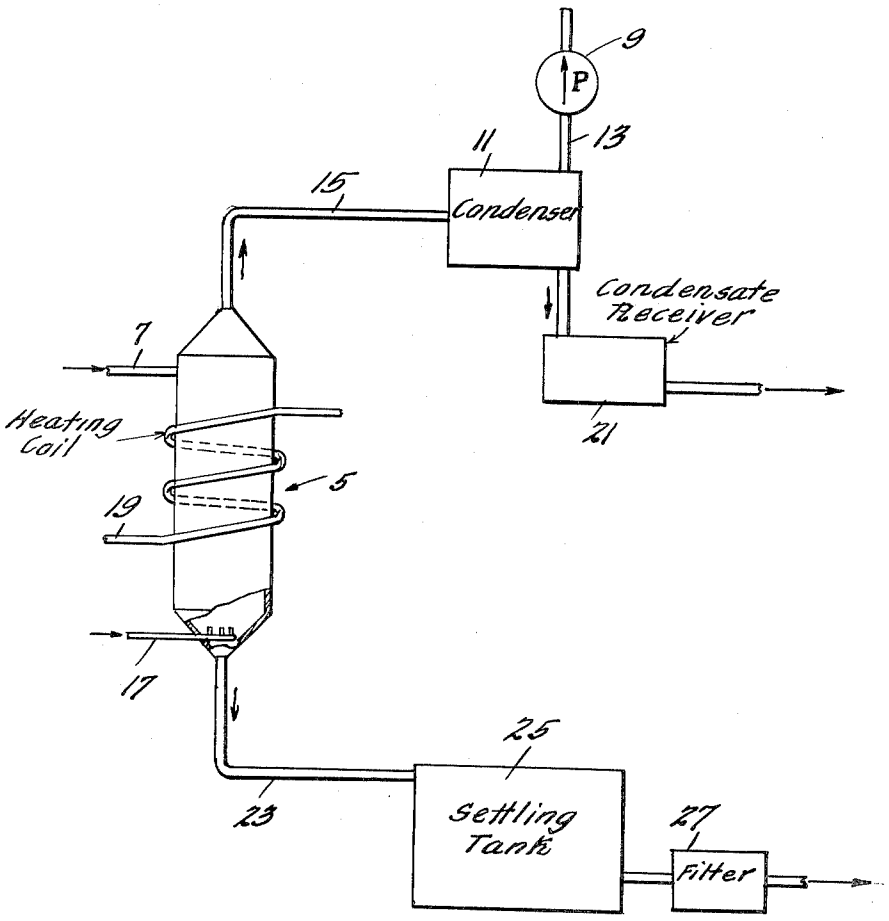
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SHORTENING PRODUCT

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SHORTENING PRODUCT

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This invention relates to new and improved shortening compositions. More particularly, it relates to a fluid shortening composition which is capable of producing more tender cakes, with a variety of recipes, under commercial conditions, than is possible with a conventional plastic shortening, with the additional feature that the cakes can be prepared with a single mixing step.

This application is a continuation-in-part of application Serial No. 107,822, filed May 4, 1961, now abandoned.

Conventional commercial baking practice has been to use a plastic shortening for baking cakes. This practice has been necessary since all of the wide variety of cakes that a commercial bakery prepares cannot be made with conventional liquid shortenings. However, fluid shortenings have a definite advantage in handling and storage, and a fluid product which would perform satisfactorily would be extremely useful.

Accordingly, it is an object of this invention to provide a liquid shortening composition which can be used in baking a wide variety of cakes.

A further object of this invention is to provide a fluid shortening product which gives more tender cakes than conventional plastic shortenings.

A still further object of this invention is to provide a fluid shortening composition which is capable of producing acceptable cakes with only a single mixing step. Other objects and advantageous features will be evident from the following detailed description of the invention.

The accompanying drawing shows a highly simplified flow chart of a process for making a preferred form of additive.

