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(CERTIFYING OFFICER)
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PROCESS FOR PRODUCING A REFINED PALM FRUIT OIL HAVING A REDUCED 3-MCPD CONTENT

FIELD OF THE INVENTION

The present invention relates to a process for producing a refined palm fruit oil having a reduced 3-MCPD content.

BACKGROUND OF THE INVENTION

Palm trees bear fruit in the third year after planting and continue producing for about 25 years. Fruit bunches of 4 to 20 kg contain 200 to 2000 individual fruits and are harvested throughout the year. The fruit bunches are transported to palm oil mills where crude palm oil is produced by mechanical and physical extraction processes along with palm kernels from which a further palm kernel oil can be produced. Typically, refined palm oil is produced from palm fruit by a multi-step process as described below.

Freshly cut fruit bunches are transported to the oil mill where they are sterilised to inactivate the lipolytic enzymes, loosen the fruit on the bunch, soften the fruit, condition the kernels, and cause protein to coagulate. The sterilisation process uses live steam at about 3 bar. Stripping the fruit from the sterilised bunches (threshing) is carried out in a rotating cage with bars that allow the fruits to pass through, but retain the empty bunches. The loosened fruit is collected by a screw conveyor below the cage and the empty bunches emerge at the end of the cage. The separated fruit is then fed to a digester, which is a cylindrical, steam-jacketed vessel kept at 90 to 100°C by the injection of live steam and the addition of hot water. It is fitted with beater arms that break up the fruit and liberate the oil. The digester contents are then fed continuously to a screw press that produces a liquid stream consisting of oil, fines and aqueous phase, and a press cake containing the fruit fibre residue and the palm kernels. The liquid stream is passed to a settling tank via a vibrating screen that returns what it retains to the digester. The oil recuperated from the settling tank is first of all passed through a clarifier and then dried (crude palm oil). The sludge collecting in the settling tank is passed to a decanter that separates this sludge into a heavy effluent phase and a light, oily phase that is

returned to the settling tank. The press cake emerging from the screw press is first of all broken up to separate the fibres from the nuts, then dried, and finally separated pneumatically.

Crude palm oil undergoes several refining steps to produce refined palm oil. Depending on whether the refined palm oil is produced by chemical (alkaline) refining or by physical refining, these refining steps include degumming, neutralization, bleaching and deodorisation above 200°C (chemical refining) or degumming, bleaching and deodorisation at 240-260°C (physical refining).

3-monochloropropane-1,2-diol (3-MCPD) esters have been found in all refined vegetable oils such as margarine and oils, and in fat-containing foods including infant formula. The 3-MCPD esters are formed at high temperatures during the refining of edible fats and oils, mainly during the deodorisation step. The main factors for the formation of 3-MCPD esters are the presence of chloride ions, glycerol, tri- di- or monoacylglycerides, as well as temperature and time *(ILSI Europe Report Series, 2009).*

Chloropropanols and their fatty acid esters (also known as chloroesters), are contaminants formed during the processing and manufacture of certain foods and ingredients. The formation of chloroesters may be widespread in processed foods derived from cereals, coffee, fish, meat, potatoes, nuts and refined oils. Chloroesters may occur in many ingredients that are processed by heat and the subsequent release of the chemical 3-MCPD from these materials during processing and storage needs to be considered *(Investigation of the formation of 3-MCPD from mono and di-esters of its fatty acids, Food Standards Agency).*

Studies have identified 3-MCPD fatty acid esters in refined oils, such as refined palm oil whereby 3-MCPD fatty acid esters are believed to be formed at high temperatures in the presence of water following a reaction between fats and chloride ions. In the refining of palm fruit oil and fractions of palm fruit oil, 3-MCPD fatty acid esters are believed to be formed predominantly during deodorisation (where the oil is heated up to more than 200°C), the last stage in refining wherein undesirable odorous and taste-bearing substances are removed. 3-MCPD esters are formed during deodorisation due to a thermal catalysed decomposition of organochlorine compounds naturally occurring in palm oil into reactive chlorinated compounds such as hydrogen chloride. These compounds can react with acylglycerols to yield MCPD diesters and also release the free fatty acids from the intact triglyceride molecule

(Destaillats, et al., 2012). Besides 3-MCPD fatty acid esters, 2-MCPD fatty acid esters and glycidyl fatty acid esters have also been identified in these refined palm fruit oils.

