

Description

Title of the Invention

METHOD FOR PRODUCING EDIBLE OIL AND/OR FAT

Technical Field

[0001]

The present invention relates to a method for producing an edible oil and/or fat.

Background Art

[0002]

There are substances called process contaminants which are mixed in or generated during food production process. It has been reported that process contaminants may have a negative impact on human health. There are reports that multiple process contaminants have been identified in the production process of edible oils and/or fats. Among them, mineral oil-derived saturated hydrocarbons and glycidol fatty acid esters are attracting attention as substances that pose health concerns. Mineral oil-derived saturated hydrocarbons are thought to be mixed in mainly during the oil extraction stage. Glycidol fatty acid esters are generally thought to be generated in deodorization, which is a step in the production process of edible oils and/or fats.

[0003]

Mineral oil-derived saturated hydrocarbons in edible oils and/or fats are mainly derived from industrial gear oils and the like which are mixed in during the production process of edible oils and/or fats. In 2017, the European Union (EU) published in its official gazette a recommendation on the monitoring of mineral oil-derived saturated hydrocarbons in food and in materials and articles intended to come into contact with food (Non-Patent Document 1).

[0004]

Meanwhile, glycidol and glycidol fatty acid esters are said to be generated in deodorization, which is a step in the production process of edible oils and/or fats. There are concerns that, when glycidol fatty acid esters are ingested into the body, they are hydrolyzed by the action of lipases present in the body, resulting in the generation of glycidol. Glycidol is classified as "Group 2A" by the International Agency for Research on Cancer (IARC). "Group 2A" is a group of compounds that are classified as probably carcinogenic to humans (Non-Patent Document 2).

[0005]

In view of the above, it is desirable to produce and distribute edible oils and/or fats containing as little mineral oil-derived saturated hydrocarbons, glycidol, and glycidol fatty acid esters as possible. Glycidol and glycidol fatty acid esters tend to be generated during deodorization treatment. In response to that, Patent Document 1 discloses a low-temperature deodorization treatment of a glyceride composition at from 190 to 230°C as a method to reduce the content of glycidol and glycidol fatty acid esters.

[0006]

Patent Document 2 proposes a method for removing mineral oil-derived saturated hydrocarbons using short-path distillation. Moreover, Patent Document 3 proposes a method for reducing glycidol fatty acid esters using short-path distillation.

Prior Art Documents

Patent Documents

[0007]

Patent Document 1: JP 2011-147436 A

Patent Document 2: JP 2019-85458 A

Patent Document 3: WO 2017/154638

Non-Patent Documents

[0008]

Non-Patent Document 1: COMMISSION RECOMMENDATION (EU) 2017/84 of 16 January 2017

Non-Patent Document 2: IARC, IARC Monogr, Eval, Carcinog, Risks Hum., 77, 469-486, 2000

Disclosure of the Invention

Technical Problem

[0009]

Patent Documents 2 and 3 adopt short-path distillation, posing the concern that the amount of processing is small when considering commercial production of edible oils and/or fats.

[0010]

An object of the present invention is to provide a method for producing an edible oil and/or fat with reduced process contaminants, the method being conducive to commercial production.

Solution to Problem

[0011]

As a result of intensive studies, the present inventors found the following and thereby completed the present invention: by performing a contact treatment using an acid during a bleaching operation, and by subjecting a raw oil and/or fat to a production process including deodorization in which steam distillation is performed at a temperature of 230°C or higher, mineral oil-derived saturated hydrocarbons can be removed, and the generation of glycidol and glycidol fatty acid esters can be suppressed.

[0012]

That is, the present invention is directed to:

(1) A method for producing an edible oil and/or fat, the method including, in bleaching and deodorization of oils and/or fats, using a raw material oil and/or fat described below, and during a bleaching operation, adding an aqueous solution of an acid, wherein a deodorization temperature is 230°C or higher:

raw material oil and/or fat:

having a 3-MCPD concentration of 1.5 mg/kg or less;

(2) The method for producing an edible oil and/or fat according to (1), wherein the raw material oil and/or fat is an oil and/or fat containing refined, bleached, and deodorized palm oil (RBDPO);