In general, the fluid shortening compositions of this invention comprise a normally liquid triglyceride oil containing as additives from about 0.5% to about 8% of the monoester of propylene glycol and a saturated fatty acid having from 14 to 22 carbon atoms; from about 1% to about 5% normally solid triglyceride fat; and from about 0.5% to about 10% saturated fatty acid having from 14 to 22 carbon atoms. All percentages mentioned herein are by total weight of the shortening composition.

The fluid shortening compositions of this invention have several advantages. First, cakes made with these shortening compositions are more tender and moist than cakes made with plastic shortenings. Second, the cakes have essentially equal or slightly greater volume than cakes made with plastic shortenings. Third, the cakes can be prepared with only a single mixing step. Fourth, the shortening compositions can be used with a wide variety of recipes and mixing procedures. Fifth, the shortening maintains satisfactory fluidity characteristics and homogeneity for extended storage periods.

The normally liquid triglyceride base oil should have satisfactory keeping quality and, preferably, only a minimum amount of solids at the expected temperatures to which the shortening will be exposed. Suitable base oils for this invention can be derived from animal, vegetable,

or marine sources including naturally-occurring liquid triglyceride oils such as cottonseed oil, soybean oil, rapeseed oil, sesame seed oil, and sunflower seed oil. Also, suitable liquid oil fractions can be obtained from palm oil, lard, and tallow, as for example, by fractional crystallization or directed interesterification, followed by separation of the oil. Oils predominating in glycerides of unsaturated acids may require some hydrogenation to maintain flavor, but care should be taken not to greatly increase the amount of glycerides melting about 60° F. When the oil has too many solids melting between 60° F. and 100° F., it may be necessary to separate out these solids. Refined cottonseed oil and refined and slightly hydrogenated soybean oil (Iodine Value of about 110±10) have proved very satisfactory for use as glyceride base oils of this invention.

The percentage limits of the additives of this invention are determined by various considerations. There should be from about 0.5% to about 8% propylene glycol monoester of a saturated fatty acid having from 14 to 22 carbon atoms dissolved in the normally liquid glyceride oil. This additive aids in the incorporation of air during the mixing step. For single-stage mixing, in which all the batter ingredients are added to the mixing container at one time, there should be present in the shortening composition at least about 1.5% propylene glycol monoester. This amount is needed only if all kinds of cakes are to be prepared, since some cake batters can be mixed single-stage with only about 0.5% propylene glycol monoester in the shortening.

There should be present in the shortening composition from about 1% to about 5% normally solid triglyceride fat which is ordinarily a substantially completely hydrogenated triglyceride oil. It is also desirable, but not essential, to include in the shortening about 0.05% to about 5% of partial ester of glycerine and substantially saturated fatty acid. These two additives can be either pure esters of fatty acids having from 14 to 22 carbon atoms, or mixtures of fatty acid esters containing such fatty acids. The upper limits are set by the viscosity, stability, and consistency requirements of the product.

There should also be present in the shortening composition at least ½% saturated free fatty acid having from 14 to 22 carbon atoms. This additive not only improves the effectiveness of the propylene glycol monoester and mono- or diglyceride emulsifiers in increasing the air incorporation during the mixing step, but also acts as a high temperature batter stabilizer which prevents loss of air during the baking step and shrinkage during and subsequent to baking of the cake. Moreover, the combined presence of this high temperature batter stabilizer and the propylene glycol monoester has been found to be necessary to achieve the single-stage mixing advantages of this invention.

The total percentage of monoester of propylene glycol, partial ester of glycerine and fatty acid in the shortening composition preferably should not exceed about 14%.

The solid triglyceride and the partial glycerides should be at least 80% in beta phase, as opposed to alpha and beta-prime phases. These types of crystalline structure can be identified by their X-ray diffraction patterns and are described in detail in U.S. Patents 2,521,242 and 2,521,243, issued September 5, 1950.

It is desirable, though unnecessary for the single-stage mixing properties of this invention, to form the shorten-

ing composition so that it is substantially free from intermediate melting solids (i.e., melting between 60° F. and 100° F.) which would cause consistency problems as a result of their melting and resolidification due to normal changes in temperature.

