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(54) **Oil extraction using fatty acid alkyl esters**

Öl-Extraktion unter Verwendung von Fettsäurealkylesters

Extraction d'huile utilisant des esters alkyliques d'acides gras

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- **DATABASE WPI Section Ch, Week 200538 Derwent Publications Ltd., London, GB; Class D23, AN 2005-367296 XP002393774 & CN 1 580 217 A (UNIV QINGHUA) 16 February 2005 (2005-02-16)**
- **ANON.: "Soybean oil methyl ester shows promise as a natural solvent" LIPID TECHNOLOGY NEWSLETTER, vol. 4, no. 3, June 1998 (1998-06), pages 56-57, XP002393679 Bridgewater, UK**
- **DATABASE COMPENDEX [Online] ENGINEERING INFORMATION, INC., NEW YORK, NY, US; January 2006 (2006-01), FREES RANDY: "VOC-compliant solvents from Soy Technologies" XP002393680 Database accession no. E2006089712278 & IND BIOPROCESS; INDUSTRIAL BIOPROCESSING JANUARY 2006, vol. 28, no. 1, January 2006 (2006-01), pages 3-4,**
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The file contains technical information submitted after the application was filed and not included in this specification

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Description

BACKGROUND

[0001] Oil has been routinely recovered from oil-bearing plants for thousands of years. A large variety of plants produce sufficient quantities of oil that can be processed into edible or industrial products.

[0002] Oil from oil-bearing plants is typically extracted by solvents. Solvent extraction is a mass-transfer process in which one or more materials are transported from a mixture to a solvent phase, resulting in their separation from the mixture. Various organic solvents have been used for commercial extraction. However, there still exists a need in developing a cost-effective solvent and environment-friendly extraction process for recovering oil from oil-bearing plants.

SUMMARY

[0003] This invention is based on the discovery that a triglyceride can be readily extracted from an oil-bearing seed by using a fatty acid alkyl ester which is obtained by reacting alcohol with a triglyceride that is identical to the triglyceride extracted from the triglyceride-containing part of the oil-bearing plant as a solvent.

[0004] In one aspect, this invention features a method of producing a triglyceride solution. The method includes contacting a liquid fatty acid alkyl ester and a substance containing triglyceride (e.g., at 15-180°C or 25-150°C) so that the triglyceride is dissolved into the fatty acid alkyl ester to form a triglyceride solution. According to the invention, the fatty acid alkyl ester is obtained, prior to the contacting step, by reacting alcohol (e.g. a C1-C8 primary or secondary alcohol) with triglyceride extracted from the same triglyceride-containing part of the oil-bearing plant. Exemplary alcohols include methanol, ethanol, n-propanol, isopropanol, n-butanol, isobutanol, n-pentanol, isopentanol, neopentanol and n-hexanol. The fatty acid alkyl ester and the triglyceride-containing part of the oil-bearing plant can be mixed at a weight ratio ranging from 1:2 to 10:1 (e.g., from 1:1 to 6:1).

[0005] The triglyceride-containing oil-bearing plant can be oil-bearing seed. The term "oil-bearing seed" refers to any plant seed suitable for oil extraction. Examples of oil-bearing seed include, but are not limited to, soybean, peanut, sunflower seed, rapeseed, corn (e.g., corn germs or distillers dried corn grains), jatropha seed, karanja seed, neem seed, mahua seed, castor bean, rubber seed, cotton seed, palm kernel, olive, almond kernel, babassu seed, ben seed, cardoon seed, camelina seed, linseed, hazelnut kernel, hemp seed, mustard seed (e.g., Ethiopian mustard seed and Indian mustard seed), jojoba seed, poppy seed, safflower seed, sesame seed, wheat grain, sal seed, crambe seed, cuphea seed, nahor seed, and tobacco seed. Alternatively, the triglyceride-containing substance can be obtained from parts other than seed in certain oil-bearing plants. The term "oil-bearing plant" refers to any plant that contains oil in any part (e.g., seed or fruit) and is suitable for oil extraction. Examples in addition to those listed above include, but are not limited to, rice bran, palm (e.g., palm fruit pulp), yellowwood, and algae.

[0006] The fatty acid alkyl ester described above can contain a C1-C8 primary or secondary alkoxy moiety or a C6-C24 fatty acid moiety. The term "alkoxy" refers to a straight or branched, saturated or unsaturated, non-aromatic hydrocarbon moiety containing an oxygen radical, such as $-OCH_3$ or $-OCH=C_2H_4$. The term "fatty acid" mentioned herein refers to a straight or branched, saturated or unsaturated monobasic organic acid. Exemplary fatty acids include, but are not limited to, caproic acid, caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, margaric acid, stearic acid, nonadecanoic acid, arachidic acid, behenic acid, lignoceric acid, palmitoleic acid, oleic acid, linoleic acid, linolenic acid, cis-11-eicosenoic acid, and erucic acid. Exemplary fatty acid alkyl esters include, but are not limited to, fatty acid methyl esters, fatty acid ethyl esters, fatty acid n-propyl esters, fatty acid isopropyl esters, fatty acid n-butyl esters, fatty acid isobutyl esters, fatty acid n-pentyl esters, fatty acid isopentyl esters, fatty acid neopentyl esters, and fatty acid n-hexyl esters. Typically, the fatty acid alkyl ester can have a boiling point of 150-500°C.