(3) The method for producing an edible oil and/or fat according to (1), wherein the deodorization temperature is from 230°C to 270°C;

(4) The method for producing an edible oil and/or fat according to (2), wherein the deodorization temperature is from 230°C to 270°C;

(5) A method for suppressing glycidol and glycidol fatty acid esters as well as saturated hydrocarbons during refining of oils and/or fats according to the method for producing an edible oil and/or fat of (1);

(6) A method for suppressing glycidol and glycidol fatty acid esters as well as saturated hydrocarbons during refining of oils and/or fats according to the method for producing an edible oil and/or fat of (2);

(7) A method for suppressing glycidol and glycidol fatty acid esters as well as saturated hydrocarbons during refining of oils and/or fats according to the method for producing an edible oil and/or fat of (3);

(8) A method for suppressing glycidol and glycidol fatty acid esters as well as saturated hydrocarbons during refining of oils and/or fats according to the method for producing an edible oil and/or fat of (4).

Advantageous Effects of Invention

[0013]

The present invention can provide an edible oil and/or fat with reduced process contaminants.

A preferred embodiment of the present invention can provide an edible oil and/or fat with reduced content of mineral oil-derived saturated hydrocarbons, mineral oil-derived aromatic hydrocarbons, glycidol, and glycidol fatty acid esters.

A preferred embodiment of the present invention yields an edible oil and/or fat satisfying the following conditions after bleaching and deodorization.

Edible oil and/or fat after bleaching and deodorization:

having a suppression ratio of glycidol and glycidol fatty acid esters of 1 or less when compared to an oil and/or fat refined at the same deodorizing temperature but without the addition of an aqueous solution of an acid during a bleaching operation; and

having a suppression ratio of mineral oil-derived saturated hydrocarbons of 0.9 or less relative to the raw material oil and/or fat.

The suppression ratio of glycidol and glycidol fatty acid esters refers to a ratio of the content of glycidol and glycidol fatty acid esters in the oil and/or fat after bleaching and deodorization according to an embodiment of the present invention relative to the content of glycidol and glycidol fatty acid esters in an oil and/or fat produced under conditions that are the same as those in the basis of comparison but without the acid-added bleaching. In addition, the suppression ratio of mineral oil-derived saturated hydrocarbons indicates a ratio of the content of mineral oil-derived saturated hydrocarbons in the oil and/or fat after bleaching and deodorization to the content of mineral oil-derived saturated hydrocarbons in the raw material oil and/or fat.

Description of Embodiments

[0014]

The present invention will be described in detail below.

In the present specification, mineral oil-derived saturated hydrocarbons may be referred to as MOSH, and mineral oil-derived aromatic hydrocarbons may be referred to as MOAH.

[0015]

The raw material oil and/or fat that can be used in an embodiment of the present invention includes an oil and/or fat having a 3-MCPD concentration of 1.5 mg/kg or less. When the raw material oil and/or fat has a 3-MCPD concentration of greater than 1.5 mg/kg, the effect of the present invention may not be achieved.

[0016]

The production process of palm oil includes refining from crude palm oil (CPO) and refining from refined, bleached, and deodorized palm oil (RBDPO). The refining from crude palm oil (CPO) includes squeezing the pulp of oil palm to obtain crude palm oil (CPO) and subjecting the resulting crude palm oil (CPO) to refining steps such as degumming, deacidification, bleaching, deodorization, and dewaxing to produce refined, bleached, and deodorized palm oil (RBDPO). The refining from refined, bleached, and deodorized palm oil (RBDPO) includes further subjecting the refined, bleached, and deodorized palm oil (RBDPO) to refining such as bleaching and deodorization.

[0017]

In an embodiment of the present invention, an oil and/or fat containing refined, bleached, and deodorized palm oil (RBDPO) is preferably used as the raw material oil and/or fat. The oil and/or fat containing refined, bleached, and deodorized palm oil (RBDPO) that can be used includes a refined, bleached, and deodorized palm oil and a fractionated oil obtained using a refined, bleached, and deodorized palm oil as a raw material. Examples of the fractionated oil obtained using a refined, bleached, and deodorized palm oil as a raw material include palm olein, palm super olein, palm stearin, and a palm mid-fraction.