Since the first finding of 3-MCPD esters and related compounds in vegetable oils, different possibilities to minimize the formation during refining have been suggested, but only little information are available about precursors for the formation, but it is not clear yet how they act and whether a certain threshold value is necessary *(Effect of Different Precursors on the Formation of 3-MCPD Esters and Related Compounds, Federal Research Institute for Nutrition and Food, Germany)*.

Processing techniques that minimise formation of the 3-MCPD fatty acid esters before and during the refining of crude palm fruit oil products have been suggested in the prior art.

EP 2716746 A1 describes a method for producing crude palm oil from which free chlorine (which is a substance causing formation of 3-monochloropropane-1,2-diol (3-MCPD) fatty acid esters) is removed before the refining process via washing with water such ultra-pure water, distilled water, and/or deionized water, which contains no chlorine ions which enables the suppression of formation of 3-MCPD esters. This method produces crude palm oil with free chlorine content of 2 ppm or less and refined palm oil produced has a content of 3-MCPD fatty acid esters of 1 mg/kg or less. This current method does not provide a combined solution from oil palm processing to palm oil refining to produce a refined crude palm oil with low levels of 3-MCPD esters.

EP 2471897 A1 describes a method for reducing chloropropanols and a formative substance in bleached and deodorized palm oil with silica gel and reducing a glycidol fatty acid ester via ascorbic acid (organic acid) which produces content of chloropropanols and a formative substance in the refined palm oil of 4 ppm or less. This current method does not provide a combined solution from oil palm processing to palm oil refining to produce a refined crude palm oil with low levels of 3-MCPD esters.

WO 2011009843 A1 describes the process of purifying palm oil / palm stearin / palm oil with an inert gas (i.e. nitrogen) and a deodorization step for removing off-taste and off-odours to limit the formation of MCPD in the oil. A food product comprising of this deodorized oil should contain less than 950 µg of bound 3-MCPD per kg of extracted fat. This current

process does not provide a combined solution from oil palm processing to palm oil refining to produce a refined crude palm oil with low levels of 3-MCPD esters.

WO2012169718A1 describes a method of removing chlorine ions from tap water used in the refining process after the degumming, deoxidizing, bleaching and deodorizing processes. The edible oil manufactured will have a content of 3-MCPD of 0.3 ppm or less. This current method does not provide a combined solution from edible oil processing to refining to produce a refined edible oil with low levels of 3-MCPD esters.

EP 2502500 A1 describes a process to produce refined plant oil free of chlorinated contaminants from crude plant oil with use of liquid-liquid extraction with a polar solvent solution and a pre-treatment step of washing crude oil with acid. This process produces refined plant oil with MCPD content less than 1 ppm or preferably less than 0.3 ppm. This current process does not provide a combined solution from oil palm processing to palm oil refining to produce a refined crude palm oil with low levels of 3-MCPD esters.

WO 2015/174820 A1 relates to a process of refined palm fruit oil products that yields a refined oil product having an exceptional low content of 3-MCPD fatty acid esters. The process of refining a crude palm fruit oil products comprised of (a) removing phospholipids and/or free fatty acids from a crude palm fruit oil product (b) simultaneously or sequentially contacting the pre-treated palm fruit oil product with a bleaching earth and a porous silica material to produce a bleached palm fruit oil product, and (c) deodorizing the bleached palm fruit oil product to produce a refined palm fruit oil product at a temperature of not more than 240°C. This current method does not provide a combined solution from oil palm processing to palm oil refining to produce a refined crude palm oil with low levels of 3-MCPD esters.