[0007] The details of one or more embodiments of the invention are set forth in the description below. Other features, objects, and advantages of the invention will be apparent from the description and from the claims.

DETAILED DESCRIPTION

[0008] The use of fatty acid alkyl ester as an extractant has been explored in various literature. Erskine (WO 2005/039727) discloses a method for extracting a compound from a plant material, the extractant including a fatty acid ester. In one embodiment, the method consists in contacting *Echium Planatagineum* with fatty acid esters to extract a mixture of fatty acids containing stearidonic acid. This method produces a stearidonic acid solution. *Echium Planatagineum* is an example of an oil bearing plant with characteristically high content of a particular fatty acid (WO 02/092779). Koslowsky (US 4,004,041) teaches the use of palm fatty acid esters in dissolving the palm glycerides. Ikehara et al. (EP 1491204) teaches the use of an oil and fat composition containing 10% by weight or more of a specific fat-soluble polyhydric fatty acid ester, in particular, a glycerol fatty acid ester, as a solvent for extracting hydrophobic components (i.e., flavonoids), which are not triglycerides, from licorice. Furthermore, a description is given in Lipid Technology Newsletter (June 1998, pages 56-57) of a clean-up process for oil spills based on using a biosolvent containing methyl esters derived from soybean and other vegetable oils to dissolve and extract spilled oil from vegetation, mussel beds and shorelines.

[0009] This invention relates to extracting a triglyceride

from an oil-bearing plant using a fatty acid alkyl ester which is obtained by reacting alcohol with a triglyceride that is identical to the triglyceride extracted from the triglyceride-containing part of the oil-bearing plant as a solvent at a certain temperature (e.g., 15-180°C) to obtain an extraction solution. When the oil-bearing plant contains a high oil content, the plant can be optionally pressed or squeezed to remove a portion of the oil before extraction. If desired, the oil-bearing plant can also be pulverized to facilitate extraction.

[0010] The extraction process can be performed by methods well known in the art. As an example, it can be carried out by mixing a pulverized oil-bearing plant and a fatty acid alkyl ester in a continuous stirred-tank reactor for a predetermined period of time. As another example, it can be carried out continuously by bring together, without mixing, a pulverized oil-bearing plant and a fatty acid alkyl ester in a plug flow reactor or a fixed bed reactor through a counter-current flow, a co-current flow, or a combination of both flows. The extraction process can be carried out by either a batch method or a flow method. Typically, a flow method can be used to help maintain reasonable manufacturing costs.

[0011] The extraction can be performed at different temperatures. Generally, extraction at a higher temperature (e.g., above 35°C) recovers more oil. However, high temperature extraction may also produce more impurities (e.g., phosphorus and moisture). The weight ratio between the solvent and the oil-bearing plant used in the extraction process depends on various factors, e.g., the type of the oil-bearing plant and the oil content in the oil-bearing plant. For example, one can use a low weight ratio for extracting a prepressed oil-bearing plant, from which a portion of the oil in the plant has been removed. Typically, the weight ratio is in the range of 1:2 to 10:1. Other extraction conditions (e.g., the extraction time) can be determined empirically.

[0012] The fatty acid alkyl ester used in the extraction process can be prepared by known methods. For example, a fatty acid alkyl ester can be prepared by an esterification reaction between an alcohol (e.g., ethanol) and a fatty acid (e.g., stearic acid). As another example, a fatty acid alkyl ester can be prepared by a transeterification reaction between an alcohol and a triglyceride, such as the transeterification reactions described in U.S. Patent Application 10/945,339. Preferably, the fatty acid alkyl ester is prepared from a C1-C4 alcohol. Extractions with such a fatty acid alkyl ester generally produce a triglyceride solution that contains less impurities (e.g., phosphorus and moisture). The triglyceride used to prepare the fatty acid alkyl ester is obtained from a plant that is the same as the plant to be extracted. The triglyceride extracted from the plant is identical to the triglyceride used to prepare the extraction solvent (i.e., the fatty acid alkyl ester). As a result, if the extracted triglyceride is subsequently used to prepare the fatty acid alkyl ester via a transesterification reaction, the fatty acid alkyl ester in an extraction solution can be used as a solvent for the reaction and therefore needs not to be separated from the extracted triglyceride.

