty acid groups consisting of short chain fatty acid radicals containing from 2 to 10 carbon atoms and long chain fatty acid radicals containing from 20 to 24 carbon atoms, the molar ratio of short chain to long chain radicals being from 5:3 to 3:5 and the degree of esterification being from 7 to 8.
2. The compound of Claim 1 wherein the short chain acid radicals contain from 6 to 10 carbon atoms.
3. The compound of Claim 1 wherein the long chain acid radical is behenate.
4. The compound of Claim 1 wherein the short chain acid radical is acetate and the long chain acid radical is behenate.



Hg.

Step C - Preparation of C₈-C₂₂ Sucrose Polyesters

Sucrose octacaprylate (from Step B above) and 7 moles of methyl behenate are combined with sodium methoxide in a reactor. While stirring, the temperature is raised to 120 °C and the reactor placed under vacuum.

The methyl caprylate formed during interesterification is distilled from the reaction mixture and collected. The reaction is continued until 4-5 moles of methyl caprylate are collected (the ratio of C₈-C₂₂ on the sucrose may be adjusted by the amount of methyl caprylate removed).

The reaction mixture is then cooled to 90 °C and neutralized with glacial acetic acid.

The product is diluted with hexane and the hexane solution washed several times with hot water.

The water washes are separated and the hexane, along with any residual water, is removed via N₂ sparging at 110 °C. The product is then rediluted with hexane and is decolorized with a mixture of charcoal and filter.

The charcoal/filter is removed by vacuum filtration and the solvent removed by vacuum distillation. Excess and/or residual methyl esters are removed by thin film evaporation and the product crystallized from a hexane/methanol solution.

(Steam stripping at 210 °C and 1 mm Hg is an optional final step.)

EXAMPLE III

Preparation of a Reduced Calorie Shortening from a Compound of Example I and a Liquid Triglyceride

Six grams of a solid C₈-C₂₂ sucrose polyester, prepared as in Example I, and 24 grams of Crisco Oil (A liquid triglyceride oil marketed by the Procter & Gamble Company.) are weighed into a sample vial. The mixture is heated on a steam bath and mixed by shaking. The mixture is then allowed to cool back to room temperature to form the plastic gel consisting of 20% of the sucrose polyester and 80% triglyceride oil.

The shortening composition can be treated in the conventional manner with air or nitrogen to form an "aerated" shortening.

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Procedure

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The shortening composition can be treated in the conventional manner with air or nitrogen to form an "aerated" shortening.

Claims

1. A fatty acid ester of sucrose, the fatty acid groups consisting of short chain fatty acid radicals containing from 2 to 10 carbon atoms and long chain fatty acid radicals containing from 20 to 24 carbon atoms, the molar ratio of short chain to long chain radicals being from 5:3 to 3:5 and the degree of esterification being from 7 to 8.
2. The compound of Claim 1 wherein the short chain acid radicals contain from 6 to 10 carbon atoms.
3. The compound of Claim 1 wherein the long chain acid radical is behenate.
4. The compound of Claim 1 wherein the short chain acid radical is acetate and the long chain acid radical is behenate.



5. The compound of Claim 1 wherein the short chain acid radical is butyrate and the long chain acid radical is behenate.
6. The compound of Claim 1 wherein the short chain acid radical is caproate and the long chain acid radical is behenate.
7. The compound of Claim 1 wherein the short chain acid radical is caprylate and the long chain acid radical is behenate.
8. The compound of Claim 1 wherein the short chain acid radical is caprate and the long chain acid radical is behenate.
9. The compound of any of Claims 1 through 6 wherein the molar ratio of short chain acid radical to long chain acid radical is about 4:4.

Patentansprüche

1. Saccharosefettsäureester, dessen Fettsäuregruppen aus den Resten kurzkettiger Fettsäuren mit 2 bis 10 Kohlenstoffatomen und aus den Resten langkettiger Fettsäuren mit 20 bis 24 Kohlenstoffatomen bestehen, wobei das Molverhältnis der kurzkettigen Reste zu den langkettigen Resten 5:3 bis 3:5 beträgt und wobei der Veresterungsgrad 7 bis 8 ausmacht.
2. Verbindung nach Anspruch 1, wobei die kurzkettigen Säurereste 6 bis 10 Kohlenstoffatome enthalten.
3. Verbindung nach Anspruch 1, wobei der langkettige Säurerest Behenat ist.
4. Verbindung nach Anspruch 1, wobei der kurzkettige Säurerest Acetat ist und der langkettige Säurerest Behenat ist.
5. Verbindung nach Anspruch 1, wobei der kurzkettige Säurerest Butyrat ist und der langkettige Säurerest Behenat ist.
6. Verbindung nach Anspruch 1, wobei der kurzkettige Säurerest Caproat ist und der langkettige Säurerest Behenat ist.
7. Verbindung nach Anspruch 1, wobei der kurzkettige Säurerest Caprylat ist und der langkettige Säurerest Behenat ist.
8. Verbindung nach Anspruch 1, wobei der kurzkettige Säurerest Caprat ist und wobei der langkettige Säurerest Behenat ist.
9. Verbindung nach einem der Ansprüche 1 bis 6, wobei das Molverhältnis von kurzkettigem Säurerest zu langkettigem Säurerest etwa 4:4 beträgt.

Revendications

1. Ester d'acide gras et de sucrose, dont les groupes acide gras sont constitués par des radicaux acide gras à chaîne courte contenant de 2 à 10 atomes de carbone et par des radicaux acide gras à longue chaîne contenant de 20 à 24 atomes de carbone, le rapport molaire des radicaux à chaîne courte aux radicaux à chaîne longue étant de 5:3 à 3:5 et le degré d'estérification étant de 7 à 8.
2. Le composé de la revendication 1, dans lequel les radicaux acide à chaîne courte contiennent de 6 à 20 atomes de carbone.
3. Le composé de la revendication 1, dans lequel le radical acide à chaîne longue est le béhénate.
4. Le composé de la revendication 1, dans lequel le radical acide à chaîne courte est l'acétate et le radical acide à chaîne longue est le béhénate.



5. Le composé de la revendication 1, dans lequel le radical acide à chaîne courte est le butyrate et le radical acide à chaîne longue est le béhénate.
- 5 6. Le composé de la revendication 1, dans lequel le radical acide à chaîne courte est le caproate et le radical acide à chaîne longue est le béhénate.
7. Le composé de la revendication 1, dans lequel le radical acide à chaîne courte est la caprylate et le radical acide à chaîne longue est le béhénate.
- 10 8. Le composé de la revendication 1, dans lequel le radical acide à chaîne courte est le caprate et le radical acide à chaîne longue est le béhénate.
- 15 9. Le composé de l'une quelconque des revendications 1 à 6, dans lequel le rapport molaire du radical acide à chaîne courte au radical acide à chaîne longue est d'environ 4:4.

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