WO 2014/081279 Al relates to a process of refining palm oil in order to produce low level of 3-MCPD fatty esters in refined palm oil. Accordingly, the process comprises the steps of water degumming of crude palm oil, removal of aqueous phase by centrifugation, followed by acid degumming at lower temperature. Subsequently, bleaching is conducted with an activated bleaching earth and silicate adsorbent (for example magnesium silicate, calcium silicate and aluminum silicate) as filter aid and final adsorption of the 3-MCPD fatty esters precursors prior to deodorization step. This current process does not provide a combined

solution from oil palm processing to palm oil refining to produce a refined crude palm oil with low levels of 3-MCPD esters.

WO 2012/165397 A1 describes a method for producing crude palm oil from which free chlorine has been removed from squeezed oil after squeezing in an oil-squeezing step and/or crude palm oil before purification in a purification step. The invention further provides for a crude palm oil in which a free chloride content is reduced to 2 ppm or less, and refined palm oil in which a content of 3-MCPD fatty acid esters is 1 mg/kg or less by refining the crude palm oil. This current method does not provide a combined solution from oil palm processing to palm oil refining to produce a refined crude palm oil with low levels of 3-MCPD esters.

There remains a need in the art to provide a combined method to remove the 3-MCPD precursors in the crude palm fruit oil stage to prevent formation of 3-MCPD esters during the refining stage, or to at least provide an alternative.

SUMMARY OF THE INVENTION

The present invention provides a process for producing a refined palm fruit oil having a reduced 3-MCPD content, the process including the steps of:

a. washing oil palm fresh fruit bunches (FFB) with water having a temperature of 0 to 100°C to produce washed oil palm FFB;
b. subjecting the washed oil palm FFB to sterilization, threshing, digestion and pressing to produce a crude palm fruit oil;
c. degumming of the crude palm fruit oil to produce a degummed palm fruit oil;
d. bleaching of the degummed palm fruit oil with a bleaching adsorbent to produce a bleached palm fruit oil; and
e. deodorising the bleached palm fruit oil at a temperature of not more than 260°C to produce a refined palm fruit oil.

Although the inventors do not wish to be bound by theory, it is believed that by washing the FFB before sterilisation, one or more 3-MCPD precursors are removed. These precursors (e.g. a chlorine source) are believed to be contained in contaminants (e.g. soil, trash, dirt, insects) that are carried on the surface of the FFB. By removing these contaminants prior to oil

extraction, the present process enables the production of refined palm fruit oil with reduced content of 3-MCPD esters.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a process flow diagram showing the general steps involved according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to **Fig. 1**, the present invention relates to a process for producing a refined palm fruit oil having a reduced 3-MCPD content, the process including the steps of:

a. washing oil palm fresh fruit bunches (FFB) with water having a temperature of 0 to 100°C to produce washed oil palm FFB;
b. subjecting the washed oil palm FFB to sterilization, threshing, digestion and pressing to produce a crude palm fruit oil;
c. degumming of the crude palm fruit oil to produce a degummed palm fruit oil;
d. bleaching of the degummed palm fruit oil with a bleaching adsorbent to produce a bleached palm fruit oil; and
e. deodorising the bleached palm fruit oil at a temperature of not more than 260°C to produce a refined palm fruit oil.

The term "water" as used herein in relation to the washing step, unless indicated otherwise, refers to an aqueous liquid such as tap water, surface water, ground water, spring water or treated waste water.

The term "oil" whenever used herein encompasses oils that are liquid, semi-solid or solid at 20°C. Typically, the crude palm fruit oil used in the present process contains at least 80 wt% triglycerides, more preferably at least 90 wt% of triglycerides. Examples of crude palm fruit oils that may be refined by the present process include crude palm oil, crude palm oil fraction, crude palm kernel oil, crude palm kernel oil fraction or combinations thereof. Preferably, the crude palm fruit oil is crude palm oil or crude palm oil fraction.

The total chlorine content of the crude palm fruit oil can be suitably determined by Mitsubishi NSX-2100 H, Trace Elemental Analyzer in accordance to standard ASTM D4929. The trace elemental analyzer is a furnace system with a micro-coulometric detector that was used for measuring and detecting total chlorine whether in organic or inorganic form.