[0013] After the extraction process, the fatty acid alkyl ester can be optionally separated from the extracted triglyceride by partially or completely removal from an extraction solution. The removal step can be carried out by distillation using a vacuum column, a short-path vacuum distillation unit, or any other suitable device known in the art. Whether to remove the fatty acid alkyl ester partially or completely from an extraction solution or to remove it at all depends on various factors, such as the ratio between the fatty acid alkyl ester and the extracted triglyceride and the end use of the extracted triglyceride.

[0014] The extracted triglyceride can be further processed for use in the food and pharmaceutical industries. It can also be used as a raw material for preparing fatty acid alkyl esters or fatty alcohols. Fatty acid alkyl esters are useful as diesel fuels, lubricant oils, or chemical intermediates. Fatty alcohols are useful as surfactants in detergent industry.

[0015] The specific examples below are to be construed as merely illustrative, and not limitative of the remainder of the disclosure in any way whatsoever. Without further elaboration, it is believed that one skilled in the art can, based on the description herein, utilize the present invention to its fullest extent. All of the publications cited herein, including patents, are hereby incorporated by reference in their entirety.

Example 1

[0016] Soybeans were first ground into a powder and sieved through a filter having a size of 40 mesh (about 425-520 μm). Soybean powder having an average particle size of less than 40 mesh, which is similar to a dehulled powder, was collected and used for oil extraction.

[0017] The soybean powder obtained above was dried until it had a moisture content of less than 6 wt%. The powder was then extracted using soybean based fatty acid methyl esters (FAMEs) as a solvent in a beaker with agitation. The soybean based FAMEs were previously prepared by a transesterification reaction between methanol and triglycerides obtained from soybean.

[0018] The extraction process was carried out by using FAMEs at a solvent-to-powder weight ratio of 6:1 at 35°C. The beaker was agitated at a revolution per minute (rpm) of 300. After 30 minutes of extraction, the content of the miscella (i.e., the solution containing extracted oil) was determined. The oil content in the miscella was determined by HPLC (JASCO model 1580; column: Luna Su C18, 2 μm, 250*4.6 mm, Phenomenex, Torrance, CA; mobile phases: methanol, and hexane/isopropyl alcohol (4:5); UV detector: UV-2075, JASCO Inc., Tokyo, Japan). The moisture content in the miscella was determined by the Karl-Fisher method according to the operation manual, MKC-500 KF Moisture Titrator Kyoto Electronic Manufacturing Co. Ltd, Ver. 04, #595-0006. The phosphorus content in the miscella was determined according to

American Oil Chemist's Society official method Ca 12-55. The results showed that miscella contained a moisture content of 818 ppm, a phosphorus content of 14.4 ppm, and an oil content of 3.60 wt%. The weight of the extracted oil was 20% of that of the soybean powder.

[0019] The soybean powder was also successively extracted with FAMEs at a reduced solvent-to-powder ratio in a beaker. Specifically, the powder was extracted twice at a solvent-to-powder ratio of 1: 1 by agitating the beaker at a rpm of 1,000 for 15 mintues. After the first extraction, the miscella contained a moisture content of 989 ppm, a phosphorus content of 23.4 ppm, and an oil content of 14.08 wt%. After the second extraction, the miscella contained a moisture content of 1,428.3 ppm, a phosphorus content of 14.23 ppm, and an oil content of 6.13 wt%. After two extractions, the total weight of the extracted oil was 21.59% of that of the soybean powder.

[0020] Finally, the soybean powder obtained above was also extracted via a conventional method. Specifically, the powder was extracted by Gerhardt's Soxtherm automated soxlet system using hexane as a solvent at a solvent-to-powder ratio of 8:1 at 65°C. This method is described in Official and Tentative Methods, the American Oil Chemist Society, Vol. 1, AOCS Champaign Il (1980) Method Am 2-93. The results show that the oil contained a phosphorus content of 265 ppm. The weight of the extracted oil was 18.8% of that of the soybean powder.

Example 2

[0021] Two types of oil-bearing seeds were extracted by FAMEs prepared from triglycerides obtained from their corresponding oil sources. Specifically, sunflower seeds were extracted by sunflower seed based FAMEs and peanuts (ground nuts) were extracted by peanut based FAMEs.

[0022] Sunflower seeds were dehulled and ground into a powder having an average particle size of less than 40 mesh. The powder was dried until it had a moisture content of less than 6 wt%. It was then extracted twice in a beaker with sunflower seed based FAME at a solvent-to-powder ratio of 1:1. Each extraction was conducted by agitating the beaker at a rpm of 1,000 for 15 minutes at 35°C. After the first and second extractions, the miscella contained a moisture content of 794 and 831 ppm, respectively, a phosphorus content of 49.6 and 47.8 ppm, respectively, and an oil content of 35.65 and 12.30 wt%, respectively. After two extractions, the total weight of the extracted oil was 54.83% of that of the sunflower seeds.