A preferred embodiment of the fluid shortening composition of this invention comprises soybean oil hydrogenated to an Iodine Value of from 100 to 120 and having therein, as additives, from about 3% to about 5% propylene glycol monostearate, from about 1% to about 3% substantially completely hydrogenated soybean oil, from about 3% to about 4% mono- and diglycerides of saturated fatty acids having from 14 to 22 carbon atoms, and from about 0.6% to about 2% stearic acid.

When the additives of this invention are used in a shortening, the presence of other additives such as the partial fatty acid esters of sucrose, sorbitol, sorbitan, polyoxyethylene sorbitan and the like is not precluded, since conventional benefits may still be derived by their use. It will be recognized, of course, that the presence of other additives may have an effect on the operation of the additives of this invention and, therefore, the desirability of their use will depend upon the results desired.

Various minor ingredients such as antioxidants, including butylated hydroxytoluene, butylated hydroxyanisole, citric acid, and methyl silicone can also be added to the shortening composition if desired.

The shortening composition can be processed according to the teaching of U.S. Patent 2,815,286, granted to Andre and Going December 3, 1957. The main steps can include heating the shortening composition to a high enough temperature to melt all the solids, rapidly chilling to form small crystals and then warming to between 90° F. and 100° F. to promote a change of the solid triglyceride fat from alpha and beta-prime phases to beta-phase either with or without "seeding" with beta-phase crystals. An alternative method is to warm the rapidly chilled mixture to a temperature above the melting point of the alpha and beta-prime phases but below the melting point of the beta phase crystals and then cooling the mixture using the beta phase crystals already present as "seed" crystals. An added tempering step for the shortenings of this invention of one to two days at 80° F. to 90° F., after packing, is desirable. This processing results in forming a stable suspension of the undissolved additives in the base oil.

The shortening compositions of this invention, in addition to being exceptionally good for baking all kinds of cakes, are also good for pie doughs, bread, "flat" icings, and sweet yeast breads.

The bulk of the additives can be prepared in a convenient single process by reacting substantially completely hydrogenated triglycerides and propylene glycol in the presence of an interesterification catalyst at elevated temperatures. Suitable equipment for preparing the additives can consist of a reaction vessel equipped with means for heating and cooling, means for agitating the contents of the vessel, means for removing excess glycerine and glycol and a condenser attached to a vapor line coming from the vessel. A condensate receiver can be attached to said condenser and raw material handling tanks and lines; a settling tank; and a means for filtering can be added to the apparatus, if desired.

It is believed that the invention will be better understood from the following example described in connection with the drawing, FIGURE 1, but is not limited to the specific process set forth therein.

EXAMPLE 1

Reference numeral 5 represents generally a pressure resistant reaction vessel.

Approximately 95.6 parts of completely hydrogenated triglycerides derived from soybean oil, were introduced

to the reaction vessel 5 through a raw material inlet pipe (raw material inlet pipes are represented generally by 7). Pipe 7, in turn, was connected to the raw material storage tanks (not shown). Approximately 47.8 parts of propylene glycol were also added through raw material inlet 7. The pressure was reduced to a range of from about 2 to about 5 inches of mercury absolute by means of a pump 9 connected to the condenser 11 through the line 13, the condenser 11 being connected in turn by the vapor line 15 to the reaction vessel 5, the sparging steam was admitted to vessel 5 through line 17, and electric heating coils 19 were energized. The mixture was heated to about 250° F., and about 0.38 part of 50% NaOH was added through raw material inlet 7. These conditions of temperature, pressure, and agitation were maintained for about 15 minutes and then about 0.55 part of 85% H_3PO_4 was added through inlet 7, and agitation of the mixture by means of the sparging steam was continued for about 15 minutes. The pressure in the reaction vessel 5 was then reduced to about ¼ inch of mercury absolute, and free glycerine and propylene glycol were removed by steam stripping for about ½ hour, the materials being removed through the vapor line 15 leading to the condenser 11 and the condensate receiver 21. The mixture at this point was 100 parts of "emulsifier intermediate." The mixture was cooled to about 200° F., the pressure was increased to about 25 inches of mercury absolute and about 4.3 parts of 50% NaOH was added through inlet 7. The mixture was then agitated for about ½ hour, and then about 6.2 of 85% H_3PO_4 was added through inlet 7. The mixture was agitated for another ½ hour, and for the last approximately 15 minutes the pressure was reduced to about ¼ inch of mercury absolute. The mixture was then cooled to about 170° F., and dropped by gravity to a settling tank 25 through the line 23 where the inorganic phosphate salts were allowed to settle out of the stock for about one hour, and the mixture was then filtered through double filter paper in a filter press 27.