A suitable analytical method for determining 3-MCPD fatty esters content of oils is described in AOCS Official Method Cd 29a-13. Glycidyl esters are converted to 3-monobromopropanediol (3-MBPD) monoesters in an acid solution containing a bromide salt. 3-MBPD esters, together with 2- and 3-MCPD fatty esters, are then converted into the free (non-esterified) form in acid methanolic solution. The fatty acid methyl esters generated during the reaction are extracted from the sample; 3-MCPD and 3-MBPD, are then derivatized with phenylboronic acid prior to GC-MS analysis.

Oil palm fresh fruit bunches (FFB) selected for the purposes of this invention typically have a free fatty acids (FFA) level of more than 3%.

In the present process oil palm FFB are washed with water to remove 3-MCPD precursor. Besides the oil palm FFB, loose oil palm fruitlets may also be subjected to this washing treatment.

Heated conditions are preferred for the washing of the FFBs (and loose oil palm fruitlets) as heated conditions will assist to wash and/or dilute the wax layer protecting the surface of the FFBs and loose oil palm fruitlets. Accordingly, the water employed to wash the FFB preferably has a temperature in the range of 30 to 90°C, more preferably in the range of 40 to 80°C and most preferably in the range of 50 to 70°C.

According to a particularly preferred embodiment of the present invention, the water used to wash the FFB is biologically treated discharge water, more preferably biologically treated discharge water that was discharged by an oil milling operation.

The biologically treated discharge water employed in the washing step preferably has a total alkalinity of 1,000-10,000 mg calcium carbonate ($CaCO_3$) per litre, preferably 500 to 5,500 mg $CaCO_3$ per litre, more preferably 750 to 4,500 mg $CaCO_3$ per litre and even more preferably 1,000 to 3,500 mg $CaCO_3$ per litre.

The period for washing the FFB preferably is in the timeframe of between 1 to 30 minutes, more preferably between 2.5 to 20 minutes, even more preferably between 3 to 10 minutes.

The washing of the FFB in the present process can be done in different ways. For instance, the FFB can be washed by spraying them with water. Alternatively, the FFB can be washed by submerging them in a water bath.

As explained herein before, the washing step employed in the present process is believed to remove contaminants from the surface of the FFB, which contaminants contain 3-MCPD precursors. In this context, examples of contaminants include soil, trash, dirt and insects. Preferably, the contaminants removed in the washing step are a source of chlorine.

The crude palm fruit oil obtained in the present process typically has a total chlorine content of 0 to 10 ppm. More preferably, the crude palm fruit oil contains 0 to 5 ppm total chlorine, even more preferably 0.25 to 3.5 ppm total chlorine, and most preferably 0.5 to 2 ppm total chlorine.

The crude palm fruit oil obtained in the present process typically contains 0.5 to 1.5% of FFA.

In this present process, the degumming step is preferably conducted at a temperature range of between 60°C to 120°C, preferably 70°C to 115°C, even more preferably 80°C to 110°C for a time period of between 1 to 30 minutes, preferably 5 to 25 minutes, even more preferably for 10 to 20 minutes using organic acid or mineral acid or any combination thereof. Longer degumming time period than what is proposed have been tested and deem not commercially feasible as it will affect the efficiency and throughput of the palm oil mills.

Regardless of any degumming agent used, the acid dosage according to this invention is between 0.01 to 0.12%, preferably 0.02 to 0.1%, even more preferably 0.03 to 0.08% for the removal of gums. The range of acids usually depends on the amount of gums (i.e. phospholipids / phosphatides) which are present in the crude palm oil. Common industrial practice of acid dosage is in the range of 0.04 to 0.08% with normal usage around 0.06%.

In accordance to this present invention, the degumming agent used is phosphoric acid with 80 to 95% concentration or citric acid with 30 to 50% concentration or any combination thereof. However, preferably the degumming agent used for this invention is citric acid with 30 to 50% concentration for the removal of the gums.