[0023] Peanuts were ground into a powder having an average particle size of less than 25 mesh (i.e., about 425-710 μm) and then dried until it contained less than 6 wt% of moisture. The powder was then extracted four times in a beaker with peanut based FAMEs at a solvent-to-powder ratio of 1:1. Each extraction was conducted by agitating the beaker at a rpm of 1,000 for 15 minutes at 35°C. After the first, second, third, and fourth extractions, the miscella contained a moisture content of 701, 690, 661, and 661 ppm, respectively, a phosphorus content of 23.5, 16.4, 0, and 0 ppm, respectively, and an oil content of 31.4, 10.9, 2.63, and 0.78 wt%, respectively. After three extractions, the total weight of the extracted oil was 45.83% of that of the peanuts. After four extractions, the total weight of the extracted oil was 47.48% of that of the peanuts.

Example 3

[0024] Soybeans were extracted by soybean based fatty acid ethyl esters (FAEEs). Soybean based FAEEs were prepared by a transesterification reaction between ethanol and triglycerides obtained from soybeans.

[0025] Soybeans were first ground into a powder having an average particle size of less than 40 mesh and then dried until it had a moisture content of less than 6 wt%. The powder was then extracted three times in a beaker with soybean based FAEEs at a solvent-to-powder ratio of 1: 1. Each extraction was conducted by agitating the beaker at a rpm of 1000 for 15 minutes at 35°C. After the first, second, and third extractions, the miscella contained a moisture content of 650, 652, and 694 ppm, respectively, a phosphorus content of 39.4, 23.3, 16.0 ppm, respectively, and an oil content of 14.09, 5.93, and 1.05 wt%, respectively. After three extractions, the total weight of the extracted oil was 20.1 % of that of the soybean powder.

Example 4

[0026] Soybeans were extracted by a method similar to that described in Example 3 except that soybean based fatty acid butyl esters (FABEs) were used as a solvent. Soybean based FABEs were prepared by a transesterification reaction between n-butanol and triglycerides obtained from soybeans.

[0027] After the first, second, and third extractions, the miscella contained a moisture content of 576, 519, and 479 ppm, respectively, a phosphorus content of 27.32,13.49, and 0.96 ppm, respectively, and an oil content of 15.93, 5.10, and 1.60 wt%, respectively. After three extractions, the total weight of the extracted oil was 21.6% of that of the soybean powder.

Example 5

[0028] Soybeans were extracted by a method similar to that described in Example 4 except that the extractions were conducted at a reduced agitation rate, i.e., at a rpm of 500. Further, the extractions were conducted at four different temperatures, i.e., 35°C, 60°C, 100°C, and 150°C.

[0029] The results show that the total weight of the extracted oil increased at higher temperatures. Specifically, at 35°C, 60°C, 100°C, and 150°C, the total weights of the extracted oil were respectively 21.42, 23.25, 28.4,

and 32.8% of those of soybean powder. The results also show that at 35°C, 60°C, 100°C, and 150°C, the phosphorus contents in a mixture containing a combination of miscella obtained after each extraction were 16.2, 18.64, 48.32, and 91.12 ppm, respectively.

Example 6

[0030] Two oil-bearing seeds were extracted by FAMEs prepared from triglycerides obtained from their corresponding oil sources and triglycerides obtained from another oil source. Specifically, sunflower seeds were extracted by sunflower seed based FAMEs and soybean based FAMEs, and peanuts (ground nuts) were extracted by peanut based FAMEs and soybean based FAMEs.

[0031] Sunflower seeds were extracted with sunflower seed based FAMEs and soybean based FAMEs using a method similar to that described in Example 2 except that a solvent-to-powder ratio of 6:1 was used and that only one extraction was performed. After the extraction with sunflower seed based FAMEs and soybean based FAMEs, the miscella contained a moisture content of 466 and 856 ppm, respectively, a phosphorus content of 10.6 and 12.78 ppm, respectively, and an oil content of 6.33 and 4.06 wt%, respectively. The total weight of the extracted oil was 39.0% of that of the sunflower seeds when sunflower seed based FAMEs were used as the solvent and 24.71% of that of the sunflower seeds when soybean based FAMEs were used as the solvent.

[0032] Peanuts were extracted with peanut based FAMEs and soybean based FAMEs using a method similar to that described in Example 2 except that the solvent-to-powder ratio was 6:1 and that only one extraction was performed. After the extraction with peanut seed based FAMEs and soybean based FAMEs, the miscella contained a moisture content of 470 and 718 ppm, respectively, a phosphorus content of 19.36 and 10.0 ppm, respectively, and an oil content of 6.23 and 6.83 wt%, respectively. The total weight of the extracted oil was 39.1% of that of the peanuts when peanut based FAMEs were used as the solvent and 39.8% of that of the peanuts when soybean based FAMEs were used as the solvent.

[0033] The above results show that oil could be extracted from a plant seed using FAMEs prepared from oil of the same plant seed and FAMEs prepared from oil of a different plant seed.

