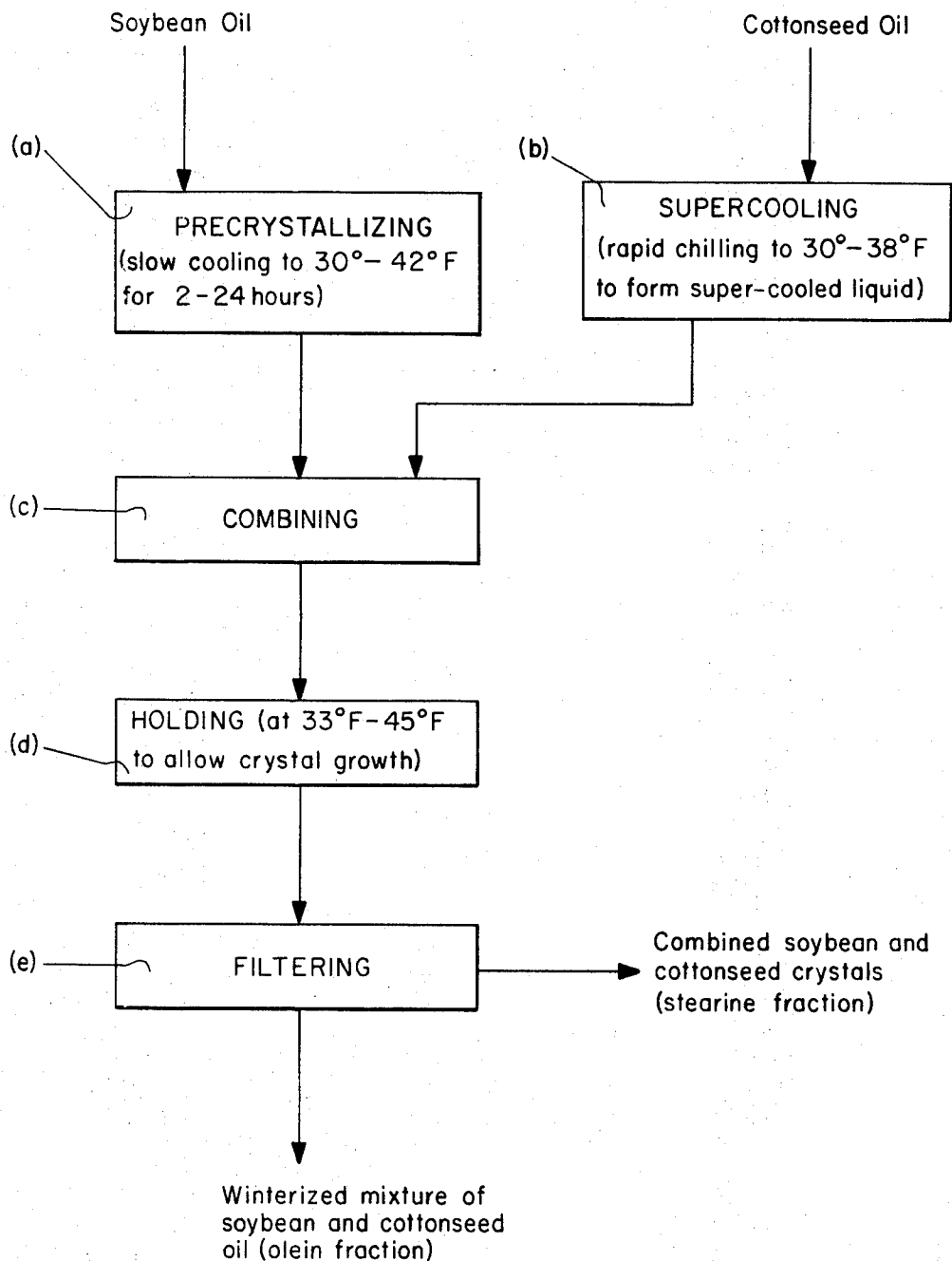


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SOYBEAN OIL AND COTTONSEED OIL
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PROCESS FOR PROVIDING WINTERIZED MIXTURES OF SOYBEAN OIL AND COTTONSEED OIL

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5 Claims

ABSTRACT OF THE DISCLOSURE

A process characterized by a relatively short winterization time and a rapid filtration rate which provides winterized mixtures of soybean oil and cottonseed oil. The process involves adding supercooled cottonseed oil to pre-crystallized soybean oil, crystallizing, and filtering.

