

A deodorized edible oil or fat with low levels of bound MCPD and process of making using an inert gas.

5 Field of the Invention

This invention relates to refining, purification, production and processing of edible oil or fat. The invention further relates to producing purified edible vegetable oil, such as palm oil, with a limited amount of bound MCPD
10 (monochloro propanediol esters).

Background to the Invention

Edible oils or fats are usually submitted to a number of process steps to transform the crude oil or fat into an elaborated product having a defined degree of purity,
15 and defined organoleptic properties.

These refining steps can include degumming, neutralization, bleaching, active carbon treatment, filtering, distillation and/or deodorization.
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In particular a deodorization step usually complements the refining of the oil or fat by removing the majority of the volatile substances. The undesired volatile substances, responsible for off-taste, and off-odours, are usually more volatile than triglycerides and can be removed by a deodorizing step.
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In a conventional deodorizing step, steam is injected into the oil or fat at high temperature (usually between 175 °C and 270 °C) and low pressure (typically under a vacuum of below 5 mbar).

Refined edible oil or fat is usually used in a number of food products. Refined oils, and in particular palm oil or fish oil are typical examples. The oils such as palm oil provide functionality in the food product and deliver the necessary lipids in the diet while delivering a particular profile of fatty acids. Also the oils serve as carriers for numerous lipid-soluble nutrients such as some lipophilic vitamins or for a number of desired flavours. In infant formula, for example, vegetable oils can represent up to 50% of the energy of the infant formula.

The invention below will be described in the context of edible vegetable oils as a non-limiting way of illustration. The invention however encompasses edible oils and fats of all sources (vegetable oils, animal fat, fish oil, milk derived fat, *etc*).

Edible oils and fats, and in particular vegetable oils, are highly susceptible to oxidation and may be an unfortunate carrier to lipophilic undesired flavors, odors or colored compounds. In particular it is often desirable to obtain fully refined and deodorized vegetable oil with a low level of free fatty acids. Being highly susceptible to oxidation, the free fatty acids, in particular polyunsaturated fatty acids, are known to induce undesired organoleptic properties. Similarly oils and fats can comprise a number of undesired molecules. The undesired compounds can be carried over from the crude oil and/or appear during the numerous processing steps of the oils: for example oils are often treated at high temperature. The combination of high temperature with the presence of particular compounds (e.g. oxygen or precursors of undesired compounds) can lead to finished oils having particular undesired compounds (generally referred to as “contaminants”).

While the aim of some process steps is to remove some undesired compounds, the same process steps can enhance the formation of other undesired compounds

in the finished product. Hence a careful balance has to be found between desired effects and presence of undesired contaminants.

For example, in many instances it is desirable to purify the native palm oil in order to remove carotenoid molecules that are responsible for a brown / orange color. Indeed obtaining a limpid oil is often of importance for the visual quality of the finished product. Carotenoids are however best removed by a treatment at a relatively high temperature (e.g. heat bleaching). Such treatment at high temperature (typically above 200 °C), although necessary, can promote the oxidation of the oil and of contaminating molecules. In turn these molecules, oxidized, may create off-flavors. A balanced process is therefore necessary to mitigate all undesired chemical reactions while inducing the desired purification. The parameters of such processes are of high complexity (e.g. temperature, pressure, sequence, duration, added reactants, characteristics of the native oils or fats, equipment design, *etc....*)

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Monochloro propanediol esters (MCPD esters) have been identified as process-induced minor components in fully refined fats and oils. They are mainly formed during the deodorisation step. Two isomers at least have been shown to be formed, *i.e.* 2- and 3-MCPD esters, the latter being the predominant isomer. All fully refined fats and oils contain 2- and 3-MCPD esters; however, palm-based oils are generally oils with a relatively high content of 2- and 3-MCPD esters. While the exact formation process of the MCPD esters has not been totally understood, it has been observed that the temperature of the process, in particular the steam deodorization process, has a large impact: the higher the temperature, the higher is the amount of bound MCPD found in the vegetable oil. In particular temperature above 180 °C, above 200 °C, above 240 °C or above 270 °C induce respectively higher formation of bound MCPD.