Claims

1. A method of producing a triglyceride solution, comprising contacting a part of an oil-bearing plant containing a triglyceride with a liquid fatty acid alkyl ester, which is obtained by reacting alcohol with a triglyceride that is identical to the triglyceride extracted from the triglyceride-containing part of the oil-bearing plant, so that the triglyceride is dissolved into the fatty acid alkyl ester to form a triglyceride solution.

2. The method of claim 1, wherein the oil-bearing plant is rice bran, palm fruit pulp, yellowwood, or algae.

3. The method of claim 1, wherein the triglyceride-containingpart of the oil-bearing plant is oil-bearing seed.

4. The method of claim 3, wherein the oil-bearing seed is soybean, peanut, sunflower seed, rapeseed, corn, jatropha seed, karanja seed, neem seed, mahua seed, castor bean, rubber seed, cotton seed, palm kernel, olive, almond kernel, babassu seed, ben seed, cardoon seed, camelina seed, linseed, hazelnut kernel, hemp seed, mustard seed, jojoba seed, poppy seed, safflower seed, sesame seed, wheat grain, sal seed, crambe seed, cuphea seed, nahor seed, or tobacco seed.

5. The method of claim 1, wherein the fatty acid alkyl ester contains a C6-C24 fatty acid moiety.

6. The method of claim 1, wherein the fatty acid alkyl ester contains a C1-C8 primary or secondary alkoxy moiety.

7. The method of claim 1, wherein the fatty acid alkyl ester is a fatty acid methyl ester, a fatty acid ethyl ester, a fatty acid n-propyl ester, a fatty acid isopropyl ester, a fatty acid n-butyl ester, a fatty acid isobutyl ester, a fatty acid n-pentyl ester, a fatty acid isopentyl ester, a fatty acid neopentyl ester, or a fatty acid n-hexyl ester.

8. The method of claim 1, wherein the fatty acid alkyl ester has a boiling point of 150-500°C.

9. The method of claim 1, wherein the contacting step is conducted at 15-180°C.

10. The method of claim 9, wherein the contacting step is conducted at 25-150°C.

11. The method of claim 1, wherein the fatty acid alkyl ester and the triglyceride-containing part of the oil-bearing plant are contacted at a weight ratio ranging from 1:2 to 10:1.

12. The method of claim 1, wherein the fatty acid alkyl ester is obtained, prior to the contacting step, by reacting alcohol with triglyceride extracted from the same triglyceride-containing part of the oil-bearing plant.

13. The method of claim 12, wherein the oil-bearing plant is rice bran, palm fruit pulp, yellowwood, or algae.

14. The method of claim 12, wherein the triglyceride-

containing part of the oil-bearing plant is oil-bearing seed.

15. The method of claim 14, wherein the oil-bearing seed is soybean, peanut, sunflower seed, rapeseeds, corn, jatropha seed, karanja seed, neem seed, mahua seed, castor bean, rubber seed, cotton seed, palm kernel, olive, almond kernel, babassu seed, ben seed, cardoon seed, camelina seed, linseed, hazelnut kernel, hemp seed, mustard seed, jojoba seed, poppy seed, safflower seed, sesame seed, wheat gain, sal seed, crambe seed, cuphea seed, nahor seed, or tobacco seed.

16. The method of claim 15, wherein the fatty acid alkyl ester contains a C6-C24 fatty acid moiety.

17. The method of claim 16, wherein the alcohol is a C1-C8 primary or secondary alcohol.

18. The method of claim 17, wherein the fatty acid alkyl ester is a fatty acid methyl ester, a fatty acid ethyl ester, a fatty acid n-propyl ester, a fatty acid isopropyl ester, a fatty acid n-butyl ester, a fatty acid isobutyl ester, a fatty acid n-pentyl ester, a fatty acid isopentyl ester, a fatty acid neopentyl ester, or a fatty acid n-hexyl ester.

19. The method of claim 18, wherein the fatty acid alkyl ester and the triglyceride-containing part of the oil-bearing plant are contacted at a weight ratio ranging from 1:2 to 10:1.

20. The method of claim 19, wherein the contacting step is conducted at 15-180°C.

21. The method of claim 20, wherein the contacting step is conducted at 25-150°C.

22. The method of claim 12, wherein the fatty acid alkyl ester contains a C6-C24 fatty acid moiety.

23. The method of claim 12, wherein the alcohol is a C1-C8 primary or secondary alcohol.

24. The method of claim 12, wherein the fatty acid alkyl ester is a fatty acid methyl ester, a fatty acid ethyl ester, a fatty acid n-propyl ester, a fatty acid isopropyl ester, a fatty acid n-butyl ester, a fatty acid isobutyl ester, a fatty acid n-pentyl ester, a fatty acid isopentyl ester, a fatty acid neopentyl ester, or a fatty acid n-hexyl ester.