[0018]

In an embodiment of the present invention, an oil and/or fat (hereinafter referred to as (B)) processed using a palm-based oil and/or fat (hereinafter referred to as (A)) can be used as a palm-based oil and/or fat. Examples of the processing method include hydrogenation, fractionation using hydrogenated oil as raw material, hydrogenation using fractionated oil as raw material, and interesterification.

In addition to (A), oils and/or fats of (B) can also be used as the raw material of (B), and (A) and/or (B) are contained as an essential component; however, another edible oil and/or fat may also be contained. Examples of oils and/or fats that can be used include vegetable oils and/or fats such as soybean oil, rapeseed oil, corn oil, cottonseed oil, peanut oil, sunflower oil, rice bran oil, safflower oil, olive oil, sesame oil, a medium-chain triglyceride (MCT) oils and/or fats, coconut oil, and palm kernel oil; animal fats such as milk fat, beef tallow, and lard; hydrogenated oils, fractionated oils, hydrogenated fractionated oils, fractionated hydrogenated oils, processed oils and/or fats obtained by interesterification; and mixed oils and/or fats of the foregoing.

[0019]

In an embodiment of the present invention, the raw material oil and/or fat contains, as an essential component, the above-described oil and/or fat containing refined, bleached,

and deodorized palm oil (RBDPO); however, the raw material oil and/or fat may also contain another edible oil and/or fat in addition to the palm-based oil and/or fat. Examples of oils and/or fats that can be used include vegetable oils and/or fats such as soybean oil, rapeseed oil, corn oil, cottonseed oil, peanut oil, sunflower oil, rice bran oil, safflower oil, olive oil, sesame oil, a medium-chain triglyceride (MCT) oils and/or fats, coconut oil, and palm kernel oil; animal fats such as milk fat, beef tallow, and lard; hydrogenated oils, fractionated oils, hydrogenated fractionated oils, fractionated hydrogenated oils, processed oils and/or fats obtained by interesterification; and mixed oils and/or fats of the foregoing.

[0020]

In an embodiment of the present invention, bleaching and deodorization includes the entire series of steps in the production process, and is not limited to the production process in a reaction device such as a bleaching tank or a deodorization column. The bleaching and deodorization is composed of a bleaching operation and a deodorization operation.

In an embodiment of the present invention, the bleaching operation includes a series of steps, including bleaching preparation, bleaching, and, when necessary after bleaching, bleaching filtration. During bleaching preparation, the raw material oil and/or fat is transferred to a reactor (bleaching tank) where bleaching is performed. During bleaching, a processing aid such as bleaching clay, and the like are placed into the bleaching tank, and the bleaching tank is heated under reduced pressure. During bleaching filtration, cooling is performed and the clay is filtered out.

In an embodiment of the present invention, the deodorization operation includes a series of steps, including deodorization preparation, deodorization, and post-deodorization treatment. In the deodorization preparation, bleached oil after bleaching filtration is transferred to a deodorization vessel (deodorization column). In the deodorization, deodorization is performed in the deodorization column. In the post-deodorization treatment, cooling is performed, an antioxidant is added, etc.

[0021]

An embodiment of the present invention includes adding an aqueous solution of an acid during the bleaching operation in the bleaching and deodorization of oils and/or fats. Preferably, an embodiment of the present invention includes adding an aqueous solution of an acid immediately before bleaching in the bleaching operation. The phrase “includes adding an aqueous solution of an acid immediately before bleaching in the bleaching operation” means that no other step is included between the addition of an aqueous solution of an acid and the bleaching. Examples of the other steps include alkali

deacidification, water washing, dehydration, transesterification reaction, and deodorization.

[0022]

In addition to the above aspect, an embodiment of the present invention includes deodorization that is performed at 230°C or higher.

[0023]

The acid for use in an embodiment of the present invention may be an organic acid and/or an inorganic acid. Examples of the organic acid include at least one organic acid or derivative thereof selected from the group consisting of ascorbic acid, erythorbic acid, lactic acid, tartaric acid, citric acid, gallic acid, phosphoric acid, malic acid, and salts thereof. The inorganic acid is preferably a phosphoric acid, such as orthophosphoric acid, diphosphoric acid (pyrophosphoric acid), and metaphosphoric acid.