BACKGROUND OF THE INVENTION

The field of this invention is processing of edible oils. More specifically, the invention relates to an improved winterization process which provides winterized mixtures of soybean oil and cottonseed oil. The process provides significantly higher filtration rates and shorter winterizing times than would be expected in the winterization of mixtures of soybean oil and cottonseed oil.

Winterization is the process of fractional crystallization of triglycerides to produce a low melting olein (liquid) fraction which is used for salad oil and a high melting stearine (solid) fraction. The stearine fraction is a commodity of commerce useful in such items as plastic shortening, but is less valuable on a weight basis than the olein fraction.

Edible oils are winterized prior to their use as salad oils because many liquid triglyceride oils such as soybean oil (particularly soybean oil which has been partially hydrogenated) and cottonseed oil tend to deposit solids or otherwise become cloudy at low temperatures whereby their visual appearance and physical characteristics are impaired. It is well known that such cloudy oils are considered objectionable by the housewife and other consumers. Unless these oils remain substantially clear at the temperatures ultimately encountered, they will not be acceptable as salad oils for table use, cooking, and the like. In this connection, it must be noted that the temperatures which have to be resisted are not only home refrigeration temperatures, which are generally between 40° F. and 50° F., but also freezing temperatures of 32° F. and lower, which are sometimes encountered during storage and shipment, particularly in cold climates. Thus, in the production of salad oils from edible oils such as partially hydrogenated soybean oil and cottonseed oil, a winterization step to remove the high melting solids is commonly applied.

Normally, winterization involves storing the oil in a tank, known as a winterization cell, which is placed in a refrigerated room, and allowing the cold air of the room and/or coolant within coils in the cell to cool the oil at a

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rate which will allow crystals of the higher melting solids to be formed and deposited. After a long period of time, generally more than about 40 hours, the oil is filtered to remove the crystals (stearin fraction) and the clear oil remaining (olein fraction) is referred to as winterized oil.

It is well known in the art that soybean oil can easily be winterized, i.e., upon slow cooling it forms large crystal clusters which can be easily filtered. On the other hand, cottonseed oil forms small, fine crystals which are difficult to filter. The crystal structure formed during the winterization of cottonseed oil is often described as "gel like" and this structure tends to clog the filtering medium and prevent high speed, efficient filtration.

Conventional winterization processes are discussed in Bailey's *Industriary Oil & Fat Products*, 3rd ed. pp. 1007 et seq.

A process for the winterization of cottonseed oil which involves supercooling the oil to "not below 40° F." prior to crystallization has the advantage of a reduced time of winterization according to the disclosure of U.S. Pat. 2,205,381, June 25, 1940.

A process for the co-winterization of soybean oil and cottonseed oil is disclosed in U.S. Pat. 3,048,491, Aug. 7, 1962. In the process of this patent, soybean oil and cottonseed oil are mixed and the mixture is then winterized by conventional slow cooling and filtering techniques. The advantage of co-winterizing mixtures of soybean oil and cottonseed oil according to said patent lies in an increased yield of the olein fraction and good resistance to freezing by salad dressings prepared from the winterized oils.

Although the above-discussed prior art processes do provide some advantages, the problem has remained in the winterization of cottonseed oil or cottonseed oil-containing mixtures that winterization times are long and filtration rates are very slow. Thus, winterization of a batch of oil is a time-consuming and costly procedure; improvements are well needed, especially in regard to filtration rate.

SUMMARY OF THE INVENTION

The process of the present invention overcomes the above-described problem and enables winterized mixtures of soybean oil and cottonseed oil to be obtained with ease and convenience, particularly in regard to the rate of filtration. Thus, winterized mixtures of soybean oil and cottonseed oil can be obtained in good yield by a process characterized by a relatively short winterizing time and a rapid filtration rate. In greater detail, the present invention provides a process for preparing winterized mixtures of soybean oil and cottonseed oil, which comprises:

(a) Pre-crystallizing soybean oil by slowly cooling to a temperature of from about 30° F. to about 42° F. for a time of from about 2 hours to about 24 hours;

(b) Supercooling cottonseed oil by rapidly chilling to a temperature of from about 30° to about 38° F. in a time of less than about 2 minutes;

(c) Combining the supercooled cottonseed oil of step (b) with the pre-crystallized soybean oil of step (a), the proportion of cottonseed oil to soybean oil being from about 0.1:1 to about 1.5:1;

(d) Holding the combined mixture of step (c) at a temperature of from about 33° F. to about 45° F. for a

time of from about 1 hour to about 20 hours to allow crystals to grow; and

(e) Filtering the mixture of step (d) to separate the crystals from a winterized mixture of soybean oil and cottonseed oil.