25. The method of claim 12, wherein the fatty acid alkyl ester has a boiling point of 150-500°C.

26. The method of claim 12, wherein the contacting step is conducted at 15-180°C.

27. The method of claim 26, wherein the contacting step is conducted at 25-150°C.

28. The method of claim 12, wherein the fatty acid alkyl ester and the triglyceride-containing part of the oil-bearing plant are contacted at a weight ratio ranging from 1:2 to 10:1.

29. The method of claim 1, wherein the alcohol is a C1-C8 primary or secondary alcohol.

Patentansprüche

1. Verfahren zur Herstellung einer Triglycerid Lösung umfassend, das Kontaktieren eines Teils einer Öl-haltigen Pflanze, die ein Triglycerid mit einem flüssigen Fettsäure-Alkylester enthält, das erhalten wird durch Reaktion von Alkohl mit Triglycerid, das identisch ist zu dem Triglycerid, das von dem Triglyceridenthaltenen Teil der Öl-haltigen Pflanze extrahiert wurde, so dass das Triglycerid in einen Fettsäure-Alkylester aufgelöst wird um eine Triglycerid Lösung zu formen.

2. Verfahren nach Anspruch 1, wobei die Öl-haltige Pflanze Reiskleie, Palmfrucht-Fruchtfleisch, Gelbholz, oder Algen ist.

3. Verfahren nach Anspruch 1, wobei der Triglyceridenthaltende Teil der Öl-haltigen Pflanze ein Öl-haltiger Samen ist.

4. Verfahren nach Anspruch 3, wobei der Öl-haltige Samen Sojabohne, Erdnuss, Sonnenblumen-Samen, Raps-Saat, Mais, Jatropha-Samen, Karanja-Samen, Neem-Samen, Mahua-Samen, Rizinussamen, Kautschuk-Samen, Baumwoll-Samen, Palmkern, Olive, Mandelkern, Babassu-Samen, Ben-Samen, Artischocken-Samen, Camelina-Samen, Leinsamen, Haselnusskern, Hanfsamen, Senfsamen, Jojoba-Samen, Mohnsamen, Färberdistel-Samen, Sesam-Samen, Weizenkorn, Sal-Samen, Krambe-Samen, Cuphea-Samen, Nahor-Samen, oder Tabak-Samen ist.

5. Verfahren nach Anspruch 1, wobei der Fettsäure-Alkylester eine C6-C24 Fettsäure-Einheit enthält.

6. Verfahren nach Anspruch 1, wobei der Fettsäure-Alkylester eine C1-C8 primäre oder sekundäre Alkoxy-Einheit enthält.

7. Verfahren nach Anspruch 1, wobei der Fettsäure-Alkylester ein FettsäureMethylester, ein Fettsäure-Ethylester, ein Fettsäure-n-Propylester, ein Fettsäure-Isopropylester, ein Fettsäure-n-Butylester, ein Fettsäure-Isobutylester, ein Fettsäure-n-Pentyles-

ter, ein Fettsäure-Isopentylester, ein Fettsäure-Neopentylester, oder ein Fettsäure-n-Hexylester ist.

8. Verfahren nach Anspruch 1, wobei der Fettsäure-Alkylester einen Siedepunkt von 150-500°C aufweist.

9. Verfahren nach Anspruch 1, wobei der Kontaktierungs-Schritt bei 15-180°C durchgeführt wird.

10. Verfahren nach Anspruch 9, wobei der Kontaktierungs-Schritt bei 25-150°C ausgeführt **wird.**

11. Verfahren nach Anspruch 1, wobei der Fettsäure-Alkylester und der Triglyceridenthaltende Teil der Öl-haltigen Pflanze bei einem Gewichtsverhältnis zwischen 1:2 bis 10:1 1 kontaktiert werden.

12. Verfahren nach Anspruch 1, wobei der Fettsäure-Alkylester erhalten wird, vor dem Kontaktierungs-Schritt, durch Reaktion von Alkohol mit Triglycerid, das aus dem gleichen Triglycerid-enthaltenden Teil der Öl-haltigen Pflanze extrahiert wurde.

13. Verfahren nach Anspruch 12, wobei die Öl-haltige Pflanze Reiskleie, Palmfrucht-Fruchtfleisch, Gelbholz, oder Algen ist.

14. Verfahren nach Anspruch 12, wobei der Triglyceridenthaltenen Teil der Öl-haltigen Pflanze ein Öl-haltiger Samen ist.

15. Verfahren nach Anspruch 14, wobei der Öl-haltiger Samen Sojabohne, Erdnuss, Sonnenblumen-Samen, Raps-Saat, Mais, Jatropha-Samen, Karanja-Samen, Neem-Samen, Mahua-Samen, Rizinussamen, Kautschuk-Samen, Baumwoll-Samen, Palmkern, Olive, Mandelkern, Babassu-Samen, Ben-Samen, Artischocken-Samen, Camelina-Samen, Leinsamen, Haselnusskern, Hanfsamen, Senfsamen, Jojoba-Samen, Mohnsamen, Färberdistel-Samen, Sesam-Samen, Weizenkorn, Sal-Samen, Krambe-Samen, Cuphea-Samen, Nahor-Samen, oder Tabak-Samen ist.