In the bleaching step of this present invention, a bleaching adsorbent is used in order to further remove any remaining contaminants, such as colour pigments, metal ions, oxidation products and chlorinated compounds to produce a bleached palm fruit oil.

The bleaching adsorbent used in this present invention is preferably selected from bentonite clay, palygorskite clay, montmorillonite clay, smectite clay or any combination thereof. Preferably, the bleaching adsorbent is in the form of naturally active clay, acid activated bleaching clay, thermal activated bleaching clay or any combination thereof. However, more preferably the bleaching adsorbent is in the form of thermal activated bleaching clay.

In accordance to this present invention, the amount of bleaching adsorbent used is between 0.5% to 3%, preferably between 0.75% to 2.5%, even more preferably between 1% to 2%, by weight of the degummed palm fruit oil. Normal practice by oil palm refineries uses the bleaching adsorbent dosage of between 0.08 to 1.2% depending on the quality of the crude palm oil. 2% is the highest dosage allowable because of the plant limitation at the refineries.

In accordance to this present invention, the degummed palm fruit oil is contacted with the bleaching adsorbent at temperatures between 85°C to 130°C, preferably between 90°C to 125°C, even more preferably between 95°C to 120°C for 10 minutes to 90 minutes, preferably for 15 minutes to 75 minutes and even more preferably for 20 minutes to 60 minutes.

In this present invention, the bleached palm fruit oil has a total chlorine content of between 0 ppm to 3 ppm, more preferably between 0.15 ppm to 2.5 ppm, even more preferably between 0.3 ppm to 2.0 ppm, prior to the deodorisation step.

In this present invention, deodorisation of the bleached palm fruit oil is preferably carried out at the temperature of 200-250°C to produce a refined palm fruit oil. Preferably, the bleached palm fruit oil is deodorised for 20-180 minutes, more preferably for 30-150 minutes.

Typically, the deodorisation according to the invention is carried out at a pressure of 5 mbar and below.

The standard current practice at the refineries uses phosphoric acid degumming approach together with acid activated bleaching clay. This present invention explores a combined effort from washing of FFBs at the mills prior to processing and at the refinery stage, uses phosphoric acid or citric acid for the degumming step and various bleaching adsorbent to produce the refined palm fruit oil with the lowest 3-MCPD content possible. This combined approach has not been described in known prior arts in this field of interest.

Advantageously, the present invention using the said combined approach produces a refined palm fruit oil with 3-MCPD content of between 0 to 1.5 ppm 3-MCPD esters, preferably 0 to 1 ppm 3-MCPD esters, more preferably 0 to 0.5 ppm.

The invention is further illustrated by the following non-limiting examples.

EXAMPLES

Example 1

CPO from unwashed FFBs

Crude palm oil (CPO) with free fatty acids of 4%, peroxide value (PV) of 4.47 meq O_2/kg, deterioration of bleachability index (DOBI) of 2.7 and total chlorine content of 5.0 ppm was degummed, bleached and deodorised as per details in Table 1.

Table 1

Processing Condition	**Experiment 1A**	**Experiment 1B**
Degumming	0.06% phosphoric acid at 85°C for 20 minutes	0.06% phosphoric acid at 85°C for 20 minutes
Bleaching	1.5% acid clay at 95°C for 30 minutes under vacuum	1.5% thermal clay at 95°C for 30 minutes under vacuum
Deodorisation	240 °C for 90 minutes Under vacuum	240 °C for 90 minutes Under vacuum

Sample Analysis		
Total Chlorine – Bleached Palm Oil	2.74 ppm	2.39 ppm
3-MCPD Ester (Refined Bleached Deodorised Palm Oil)	3.07 ppm	2.57 ppm

Example 2

CPO from washed FFBs

Fresh fruit bunches (FFBs) were selected based on their ripeness quality, indicated by the free fatty acid (FFA) content containing FFA of more than 3%. The FFBs were subjected to washing using biologically treated discharge water under heated condition of 60^{O}C and washing time of 4 minutes. The biologically treated discharge water used as a washing agent had a total alkalinity of 1204 mg.$CaCO_3$/L. Then the FFBs were sterilised using the mill's steriliser cage and extracted for its oil manually. The content of the crude palm oil of the washed FFBs were then tested and found to contain 0.89% FFA, 0 O_2 meq/kg, 3.15 DOBI and 0.77 ppm total chlorine.