BRIEF DESCRIPTION OF THE DRAWING

The drawing presents a schematic summary of the steps involved in the process of the present invention. Thus, the drawing shows the steps of (a) pre-crystallizing soybean oil; (b) supercooling cottonseed oil; (c) combining the supercooled cottonseed oil with the pre-crystallized soybean oil; (d) holding the combined mixture; and (e) filtering to obtain a winterized mixture of soybean oil and cottonseed oil.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The process of the present invention provides winterized mixtures of soybean oil and cottonseed oil. The term "winterized" refers to oils which have a cold test of at least 5½ hours according to the standard cold test (Official Method Cc 11-53 of the American Oil Chemists Society). This test consists of maintaining a sample of the oil at 32° F. and measuring the time required for visible clouding. Preferably, the winterized oils obtained by the process of this invention exhibit a standard cold test of at least 8 hours.

Winterized oils obtained by the process of this invention are useful for a wide variety of edible purposes. For example, they can be used for frying, baking, and to prepare liquid salad dressings and mayonnaise emulsions.

The soybean oil winterized in the present process can be any edible soybean oil and is preferably one which has been refined and bleached in accord with conventional practice. See, for example Bailey's supra, pp. 719 et seq. Natural soybean oil has an iodine value (I.V.) which varies between about 110 and about 150 with an average being about 130. Soybean oil is normally partially hydrogenated to prevent flavor deterioration caused by the more highly unsaturated components such as the glycerides of linolenic acid. The partial hydrogenation of soybean oil can be accomplished by any one of a number of well known techniques, all of which involve contacting the oil with gaseous hydrogenation in the presence of a catalyst such as nickel and/or copper. See, for example, U. S. Pat. 2,168,603.

However, hydrogenation of soybean oil increases the melting point of certain fatty glyceride components, making them less soluble in the oil. These components create the need for, and are removed by winterization. Thus, in the winterization process of this invention, it is preferred to use soybean oil which has been partially hydrogenated, preferably having an I.V. of from about 90 to about 125, most preferably an I.V. of from about 100 to about 115.

The cottonseed oil used is also preferably one which has been refined and bleached in the conventional manner. Natural cottonseed oil which has not been hydrogenated is preferred. Such cottonseed oil generally has an I.V. of from about 90 to about 117.

In the winterization process of the invention, the soybean oil and cottonseed oil are used in the proportion of cottonseed oil to soybean oil of from about 0.1:1 to about 1.5:1, preferably from about 0.4:1 to about 1.2:1. The upper limit of cottonseed oil to soybean oil is most important, for if more than about 1.5:1 cottonseed oil to soybean oil is used, the advantages of the process diminish, particularly in regard to filtration rate.

Referring now to the operative steps of the process, and with reference to the drawing, step (a) involves pre-crystallizing soybean oil by slowly cooling to a temperature of from about 30° F. to about 42° F. for a time of from about 2 hours to about 24 hours. Preferred conditions for this step are a temperature of from about 34° F.

to about 38° F. for a time of from about 5 hours to about 18 hours. It is desirable to heat, e.g., to at least 70° F., the soybean oil to insure dissolution of all crystals prior to the pre-crystallization step. The rate of cooling during the pre-crystallization step is preferably such that the temperature drop does not exceed about 10° F. per hour below 50° F.

The pre-crystallizing step is best conducted in refrigerated rooms, e.g., rooms maintained at a temperature of from about 35° F. to about 45° F., in winterization cells of conventional size and shape equipped with cooling coils which circulate brine or ice-water. Preferably, the soybean oil is gently agitated, e.g., with air from a perforated pipe, during the pre-crystallization step.

In step (b) of the process, cottonseed oil, preferably at a temperature of from about 70° F. to about 90° F., is supercooled by rapidly chilling to a temperature of from about 30° F. to about 38° F. in a period of time of less than about 2 minutes. Preferred conditions for the supercooling step are an end temperature of from about 34° F. to about 37° F. and a time of from about 20 seconds to about one minute.

The supercooling step can be performed in a scraped-wall heat exchanger such as an apparatus commonly referred to as a freezer or a Votator. Use of this equipment is described in detail at p. 1066 of Bailey's, supra, and the apparatus is fully disclosed by Vogt in U.S. Re. Pat. 21,406.