16. Verfahren nach Anspruch 15, wobei der Fettsäure-Alkylester eine C6-C24 Fettsäure-Einheit enthält.

17. Verfahren nach Anspruch 16, wobei der Alkohol ein C1-C8 primärer oder sekundärer Alkohol ist.

18. Verfahren nach Anspruch 17, wobei der Fettsäure-Alkylester ein FettsäureMethylester, ein Fettsäure-Ethylester, ein Fettsäure-n-Propylester, ein Fettsäure-Isopropylester, ein Fettsäure-n-Butylester, ein Fettsäure-Isobutylester, ein Fettsäure-n-Pentylester, ein Fettsäure-Isopentylester, ein Fettsäure-Neopentylester, oder ein Fettsäure-n-Hexylester ist.

19. Verfahren nach Anspruch 18, wobei der Fettsäure-Alkylester und der Triglyceridenthaltende Teil der Öl-haltigen Pflanze bei einem Gewichtsverhältnis zwischen 1:2 bis 10:1 kontaktiert werden.

20. Verfahren nach Anspruch 19, wobei der Kontaktierungs-Schritt bei 15-180°C durchgeführt wird.

21. Verfahren nach Anspruch 20, wobei der Kontaktierungs-Schritt bei 25-150°C ausgeführt wird.

22. Verfahren nach Anspruch 12, wobei der Fettsäure-Alkylester eine C6-C24 Fettsäure-Einheit enthält.

23. Verfahren nach Anspruch 12, wobei der Alkohol ein C1-C8 primärer oder sekundärer Alkohol ist.

24. Verfahren nach Anspruch 12, wobei der Fettsäure-Alkylester ein FettsäureMethylester, ein Fettsäure-Ethylester, ein Fettsäure-n-Propylester, ein Fettsäure-Isopropylester, ein Fettsäure-n-Butylester, ein Fettsäure-Isobutylester, ein Fettsäure-n-Pentylester, ein Fettsäure-Isopentylester, ein Fettsäure-Neopentylester, oder ein Fettsäure-n-Hexylester ist.

25. Verfahren nach Anspruch 12, wobei der Fettsäure-Alkylester einen Siedepunkt von 150-500°C aufweist.

26. Verfahren nach Anspruch 12, wobei der Kontaktierungs-Schritt bei 15-180°C durchgeführt wird.

27. Verfahren nach Anspruch 26, wobei der Kontaktierungs-Schritt bei 25-150°C ausgeführt wird.

28. Verfahren nach Anspruch 12, wobei der Fettsäure-Alkylester und der Triglyceridenthaltende Teil der Öl-haltigen Pflanze bei einem Gewichtsverhältnis zwischen 1:2 bis 10:1 kontaktiert werden.

29. Verfahren nach Anspruch 1, wobei der Alkohol ein C1-C8 primärer oder sekundärer Alkohol ist.

Revendications

1. Procédé de production d'une solution de triglycéride, comprenant la mise en contact d'une partie d'une plante oléagineuse contenant un triglycéride avec un ester alkylique d'acide gras liquide qui est obtenu en faisant réagir un alcool avec un triglycéride qui est identique au triglycéride extrait de la partie contenant un triglycéride de la plante oléagineuse, de sorte que le triglycéride soit dissous dans l'ester alkylique d'acide gras pour former une solution de triglycéride.

2. Procédé selon la revendication 1, dans lequel la

plante oléagineuse est du son de riz, de la pulpe de fruit de palmier, du podo ou des algues.

3. Procédé selon la revendication 1, dans lequel la partie contenant un triglycéride de la plante oléagineuse est une graine oléagineuse.

4. Procédé selon la revendication 3, dans lequel la graine oléagineuse est le soja, l'arachide, la graine de tournesol, la graine de colza, le maïs, la graine de jatropha, la graine de karanja, la graine de margousier, la graine de mahua, la graine de ricin, la graine d'hévéa, la graine de coton, l'amande de palmiste, l'olive, l'amande, la graine de babassu, la graine de Moringa oleifera, la graine de cardon, la graine de caméline, la graine de lin, la noisette, la graine de chènevis, la graine de moutarde, la graine de jojoba, la graine de pavot, la graine de carthame, la graine de sésame, la graine de blé, la graine de sal, la graine de crambe, la graine de cuphéa, la graine de nahor ou la graine de tabac.

5. Procédé selon la revendication 1, dans lequel l'ester alkylique d'acide gras contient une fraction acide en C6 à C24.

6. Procédé selon la revendication 1, dans lequel l'ester alkylique d'acide gras contient une fraction alcoxy primaire ou secondaire en C1 à C8.