Any triglyceride source can be used other than soybean oil so long as it contains a major portion of saturated fatty acid radicals having from 14 to 22 carbon atoms. Examples of such sources include tallow, rapeseed oil, cottonseed oil, palm kernel oil, herring oil, peanut oil, corn oil, olive oil, whale oil, and coconut oil which have been hydrogenated.

The product of Example 1 was analyzed and it was found to consist of the following approximate percentages of components.

Glycerol monostearate	2.7
Propylene glycol monostearate	27.3
Distearin	5.6
Tristearin + Propylene glycol distearin	63.3
Glycerin	0.9
Glycol	0.2

The figures given as total percent of tristearin-propylene glycol distearin, and distearin also include 16.2% free stearic acid. The glycerol monostearate is about 90% glycerol 1-monostearate and the distearin is about 90% 1,3 distearin.

About 6% to 12%, preferably 8% (and in no event less than about 2%), of the emulsifier system prepared by the process hereinbefore described and about 2% to 4% completely hydrogenated soybean oil, preferably 2%, are added to a base oil and give a highly improved liquid shortening composition having the capability of being used in single-stage mixing.

The following examples are illustrative of the superior results that can be achieved with the shortening compositions of this invention.

In the following examples, four cakes were used. The recipes for these cakes are as follows:

White Cake

Ingredients	Instructions (All mixing is at slow speed)
454 gm. flour 250 gm. shortening	Mix these ingredients in a 3-quart bowl for 90 seconds, scrape down, and then mix for an additional 90 seconds.
636 gm. sugar 17 gm. salt 28 gm. baking powder 200 gm. water 54 gm. non-fat milk solids	Add these ingredients, mix for 90 seconds, scrape down, and then mix for an additional 90 seconds.
178 gm. water 341 gm. egg whites	Add approximately ½ of these ingredients and mix for 45 seconds, then scrape down. Mix an additional 45 seconds, add the rest of the ingredients, mix 45 seconds, scrape down and then mix for 45 more seconds.

Place 400 gm. of the batter in 8-inch pans and bake at 375° F. for 20 minutes.

Yellow Cake

Ingredients	Instructions (All mixing is at slow speed)
454 gm. flour 250 gm. shortening	Mix these ingredients for 90 seconds, scrape down, mix an additional 90 seconds, and then scrape down again.
636 gm. sugar 17 gm. salt 28 gm. baking powder 200 gm. water 60 gm. non-fat milk solids	Add these ingredients, mix for 90 seconds, scrape down and then mix for an additional 90 seconds.
217 gm. water 272 gm. whole eggs	Add approximately ½ of these ingredients, mix 45 seconds, scrape down, mix 45 more seconds, add the rest of the ingredients, mix 45 seconds, scrape down, and then mix for an additional 45 seconds.

Place 400 gm. of the batter into an 8-inch pan and bake at 375° F. for 23 minutes.

Yellow Pound Cake

Ingredients	Instructions
454 gm. flour 318 gm. shortening	Mix these ingredients for 90 seconds at second speed, scrape down, mix an additional 90 seconds, and then scrape down.
545 gm. sugar 17 gm. salt 200 gm. water 27 gm. non-fat milk solids	Add these ingredients, mix 180 seconds at second speed, scrape down, and then mix an additional 180 seconds.
318 gm. whole eggs	Add approximately ½ of these eggs in 70 seconds while mixing at slow speed, mix for 40 seconds, add the rest of the eggs in 70 seconds while mixing at slow speed, scrape down, and then mix for an additional 120 seconds.