The supercooled cottonseed oil obtained in the above step is preferably a clear oil substantially free from any visible crystal formation. Preferably, the cottonseed oil is in this same clear condition when combined with the pre-crystallized soybean oil in the next step. Thus, step (c) of the process in which the supercooled cottonseed oil is combined with the pre-crystallized soybean oil is preferably effected immediately after obtaining the supercooled cottonseed oil, i.e., prior to any visible crystal formation therein. A convenient means of performing this step is to directly pump the supercooled cottonseed oil emitting from the Votator at about 30° F. to about 38° F. into the winterizing cell containing the pre-crystallized soybean oil at a temperature of from about 30° F. to about 42° F.

After the supercooled cottonseed oil and pre-crystallized soybean oil have been combined in step (c), the combined mixture is held in step (d) at a temperature of from about 33° F. to about 45° F. for a time of from about 1 hour to about 20 hours to allow crystals to grow. This crystallization involves primarily the cottonseed oil, along with some further crystallization of the soybean oil. Preferred conditions for this step are a temperature of from about 34° F. to about 43° F. for a time of from about 5 hours to about 18 hours. Step (d) is best conducted in the same manner as step (a), i.e., in a conventional winterizing cell in a refrigerated room. The specified temperature is preferably maintained by the room and with brine or ice-water circulating in a cooling coil. Gentle agitation, e.g., with air from a perforated pipe, is also preferred during this step.

After holding for the specified time according to step (d), the combined mixture of soybean oil and cottonseed oil is filtered to separate the crystals (stearine fraction) from a winterized mixture of soybean oil and cottonseed oil (olein fraction) which is the desired product of the process. Preferably, a yield of at least 60%, most preferably from about 70% to about 90%, of the winterized oil (olein fraction) is obtained.

The filtration step can be performed in any conventional filtration apparatus such as a plate and frame filter, a batch leaf filter or a rotary vacuum filter. Preferably, the filtration step is carried out at a temperature of from about 34° F. to about 45° F. and a pressure of from about 10 p.s.i.g. to about 30 p.s.i.g. in a conventional plate and frame filter, most preferably equipped with

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cotton duck filter medium of #3 to #8 grade. Filtration rates of at least 2.0 lbs. per square foot of filter surface per hour can be achieved under these conditions.

EXAMPLE I

(Step (a), pre-crystallizing soybean oil)

150 lbs. of refined, bleached and partially hydrogenated (I.V. 107) soybean oil at an initial temperature of 160° F. was placed in a 400 lbs. capacity winterizing cell and allowed to cool at the rate indicated by Table 1. The cell, which was in a 40° F. room, was also equipped with a coil through which an ice-water mixture was pumped. During the cooling, the oil was gently agitated with air introduced into the cell from a perforated pipe. Crystallization began at 2 hours and 42° F. At 5.25 hours and 38° F., the supercooled cottonseed oil of step (b) was added as described below.

TABLE 1.—PRE-CRYSTALLIZING
SOYBEAN OIL

Time, hours:	Temperature, ° F.
0	160
0.75	96
2	42
3	39
4	38
5.25	38

Step (b), supercooling cottonseed oil)

150 lbs. of refined and bleached cottonseed oil (I.V. 112) at an initial temperature of about 75° F. was rapidly chilled in a Votator scraped-wall heat exchanger to 34° F. in less than 1 minute to form supercooled cottonseed oil.

(Steps (c) and (d), combining and holding)

The 34° F. supercooled cottonseed oil of step (b) was immediately added to the 38° F. pre-crystallized soybean oil of step (a) prior to any visible crystal formation in the cottonseed oil. Application of the 40° F. atmosphere, ice-water circulation, and agitation were continued. (During the first 1.25 hours, the temperature rose to 42° F. due to crystallization of the cottonseed oil but then gradually came down to 36° F. as crystal growth was completed.) After 14 hours, the temperature was 36° F., and the oil was filtered as described below.

(Step (e), filtering)

The 36° F. oil of step (d) was filtered in a conventional chilled (40° F.) plate and frame filter (equipped with #4 cotton duck filter medium) at a pressure of 15–25 p.s.i.g. and an average rate of 10.1 lbs./ft.²/hr. (pounds per square foot of filter surface per hour) to yield 83.7% of combined winterized soybean oil and cottonseed oil. The winterized oil exhibited a standard cold test of 8 hours.