[0024]

In a preferred embodiment of the present invention, the acid to be used is an aqueous solution of citric acid and/or phosphoric acid. The concentration of the aqueous solution of citric acid and/or phosphoric acid to be added is preferably from 1 to 85 wt.%, and the amount of the aqueous solution of citric acid and/or phosphoric acid to be added is preferably from 0.01 to 10 wt.%. The conditions are not specified as long as the above ranges are satisfied. However, among the ranges, the amount of the aqueous solution of citric acid and/or phosphoric acid to be added is more preferably from 0.01 to 5 wt.%, even more preferably from 0.05 to 1 wt.%, and further preferably from 0.05 to 0.5 wt.%. When the amount of the aqueous solution of citric acid and/or phosphoric acid to be added is less than 0.01 wt.%, the amount of glycidol and glycidol fatty acid esters may not be sufficiently reduced. Meanwhile, when the amount of the aqueous solution of citric acid and/or phosphoric acid to be added exceeds 10 wt.%, the burden on the equipment may be increased.

[0025]

In a preferred embodiment, desirably, deodorization is performed at a deodorization temperature of from 230 to 280°C, a vacuum degree of from 100 to 800 Pa, and an amount of steam used of from 0.5 to 5 wt.%. When the deodorization temperature is lower than 230°C, mineral oil-derived saturated hydrocarbons may not be sufficiently reduced, or the flavor and color of the deodorized edible oil and/or fat may deteriorate, which is not preferable. When the deodorization temperature exceeds 280°C, the content of glycidol and glycidol fatty acid esters may increase. The vacuum degree is more preferably from 200 to 800 Pa, and even more preferably from 200 to 700 Pa. When the vacuum degree exceeds 800 Pa, the content of mineral oil-derived saturated hydrocarbons

as well as the content of glycidol and glycidol fatty acid esters after deodorization may not be sufficiently reduced, or the flavor of the edible oil and/or fat may deteriorate, which is not preferable. Similarly, when the amount of steam used is less than 0.5 wt.%, the content of mineral oil-derived saturated hydrocarbons as well as the content of glycidol and glycidol fatty acid esters may not be sufficiently reduced, or the flavor of the edible oil and/or fat may deteriorate, which is not preferable. Further, when the amount of steam used exceeds 5 wt.%, the burden on the equipment may be increased, which is not preferable. The deodorization temperature is more preferably from 230°C to 270°C. The deodorization time is preferably from 30 to 120 minutes, and particularly preferably from 60 to 90 minutes. When the deodorization time is less than 30 minutes, the content of mineral oil-derived saturated hydrocarbons may not be sufficiently reduced, or the flavor of the deodorized edible oil and/or fat may deteriorate, which is not preferable. When the deodorization time exceeds 120 minutes, the content of glycidol and glycidol fatty acid esters may be increased, which is not preferable.

[0026]

Examples of a deodorization device to be used in an embodiment of the present invention include a reduced-pressure steam distillation device, and the deodorization may be performed in a batch type, a semi-continuous type, or a continuous type device. When the amount of oil and/or fat to be treated is small, a batch type device is preferable; when the amount of the oil and/or fat to be treated is large, a semi-continuous type or continuous type device is preferable.

The semi-continuous type device to be used may be, for example, a Girdler deodorizer composed of a deodorization column equipped with several trays. The treatment performed using this device is as follows. An oil and/or fat is supplied from the upper part of the device and brought into contact with steam on a tray for an appropriate period of time. Then, the oil and/or fat is descended to the tray below, and after an interval, moved to the next tray below, and so on. The continuous type device to be used may be, for example, a thin film deodorizing device capable of bringing a thin film of oil and/or fat into contact with steam. The semi-continuous type device is preferably from the perspective of the ability to control the temperature and the amount of steam used.

[0027]

In an embodiment of the present invention, the content of mineral oil-derived saturated hydrocarbons as well as the content of glycidol and glycidol fatty acid esters are measured by the following methods.

[0028]

Method for Measuring Saturated Hydrocarbons

The Institut Kirchhoff Berlin GmbH (IKB) was commissioned to perform the analysis of mineral oil-derived saturated hydrocarbons (MOSH) content and mineral oil-derived aromatic hydrocarbons (MOAH) content. IKB performed measurements in accordance with the following method.