Example 3

CPO from washed FFBs - Phosphoric Acid Degumming (Acid Clay vs Thermal Clay Bleaching)

The crude palm oil obtained from the washed FFB of Example 2 were then subjected to the refining process using two different types of bleaching clay as shown in Table 2.

Table 2

Processing Condition	Experiment 3A	Experiment 3B
Degumming	0.06% phosphoric acid at 85°C for 20 minutes	0.06% phosphoric acid at 85°C for 20 minutes
Bleaching	1.5% acid clay at 95°C for 30	1.5% thermal clay at 95°C for 30

	minutes under vacuum	minutes under vacuum
Deodorisation	240 °C for 90 minutes Under vacuum	240 °C for 90 minutes Under vacuum
Sample Analysis		
Total Chlorine – Bleached Palm Oil	1.05 ppm	0.85 ppm
3-MCPD Ester (Refined Bleached Deodorised Palm Oil)	0.65 ppm	0.42 ppm

Example 4

CPO from washed FFBs - Citric Acid Degumming (Acid Clay vs Thermal Clay Bleaching)

The crude palm oil obtained from the washed FFB of Example 2 were then subjected to citric acid degumming, acid clay and thermal clay bleaching and deodorisation as shown in Table 3.

Table 3

Processing Condition	**Experiment 4A**	**Experiment 4B**
Degumming	0.06% citric acid at 85°C for 20 minutes	0.06% citric acid at 85°C for 20 minutes
Bleaching	1.5% acid clay at 95°C for 30 minutes under vacuum	1.5% thermal clay at 95°C for 30 minutes under vacuum
Deodorisation	240 °C for 90 minutes Under vacuum	240 °C for 90 minutes Under vacuum
Sample Analysis		
Total Chlorine – Bleached Palm Oil	0.51 ppm	0.45 ppm
3-MCPD Ester (Refined Bleached Deodorised Palm Oil)	0.33 ppm	0.10 ppm

Summary Results

Example	Degumming & Bleaching Condition	Oil Analysis	
		BPO	RBDPO
		Total Chlorine (ppm)	3-MCPD Ester (ppm)
CPO from unwashed FFBs			
Example 1			
Experiment 1A	Phosphoric acid Degumming, 1.5% Acid Clay	2.74	3.07
Experiment 1B	Phosphoric acid Degumming, 1.5% Thermal Clay	2.39	2.57
CPO from washed FFBs			
Example 3A	Phosphoric acid Degumming, 1.5% Acid Clay	1.05	0.65
Example 3B	Phosphoric acid Degumming, 1.5% Thermal Clay	0.85	0.42
Example 4A	Citric Acid Degumming, 1.5% Acid Clay	0.51	0.33
Example 4B	Citric acid Degumming, 1.5% Thermal Clay	0.45	0.10

CLAIMS

1. A process for producing a refined palm fruit oil having a reduced 3-MCPD content, the process including the steps of:

a. washing oil palm fresh fruit bunches (FFB) with water having a temperature of 0 to 100°C to produce washed oil palm FFB;

b. subjecting the washed oil palm FFB to sterilization, threshing, digestion and pressing to produce a crude palm fruit oil;

c. degumming of the crude palm fruit oil to produce a degummed palm fruit oil;

d. bleaching of the degummed palm fruit oil with a bleaching adsorbent to produce a bleached palm fruit oil; and

e. deodorising the bleached palm fruit oil at a temperature of not more than 260°C to produce a refined palm fruit oil.