EXAMPLES II–V

The process of Example I was repeated except under the conditions, and with the results, shown in Table 2.

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It can be seen from the above examples that the process of the invention provides winterized mixtures of soybean and cottonseed oil in good yield and with good cold tests. Moreover, the process is convenient and advantageous in terms of winterizing time (total time of steps (a) and (d)), and particularly in terms of filtration rate.

For comparative purposes, compositions A–E which each comprised a 50:50 mixture of the soybean oil and cottonseed oil of Example I were prepared. Each mixture was winterized in the conventional manner by cooling to 40° F. and holding at this temperature for the times shown in Table 3 to allow crystal growth. The winterized mixtures were then filtered as in Example I.

TABLE 3

Composition:	Winterization time at 40° F. (hours)	Filtering rate, lbs./ft. ² /hr.	Yield, percent winterized oil	Standard cold test (hours)
A	4	(1)	-----	-----
B	8	(1)	-----	-----
C	17	0.59	72	20
D	20	1.0	72	25
E	40	1.1	72	25

¹ Unfilterable.

It can be seen from Table 3 that when mixtures of soybean oil and cottonseed oil are subjected to a conventional winterization process, highly inefficient filtration rates result.

All proportions, percentages and ratios herein are by weight unless specified otherwise.

What is claimed is:

1. Process for preparing winterized mixtures of soybean oil and cottonseed oil, which comprises:
 - (a) pre-crystallizing soybean oil by slowly cooling to a temperature of from about 30° F. to about 42° F. for a time of from about 2 hours to about 24 hours;
 - (b) supercooling cottonseed oil by rapidly chilling to a temperature of from about 30° to about 38° F. in a time of less than about 2 minutes;
 - (c) combining the supercooled cottonseed oil of step (b) with the precrystallized soybean oil of step (a), the proportion of cottonseed oil to soybean oil being from about 0.1:1 to about 1.5:1;
 - (d) holding the combined mixture of step (c) at a temperature of from about 33° F. to about 45° F. for a time of from about 1 hour to about 20 hours to allow crystals to grow; and
 - (e) filtering the mixture of step (d) to separate the crystals from a winterized mixture of soybean oil and cottonseed oil.
2. The process of claim 1 wherein the soybean oil of step (a) is partially hydrogenated soybean oil having an I.V. of about 90 to about 125.
3. The process of claim 2 wherein the proportion of cottonseed oil to soybean oil in step (c) is from about 0.4:1 to about 1.2:1.
4. The process of claim 3 wherein
 - step (a), the temperature is from about 34° F. to about 38° F. for a time of from about 5 hours to about 18 hours; in
 - step (b), the temperature is from about 34° F. to about 37° F. in a time of from about 20 seconds to about one minute; in

TABLE 2

Example	Precrystallization (Step a)		Supercooling (Step b), final temperature (° F.)	Holding (Step d)		Filtering rate, lbs./ft. ² /hr.	Yield, percent winterized oil	Standard cold test (hours)
	Time (hours)	Final temperature (° F.)		Time (hours)	Temperature (° F.)			
II. 1:1 cottonseed oil to soybean oil	116.5	39	34	5.75	34–40	8.87	85.4	16
III. 1.2:1 cottonseed oil to soybean oil	5.2	36	34	17	34–43	2.82	66	28
IV. 1:1 cottonseed oil to soybean oil	7.2	36	34	15	34–42	5.0	70	20
V. 1.1:1 cottonseed oil to soybean oil	11.5	36	37	5.5	37–38	12.35	83.2	16

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step (c), the cottonseed oil is combined prior to any
 visible crystal formation therein; in
 step (d), the temperature is from about 34° F. to
 about 43° F. for a time of from about 5 hours to
 about 18 hours, and in
 step (e), filtering is at a temperature of from about
 34° F. to about 45° F. and a pressure of from
 about 10 p.s.i.g. to about 30 p.s.i.g. in a plate and
 frame filter.
 5. Process of claim 4 wherein the filtration rate is at
 least 2.0 lbs. per square foot of filter surface; the yield of

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winterized oil is at least 60%; and the winterized oil has
 a standard cold test of at least 8 hours.

References Cited

UNITED STATES PATENTS

2,205,381	6/1940	Eckey et al.	260—428
3,048,491	8/1962	Gooding	99—118

JOSEPH M. GOLIAN, Primary Examiner