DIN EN 16995:2017

[0029]

Method for Measuring Glycidol and Glycidol Fatty Acid Esters

0.3 mL of isooctane is added to 100 mg of an oil and/or fat sample to dissolve the oil and/or fat sample. 3 mL of sodium bromide solution containing 90 U/mL lipase is added to a test tube, and the test tube is shaken on a shaker for 30 minutes. The test tube is heated at 80°C for 10 minutes, and then is allowed to be cooled or water-cooled to room temperature. 50 µL of 2.0 µg/mL internal standard mixed solution and 3 mL of hexane are added to the test tube, and the test tube is capped. The test tube is stirred with a vortex mixer. After centrifugation, the aqueous layer is transferred to a new test tube using a Pasteur pipet. 3 mL of hexane is added to the test tube to which the aqueous layer has been transferred, and the test tube is capped. The test tube is stirred with a vortex mixer. After centrifugation, the organic layer is removed. 20 µL of phenylboronic acid solution and 3 mL of hexane are added to the test tube, and the test tube is capped. The test tube is shaken on a shaker for 10 minutes. The organic layer is transferred to a new test tube using a Pasteur pipet. The organic layer in the new test tube is concentrated to 0.5 to 0.8 mL under nitrogen, and then analyzed by GC-MS.

Note that, in the GC-MS, molecular ion peaks m/z 147 and m/z 150 are used in the quantification.

Examples

[0030]

The present invention will be described in more details using examples presented below. Note that in the examples, "%" indicates weight basis.

[0031]

The raw material oil and/or fat used in Example 1 and Comparative Example 1 was a refined, bleached, and deodorized palm oil (RBDPO) obtained by subjecting crude palm oil (CPO) to degumming with an aqueous solution of phosphoric acid, bleaching, and deodorization. This raw material oil and/or fat had a 3-MCPD concentration of 0.30 mg/kg.

Analyses were performed using the methods described above, and the MOSH content, the MOAH content, the content of glycidol and glycidol fatty acid esters were determined as glycidol equivalents.

[0032]

Example 1

A 50% aqueous solution of citric acid was added to the raw material oil and/or fat in an amount of 0.1 wt.% with respect to the weight of oil and/or fat. Activated clay was added in an amount of 1.5 wt.% with respect to the weight of oil and/or fat, and the mixture was subjected to a bleaching treatment for 10 minutes under the conditions of 110°C and 1330 Pa. After completion of bleaching, the oil and/or fat from which activated clay was filtered and removed was subjected to a deodorization treatment for 90 minutes under the conditions of 265°C, 266 Pa, and an amount of steam used of 3 wt.%. After the deodorization treatment, analyses of the MOSH content and the MOAH content contained in the oil and/or fat, as well as the glycidol equivalents were performed.

[0033]

Comparative Example 1

Activated clay was added to the raw material oil and/or fat in an amount of 1.5 wt.% with respect to the weight of oil and/or fat, and the mixture was subjected to a bleaching treatment for 10 minutes under the conditions of 110°C and 1330 Pa. After completion of bleaching, the oil and/or fat from which activated clay was filtered and removed was subjected to a deodorization treatment for 90 minutes under the conditions of 265°C, 266 Pa, and an amount of steam used of 3 wt.%. After the deodorization treatment, analyses of the MOSH content and the MOAH content contained in the oil and/or fat, as well as the glycidol equivalents were performed.

[0034]

The analytical values are listed in Table 1.

[0035]

[Table 1]

	Raw Material Oil and/or Fat	Example 1	Comparative Example 1
MOSH Content (mg/kg)	27.0	17.0	17.0
MOSH Suppression Ratio	-	0.63	0.63
MOAH Content (mg/kg)	4.5	4.0	4.0
MOAH Suppression Ratio	-	0.90	0.90
Glycidol Equivalent (mg/kg)	-	2.39	3.48
Glycidol Suppression Ratio	-	0.69	-

- MOSH and MOAH suppression ratios indicate suppression ratios with respect to the content in the raw material oil and/or fat.

- The glycidol suppression ratio indicates the suppression ratio with respect to the glycidol equivalents of Comparative Example 1.