2. The process according to claim 1, wherein the FFB are washed with water having a temperature range of 30 to 90°C.

3. The process according to claim 1, wherein the FFB are washed with biologically treated discharge water having a total alkalinity of 1,000-10,000 mg calcium carbonate ($CaCO_3$) per litre.

4. The process according to claim 1, wherein the FFB are washed with water for 1 – 30 minutes.

5. The process according to claim 1, wherein the FFB are washed by spraying them with water or by submerging them in a water bath.

6. The process according to claim 1, wherein the degumming step is conducted at a temperature range of 60°C to 120°C.

7. The process according to claim 1, wherein the degumming uses organic acid or mineral acid or any combination thereof in a dosage range of 0.01 to 0.12%.

8. The method according to claim 7, wherein the mineral acid is a phosphoric acid with concentration in the range of 80 to 95% and the organic acid is a citric acid with concentration in the range of 30 to 50%.

9. The method according to claim 1, wherein the bleaching step is conducted at a temperature in the range of 85 to 130°C for 10 to 90 minutes;

10. The method according to claim 1, wherein the bleaching step uses bleaching adsorbent in the amount of between 0.5 to 3% by weight of the degummed palm fruit oil;

11. The method according to claim 10, wherein the bleaching adsorbent is selected from bentonite clay, palygorskite clay, montmorillonite clay, smectite clay or any combination thereof.

12. The method according to claim 11, wherein the bleaching adsorbent is a naturally active clay, acid activated bleaching clay, thermal activated bleaching clay or any combination thereof.

13. The method according to claim 1, wherein the crude palm fruit oil obtained from step (b) contains 0.5 to 1.5% free fatty acids.

14. The process according to claim 1, wherein the total chlorine content of the crude palm fruit oil of step b) is in the range of 0 to 5 ppm.

15. The process according to claim 1, wherein total chlorine content of the bleached palm fruit oil of step d) is in the range of 0 to 3 ppm.

16. The process according to claim 1, wherein 3-MCPD content of the refined palm fruit oil of step e) is in the range of 0 to 1.5 ppm.

17. The process according to claim 1, wherein the crude palm fruit oil is selected from crude palm oil, crude palm oil fraction and combinations thereof.

ABSTRACT

PROCESS FOR PRODUCING A REFINED PALM FRUIT OIL HAVING A REDUCED 3-MCPD CONTENT

Provided is a process for producing a refined palm fruit oil having a reduced 3-MCPD content, the process including the steps of:

a. washing oil palm fresh fruit bunches (FFB) with water having a temperature of 0 to 100°C to produce washed oil palm FFB;
b. subjecting the washed oil palm FFB to sterilization, threshing, digestion and pressing to produce a crude palm fruit oil;
c. degumming of the crude palm fruit oil to produce a degummed palm fruit oil;
d. bleaching of the degummed palm fruit oil with a bleaching adsorbent to produce a bleached palm fruit oil; and
e. deodorising the bleached palm fruit oil at a temperature of not more than 260°C to produce a refined palm fruit oil.

The most illustrative drawing: **FIG. 1**

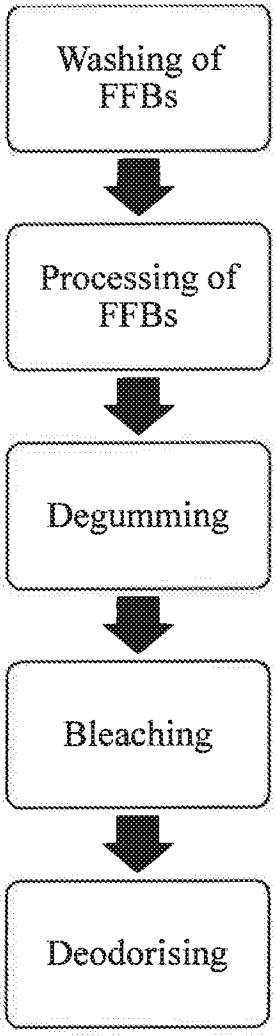
Washing of FFBs
Processing of FFBs
Degumming
Bleaching
Deodorising

FIG. 1