Place 454 gm. of the batter in a standard loaf pan and bake at 360° F. for 55 minutes.

Chocolate Fudge Cake

Ingredients	Instructions
482 gm. flour 85 gm. cocoa 400 gm. shortening	Mix these ingredients for 3 to 5 minutes, scraping down at least once. All mixing is at slow speed in a three-speed mixer, or at the second slowest speed in a four-speed mixer.
710 gm. sugar 21 gm. salt 10 gm. soda 21 gm. baking powder 227 gm. water 50 gm. non-fat milk solids	Add these ingredients and mix for 3 to 5 minutes, scraping down at least once.
510 gm. whole eggs 743 gm. water Flavor to taste	Add approximately ½ of these ingredients, mix until smooth, scrape down, mix until smooth again, add the rest of the ingredients, and mix for an additional 3 to 5 minutes, scraping down to insure a smooth batter.

Place 400 gm. of the batter in an 8-inch pan and bake at 360° F. for 30 minutes.

TABLE I

Cakes made with a standard plastic shortening derived from vegetable oil, referred to in the following table as "plastic," were compared with a refined, bleached, and deodorized soybean oil (hydrogenated to an Iodine Value of 107) containing 8% commercial grade propylene glycol monostearate (50% monoester), 4% substantially completely hydrogenated (i.e., solid) mono- and diglyceride of soybean oil, 1% stearic acid, and 2% substantially completely hydrogenated soybean oil, referred to in the following table as "Invention." Penetration values were obtained by placing a standard grease cone on the cake and measuring the number of tenths of a millimeter the cone penetrated the cake in five seconds.

Example number	Shortening	Type of cake	Cake volume, cc./lb.	Penetration, 0.1 mm./5 secs.	Batter density, gm./cc.
2	Plastic	White	1,250	219	1.02
3	Invention	do	1,195	223	.96
4	Plastic	Yellow	1,515	229	1.00
5	Invention	do	1,635	262	.93
6	Plastic	Yellow pound	1,135	170	.81
7	Invention	do	1,055	182	.87

As can be seen, the penetration was generally greater for the cakes made with the shortening composition of this invention. This indicates that these cakes were more tender than the cakes made with conventional plastic shortenings. The cakes were of comparable size and it was more convenient to measure the shortening and mix the ingredients with a pourable shortening composition.

TABLE II

This table demonstrates the effectiveness of the instant invention in permitting single-stage batter mixing. The shortening was the fluid shortening composition of Table I. The recipes were altered in that all the ingredients were mixed together at once in single-stage mixing.

Example No.	Type of mixing	Type of cake	Cake volume, cc./lb.	Penetration, 0.1 mm./5 secs.	Batter density
8	Regular	White	1,115	243	0.99
9	Single stage	do	1,130	230	.90
10	Regular	Yellow	1,530	255	.97
11	Single stage	do	1,510	276	.87
12	Regular	Yellow pound	1,110	191	.88
13	Single stage	do	1,220	210	.77
14	Regular	Chocolate fudge	1,580	272	.93
15	Single stage	do	1,930	338	.73

As can easily be seen, the shortening composition gives comparable results with single-stage mixing for a wide variety of cakes. This is a distinct advantage in a commercial product where simplicity leads directly to savings in time and cost.

EXAMPLE 16

A mixture of additives was prepared by generally the same reactions as in Example 1, but under somewhat different conditions of temperature and pressure. 92.5 parts of refined and bleached soybean oil hydrogenated to an Iodine Value of about 8 was heated to about 250° F. at an absolute pressure of 25 inches of mercury in a reaction vessel and 46.2 parts of propylene glycol and 1.39 parts of 50% NaOH were added. The temperature was increased to 350° F., the pressure was increased to 15 pounds per square inch in an atmosphere of nitrogen, and the mixture was mechanically agitated while the reaction continued for one hour. The mixture was cooled to about 200° F. and the NaOH was neutralized with 2.16 parts of 85% phosphoric acid while the mixture was agitated for a half hour. The mixture was then heated to 250° F. and a full vacuum was produced in the reaction vessel to remove the free propylene glycol and glycerine. This