7. Procédé selon la revendication 1, dans lequel l'ester alkylique d'acide gras est un ester méthylique d'acide gras, un ester éthylique d'acide gras, un ester n-propylique d'acide gras, un ester isopropylique d'acide gras, un ester n-butylique d'acide gras, un ester isobutylique d'acide gras, un ester n-pentylique d'acide gras, un ester isopentylique d'acide gras, un ester néopentylique d'acide gras ou un ester n-hexylique d'acide gras.

8. Procédé selon la revendication 1, dans lequel l'ester alkylique d'acide gras a un point d'ébullition de 150 à 500° C.

9. Procédé selon la revendication 1, dans lequel l'étape de mise en contact est réalisée à 15 à 180° C.

10. Procédé selon la revendication 9, dans lequel l'étape de mise en contact est réalisée à 25 à 150° C.

11. Procédé selon la revendication 1, dans lequel l'ester alkylique d'acide gras et la partie contenant un triglycéride de la plante oléagineuse sont mis en contact à un rapport en poids allant de 1 : 2 à 10 : 1.

12. Procédé selon la revendication 1, dans lequel l'ester alkylique d'acide gras est obtenu, avant l'étape de mise en contact, en faisant réagir de l'alcool avec un triglycéride extrait de la même partie contenant un triglycéride de la plante oléagineuse.

13. Procédé selon la revendication 12, dans lequel la plante oléagineuse est du son de riz, de la pulpe de fruit de palmier, du podo ou des algues.

14. Procédé selon la revendication 12, dans lequel la partie contenant un triglycéride de la plante oléagineuse est une graine oléagineuse.

15. Procédé selon la revendication 14, dans lequel la graine oléagineuse est le soja, l'arachide, la graine de tournesol, la graine de colza, le maïs, la graine de jatropha, la graine de karanja, la graine de margousier, la graine de mahua, la graine de ricin, la graine d'hévéa, la graine de coton, l'amande de palmiste, l'olive, l'amande, la graine de babassu, la graine de Moringa oleifera, la graine de cardon, la graine de caméline, la graine de lin, la noisette, la graine de chènevis, la graine de moutarde, la graine de jojoba, la graine de pavot, la graine de carthame, la graine de sésame, la graine de blé, la graine de sal, la graine de crambe, la graine de cuphéa, la graine de nahor ou la graine de tabac.

16. Procédé selon la revendication 15, dans lequel l'ester alkylique d'acide gras contient une fraction acide en C6 à C24.

17. Procédé selon la revendication 16, dans lequel l'alcool est un alcool primaire ou secondaire en C1 à C8.

18. Procédé selon la revendication 17, dans lequel l'ester alkylique d'acide gras est un ester méthylique d'acide gras, un ester éthylique d'acide gras, un ester n-propylique d'acide gras, un ester isopropylique d'acide gras, un ester n-butylique d'acide gras, un ester isobutylique d'acide gras, un ester n-pentylique d'acide gras, un ester isopentylique d'acide gras, un ester néopentylique d'acide gras ou un ester n-hexylique d'acide gras.

19. Procédé selon la revendication 18, dans lequel l'ester alkylique d'acide gras et la partie contenant un triglycéride de la plante oléagineuse sont mis en contact à un rapport en poids allant de 1 : 2 à 10 : 1.

20. Procédé selon la revendication 19, dans lequel l'étape de mise en contact est réalisée à 15 à 180° C.

21. Procédé selon la revendication 20, dans lequel l'étape de mise en contact est réalisée à 25 à 150° C.

22. Procédé selon la revendication 12, dans lequel l'ester alkylique d'acide gras contient une fraction acide en C6 à C24.

23. Procédé selon la revendication 12, dans lequel l'alcool est un alcool primaire ou secondaire en C1 à C8.

24. Procédé selon la revendication 12, dans lequel l'ester alkylique d'acide gras est un ester méthylique d'acide gras, un ester éthylique d'acide gras, un ester n-propylique d'acide gras, un ester isopropylique d'acide gras, un ester n-butylique d'acide gras, un ester isobutylique d'acide gras, un ester n-pentylique d'acide gras, un ester isopentylique d'acide gras, un ester néopentylique d'acide gras ou un ester n-hexylique d'acide gras.

25. Procédé selon la revendication 12, dans lequel l'ester alkylique d'acide gras a un point d'ébullition de 150 à 500° C.

26. Procédé selon la revendication 12, dans lequel l'étape de mise en contact est réalisée à 15 à 180° C.

27. Procédé selon la revendication 12, dans lequel l'étape de mise en contact est réalisée à 25 à 150° C.

28. Procédé selon la revendication 12, dans lequel l'ester alkylique d'acide gras et la partie contenant un triglycéride de la plante oléagineuse sont mis en contact à un rapport en poids allant de 1 : 2 à 10 : 1.

29. Procédé selon la revendication 1, dans lequel l'alcool est un alcool primaire ou secondaire en C1 à C8.

REFERENCES CITED IN THE DESCRIPTION

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