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SOYBEAN OIL

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2 Claims. (Cl. 260—420)

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The present invention relates to the treatment of soybean oil and is particularly concerned with the improvement of quality and flavor stability of such soybean oil.

It has been well recognized that edible soybean oil is distinctly subject to flavor instability, and after short periods of time, particularly when exposed to air and light or when subjected to heat, it develops off-flavors and the oil is said to have "reverted." This "reversion" is characterized by the development of off-flavors, often described as "grassy" or "fishy." Although the off-flavors developed by the "reverted" soybean oil are not characteristic of the oil, either in its crude form or in its refined form, the term "reverted" has been generally adopted to indicate the characteristic off-flavors developed in soybean oil when exposed to light and air, and is used herein to indicate such changes in the oil.

Various attempts have been made to overcome this objection to soybean oil. These, however, have not been notably successful, and the problem of developing a stable non-reverting soybean oil had not been satisfactorily solved up to the time of the present invention.

It has now been discovered that by processing soybean oil in a certain manner, the tendency for reversion can be reduced very substantially, and may even be practically eliminated.

It is, therefore, an object of the present invention to provide a process of flavor stabilizing soybean oil.

Another object of the present invention is to provide a flavor stable soybean oil product.

These and other objects of the invention will be more fully apparent from the following description of the invention, with particular reference to the specific examples which are to be considered as illustrative only and not as limiting the invention.

In general, the invention involves the discovery that soybean oil processed in accordance with a definite sequence of operations is more flavor stable and much less likely to develop off-flavors than is soybean oil processed according to conventional present-day procedure. Broadly, the sequence of steps to which the soybean oil is subjected includes the following: degumming, distillation of a small fraction of the oil, and deodorization.

Degumming of the oil may be conducted in accordance with the conventional procedure. The oil is treated with water or an aqueous solution of a weak acid, or an aqueous solution of various salts. The phosphatides and various mucilaginous substances present in the oil become hydrated and insoluble in the oil and may be removed therefrom by settling, centrifuging and the like.

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Thereafter, the oil is subjected to the second step in the process, namely, the vaporization of a small fraction of the oil. This step may be conducted in either of two ways. The vaporization and distillation of the fraction desired to be removed may be performed in a high vacuum still of the type commonly employed for high vacuum short path distillation. In order to prepare the oil for this step, it is preferable to dry the oil and then filter any insoluble material still present in the oil after removal of the phosphatides. The oil is then passed through a degasser preparatory to introduction into the high vacuum still. The drying and filtering of the oil are not essential, but it will be appreciated that if the oil is not dried, a heavy burden will be placed on the degasser. If the remaining suspended material in the oil is not removed by filtration, part of it may deposit in the degasser or in the still and necessitate frequent cleaning.

After the oil has been degassed in a manner conventional to this high vacuum distillation, it is conducted into a high vacuum short path still, preferably of the centrifugal type, in which the oil is spread out in the form of a thin film over the face of the rapidly rotating circular form, from which the selected fraction is vaporized and passes to a condensing surface not far removed from the distilling surface.

In this high vacuum distillation, the small fraction in the form of from 2–6% of the most volatile materials in the oil is removed. Preferably this fraction amounts to about 5% of the original oil. Temperature within this still is preferably maintained within the range 225° C. to 250° C., and it has been found that a temperature of about 230° C. is highly satisfactory. The pressure in this distillation zone is maintained at a very low level, preferably below 10 microns, for example, 7–8 microns. The time period in the still may vary, depending upon the particular type of construction, rate of feed, temperature, vacuum, etc. In general, however, the material passes through the still rapidly and is exposed to still conditions for a matter of only a few seconds.

The exact nature of all the material removed during this distillation step is not known. It is known that practically all of the free fatty acids in the original oil are distilled over, as likewise is a very large percentage (65% to 90%) of the tocopherols. In addition, small amounts of neu-

tral fats are removed. The distillate may likewise contain minute quantities of unidentified materials present in the original oil which have an adverse effect upon the stability of the oil. Whatever the nature of the materials removed, it has been definitely found that the oil processed in accordance with the present disclosure is far more stable with respect to flavor than oils processed in conventional manners.

As an alternative distillation procedure, the following may be used: the degummed oil is degassed in a vacuum chamber, for example, at a temperature of 100° C. and under a vacuum, for example, 10 millimeters. The time period for degassing is usually less than a minute and depends on the particular conditions employed, as well as on the particular design of the degasser. The degassed oil is then run through a vacuum chamber in the form of a packed column containing Raschig rings and Berl saddles. Temperature within the vacuum chamber may vary within the range of 240–275° C. and the pressure may be between 3 and 5 millimeters. As the oil trickles over the packing material, it is subjected to a current of inert gas, preferably a condensable gas such as steam or carbon dioxide, although inert non-condensable gases such as nitrogen and hydrogen may be used. These non-condensable gases are less satisfactory, however, in view of the increased costs and since they require the use of larger capacity vacuum equipment. It is important that the inert gas employed in this step be substantially free from oxygen. It has been found essential to avoid any tendency toward oxidation throughout the processing wherever a high temperature is employed. The preferred inert gas is de-aerated steam (for example, steam generated from thoroughly boiled water).