removal was continued for one and a half hours. The absolute pressure was then raised to 25 inches of mercury, the mixture was cooled to 200° F., 4.53 parts of 50% NaOH was added, and the mixture was agitated for a half hour. The NaOH was then neutralized with 6.66 parts 85% phosphoric acid, and the mixture was agitated for another half hour. A full vacuum was produced in the reaction vessel, the mixture was cooled to 100° F., and allowed to drain to a settling tank. After the inorganic salt had settled, they were filtered. This reaction mixture had a higher percentage of propylene glycol monostearate than the reaction product in Example 1.

Shortenings which will give results equivalent to the shortenings prepared with the reaction product of Example 1 can be prepared with this reaction product. In general, less of this product is required to give the same level of propylene glycol monostearate than the shortenings made from the reaction product of Example 1.

Table III contains data relating to white cakes prepared with both regular and single-stage mixing. The shortenings contain as a base oil, hydrogenated, refined, bleached, and deodorized soybean oil (Iodine Value of 107) containing 2.3%, by weight of this base oil, of soybean oil hydrogenated to an Iodine Value of 8. 92% of this mixture of hydrogenated soybean oils was processed with 8% of the reaction product of Example 1 to give a shortening, hereinafter referred to as Invention[1], and 92% of the mixture of hydrogenated soybean oils was mixed with 8% of the reaction product of Example 16 to give a shortening, hereinafter referred to as Invention[2].

TABLE III

Example number	Type of shortening	Type of mixing	Cc./lb.	Penetration, 0.1 mm./5 secs.
17	Invention [1]	Single stage	1,210	240
18	Invention [2]	do	1,250	249
19	Invention [1]	Regular	1,245	255
20	Invention [2]	do	1,285	263

As can be seen, these cakes were acceptable and in addition they were tender. Mixing was easier than with a conventional plastic shortening.

A specific base oil was used in the preceding examples, but other triglyceride base oils including cottonseed oil, rapeseed oil, sesame seed oil, sunflower oil, fish oil, and liquid oil fractions obtained from palm oil, lard, and tallow can be substituted with equivalent results.

The scope of this invention should not be limited in any way by these examples which are merely illustrative of the results obtainable with this invention.

What is claimed is:

1. A stable fluid shortening composition, suitable for use in the preparation of recipe cake batters with a single mixing step in large scale commercial baking operations, which comprises a normally liquid glyceride oil having therein from about 0.5% to about 8% by weight of the composition, of mono-ester of propylene glycol and saturated fatty acid containing from 14 to 22 carbon atoms, said shortening composition additionally comprising, by weight of the composition, from about 1% to about 5% normally solid triglyceride fat and from about 0.5% to about 10% of saturated fatty acid having from 14 to 22 carbon atoms, said triglyceride fat being at least 80% in beta phase.

2. The composition of claim 1 in which the normally liquid glyceride oil is soybean oil with an Iodine Value of from about 100 to about 120, the monoester of propylene glycol is monostearate, the normally solid triglyceride fat is substantially completely hydrogenated soybean oil and the fatty acid is stearic acid.

3. A stable fluid shortening composition, suitable for use in the preparation of recipe cake batters with a single mixing step in large scale commercial baking operations, which comprises soybean oil hydrogenated to an Iodine Value of from about 100 to about 120 having therein from about 3% to 5%, by weight of the composition of propylene glycol monostearate, said shortening composition additionally comprising, by weight of the composition, from about 1% to about 3% substantially completely hydrogenated soybean oil, from about 3% to about 4% normally solid partial ester of glycerine and substantially saturated fatty acid having from 14 to 22 carbon atoms, and from about 0.6% to about 2% of stearic acid, said substantially completely hydrogenated soybean oil and said partial ester of glycerine being at least 80% in beta phase, said shortening being substantially free from intermediate melting solids.

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