[0036]

In the Example, the MOSH content and the MOAH content were able to be reduced compared to the raw material oil and/or fat. Further, the Example was able to have less glycidol compared to Comparative Example 1.

[0037]

The raw material oil and/or fat used in Example 2 and Comparative Example 2 was a refined, bleached, and deodorized palm oil (RBDPO) obtained by subjecting crude palm oil (CPO) to degumming with an aqueous solution of phosphoric acid, bleaching, and deodorization. This raw material oil and/or fat had a 3-MCPD concentration of 0.70 mg/kg.

Analyses were performed using the methods described above, and the MOSH content, the MOAH content, the content of glycidol and glycidol fatty acid esters were determined as glycidol equivalents.

[0038]

Example 2

A 50% aqueous solution of citric acid was added to the raw material oil and/or fat in an amount of 0.1 wt.% with respect to the weight of oil and/or fat. Activated clay was added in an amount of 1.5 wt.% with respect to the weight of oil and/or fat, and the mixture was subjected to a bleaching treatment for 10 minutes under the conditions of 110°C and 1330 Pa. After completion of bleaching, the oil and/or fat from which activated clay was filtered and removed was subjected to a deodorization treatment for 90 minutes under the conditions of 250°C, 266 Pa, and an amount of steam used of 3 wt.%. After the deodorization treatment, analyses of the MOSH content and the MOAH content contained in the oil and/or fat, as well as the glycidol equivalents were performed.

[0039]

Comparative Example 2

Activated clay was added to the raw material oil and/or fat in an amount of 1.5 wt.% with respect to the weight of oil and/or fat, and the mixture was subjected to a bleaching treatment for 10 minutes under the conditions of 110°C and 1330 Pa. After completion of bleaching, the oil and/or fat from which activated clay was filtered and removed was subjected to a deodorization treatment for 90 minutes under the conditions of 250°C, 266 Pa, and an amount of steam used of 3 wt.%. After the deodorization

treatment, analyses of the MOSH content and the MOAH content contained in the oil and/or fat, as well as the glycidol equivalents were performed.

[0040]

The analytical values are listed in Table 2.

[0041]

[Table 2]

	Example 2	Comparative Example 2
Glycidol Equivalent (mg/kg)	0.47	1.25
Glycidol Suppression Ratio	0.38	-

· The glycidol suppression ratio indicates the suppression ratio with respect to the glycidol equivalents of Comparative Example 2.

Industrial Applicability

[0042]

The present invention can provide an edible oil and/or fat with reduced process contaminants.

Claims

[Claim 1]

A method for producing an edible oil and/or fat, the method comprising, in bleaching and deodorization of oils and/or fats, using a raw material oil and/or fat described below, and during a bleaching operation, adding an aqueous solution of an acid, wherein a deodorization temperature is 230°C or higher:

raw material oil and/or fat:

having a 3-MCPD concentration of 1.5 mg/kg or less

[Claim 2]

The method for producing an edible oil and/or fat according to claim 1, wherein the raw material oil and/or fat is an oil and/or fat comprising refined, bleached, and deodorized palm oil (RBDPO).

[Claim 3]

The method for producing an edible oil and/or fat according to claim 1, wherein the deodorization temperature is from 230°C to 270°C.

[Claim 4]

The method for producing an edible oil and/or fat according to claim 2, wherein the deodorization temperature is from 230°C to 270°C.

[Claim 5]

A method for suppressing glycidol and glycidol fatty acid esters as well as saturated hydrocarbons during refining of oils and/or fats according to the method for producing an edible oil and/or fat of claim 1.

[Claim 6]

A method for suppressing glycidol and glycidol fatty acid esters as well as saturated hydrocarbons during refining of oils and/or fats according to the method for producing an edible oil and/or fat of claim 2.

[Claim 7]

A method for suppressing glycidol and glycidol fatty acid esters as well as saturated hydrocarbons during refining of oils and/or fats according to the method for producing an edible oil and/or fat of claim 3.

[Claim 8]

A method for suppressing glycidol and glycidol fatty acid esters as well as saturated hydrocarbons during refining of oils and/or fats according to the method for producing an edible oil and/or fat of claim 4.