The time in the vacuum chamber is subject to considerable variation, depending upon the type of equipment and the particular processing conditions; for example, with the conditions set forth above, a time period of slightly less than one minute was found satisfactory for a column 2" in diameter and 36" long. This time period may be increased to as much as 8 to 10 minutes in a column 3 feet in diameter and 30 feet long. The amount of material stripped off during this step should be about the same as that described under the high vacuum distillation step, namely from 2–6%. The nature of the material stripped off is essentially the same as that stripped off in the high vacuum distillation process.

The residual oil obtained after the distillation process in either case is substantially free from free fatty acids, and likewise is essentially tocopherol free. It is then subjected to a deodorization process. For this purpose we prefer a relatively low temperature, preferably 185° C. for a period of about three hours, followed by a further treatment at 125° C. for two hours. The upper temperature may vary within the range 180° C. to 190° C. and the lower temperature may vary within the range 120° C. to 130° C. During the deodorization, the material is subjected to a vacuum of the order ordinarily employed in this operation, and is likewise subjected to a treatment with an inert gas such as steam, carbon dioxide, nitrogen, or hydrogen. Here again, it is important that the inert gas be oxygen free.

If desired, the oil may be subjected to a hydrogenation treatment, and this is preferably employed after the distillation step but before deodorization. It may be conducted in accordance with any of the well-known procedures of the prior art.

Following deodorization, the product is cooled and packaged. If the oil has been hydrogenated, it should be subjected to a texturizing step in accordance with well-known procedures, prior to packaging.

It is desired to stress the importance of avoiding oxidation during any of the high-temperature operations, such as distillation and deodorization. It is necessary that special precautions be taken to insure oxygen-free steam. Thus in conventional steam generating equipment, it will be found that steam is not oxygen free even after the air in the system has been flushed out by discharging steam to atmosphere. The incoming fresh water introduces additional oxygen and even where condensed steam is returned to the boiler, the usual boiler feed pump will introduce air unless special precautions are taken in the form of special packing glands and the like, to prevent the introduction of air. With these precautions, it is possible to produce oxygen-free steam and thus to maintain oxygen-free conditions during these high temperature treatments.

Example 1

One hundred gallons of solvent-extracted, crude soybean oil (1.2% free fatty acids as oleic) are degummed by adding about 1% of water, heating the mixture to 77–82° C. and centrifuging. The oil is then completely clarified by being filtered in a filter-press. Next it is degassed at about 100° C. just before entering a high vacuum still where it is subjected to a short path distillation at a temperature of 240–245° C. and a pressure of 7–9 microns. The distillate amounts to about 5% of the ingoing crude oil. The 95% residue contains 0.028% of free fatty acids (as oleic). This residue is then subjected to a deodorization process by being heated to 185° C. for 3 hours, followed by a temperature of 125° C. for 2 hours under a vacuum of about 10 mm. pressure while oxygen-free superheated steam is blown through the oil. The oil is then cooled while under the above vacuum to about 60° C., the vacuum released and the oil removed from the vessel. When subjected to a test for flavor stability by being kept at room temperature in a clear glass bottle and exposed to daylight, this oil does not show any deterioration of flavor for 19 days, while the same crude oil after being processed in a conventional manner shows a distinct deterioration of flavor when being kept under similar conditions after 3 days.

Example 2

Soybean oil is degummed in a manner similar to that of Example 1. It is then subjected to a degassing treatment in which it is heated to a temperature of about 100° C. and subjected to a vacuum of about 3–5 mm. From the degasser, the oil is passed through a preheater where the temperature is raised to 250–260° C., and then to a packed column through which it trickles by gravity in the form of a thin film. The temperature in the column is maintained within the range 250–260° C. and a vacuum of 3–4 mm. Deaerated superheated steam at a temperature of around 300° C. is passed counter-currently through the column and is removed at the top. The oil, which has been stripped of its free fatty acids and other volatile compounds, is taken off at the bottom of the column and passed to a vacuum chamber where it is cooled to room temperature. The

volatile compounds passing off with the steam are condensed and recovered. The stripped oil has attained a thermal bleaching, and possesses a very low free fatty acid content; for example, 0.017% free fatty acids as oleic. The stripped oil is then subjected to a steam vacuum deodorization in the manner described in Example 1, to produce a flavor stable oil.

It will be seen from the above description, that the present invention provides a novel process of producing soybean oil possessing flavor stability. In general, the soybean oils produced according to the present invention are quite stable to air and light. They remain in good condition for months when exposed at room temperature in colorless bottles to daylight.

While various embodiments of the invention have been discovered, it is to be understood that the invention is not limited thereto, and may be varied within the scope of the following claims.

I claim as my invention:

1. Process of refining soybean oil which comprises degumming the oil, subjecting the oil to vacuum distillation treatment, including passing a substantially oxygen-free inert gas through the oil, whereby from 2–6% of the oil composed principally of free fatty acids and tocopherols and including substantially all the free fatty acids and tocopherols in the degummed oil, is volatilized and removed, and then deodorizing the residual oil at a temperature not substantially in excess of 190° C., including treatment of the oil with a substantially oxygen-free inert gas.

2. Process of refining soybean oil which comprises degumming the oil, flowing the degummed oil through a tower packed with an inert material, subjecting the oil in the packed tower to a temperature of from 240–275° C. and a vacuum of less than 10 mm. while blowing substantially oxygen-free steam through the tower, to distill off from 2–6% of the oil including substantially all the free fatty acids and tocopherols in the degummed oil, and deodorizing the residual oil at a temperature of about 185° C. for about 3 hours, and at a temperature of about 125° C. for about 2 hours, while passing a substantially oxygen-free inert gas through the oil.

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