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Free 3-MCPD has been highlighted for its potential for adverse health effects and has been a subject of concern in regards to food products. It has recently been hypothesized that 3-MCPD esters could be at least partially hydrolysed into free 3-MCPD after ingestion. However there is currently no data indicating negative health effects of 3-MCPD esters (bound 3-MCPD) in food products.. Nevertheless, in view of the potential for hydrolysis to free 3-MCPD, some authorities may regard bound MCPD as undesirable molecules in food products such as infant formula. It is of interest to monitor the levels of bound 3-MCPD in food products, especially infant formulae. Similarly it is of interest to investigate means to control the formation of bound 3-MCPD during the process steps used for the purification of edible oil or fat. By extension, similar considerations could in theory be applied to bound 2-MPCD.

Limiting the presence of bound 3-MCPD in the refined oils might be achieved by a careful selection of the oil or fat source or of the type of oil or fat used. However, the supply of material with low bound MCPD is uncertain and so far, no palm-based oil with guaranteed low levels of MCPD esters is commercially available.

Limiting the formation of bound MCPD during the process steps is another route to be explored.

There is a need to obtain an oil or fat that is low in bound MCPD while being free of other contaminants or undesired molecules.

There is a need for an edible oil or fat that is low in bound MCPD while being fully refined and deodorized. Such oil or fat has to have a neutral odour, and/or no off-taste, and/or a limpid aspect, and/or a low level in free fatty acids.

There is a need for an edible oil or fat that is low in bound MCPD while preserving all the other desirable lipo-soluble nutrients.

- 5 There is a corresponding need for a process that keeps the level of bound MCPD to a minimum level in the finished oil or finished product.

There is a need for a process of purifying an edible oil or fat that removes, or limits the formation, of bound MPCD or of precursors of bound MCPD.

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There is finally a need for a process of purifying an oil or fat that leads to a low level of bound MCPD and has no off-odors and/or no off-taste and/or has a limpid aspect and/or has a limited level of free fatty acids.

- 15 In combination with the above needs, there is a need for obtaining oils or fats as described above and processes of making, that relates to a low levels of bound 3-MCPD as bound 3-MCPD has been described as the MCPD compound of highest interest.

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Summary of the Invention

- 25 The invention relates to a process for purifying an edible oil or fat. The process comprises a step of deodorization for removing off-taste, off-odours and other volatile environmental contaminants and a step of stripping the oil with an inert gas. The step of stripping is such as to limit the formation of bound MCPD in the oil or fat. The oil or fat, after the process, comprises an amount of 1000 µg or less of bound MCPD per kg of oil or fat.

In a first aspect the present invention provides a vegetable oil, preferably palm oil or olein or stearin, derived from palm, that has a low content in bound MCPD while having no off-odours, off-flavors and/or having a low level in free fatty acids acceptable level of environmental contaminants.

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In a second aspect, the present invention provides a food product, preferentially an infant formula, baby food, infant cereal or enteral nutritional composition that comprises the cited oil or fat while being fully adequate for the nutrition of the targeted babies, infants or patients. By extension the invention can relate to any

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type of food and beverages comprising edible oils or fats.

Detailed Description of the Invention

15 Definitions: In this specification, the following terms have the following meanings:-

“infant” means a child under the age of 12 months.

20 “Babies” usually refers to young children below the age of 3.

“infant formula” is a nutritional composition intended for infants and babies. Infant formula can be complete nutritional compositions, *i.e.* able to fulfil all nutritional needs of the targeted infants or babies or can be complemented with

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other food.

“Enteral nutritional compositions” relate to nutritional products administered enterally, orally or by tube feeding to children or adults having particular

nutritional needs. Usually those children or infants are most fragile patients (illness, infection,...) and require specific nutrition.

5 “probiotic” means microbial cell preparations or components of microbial cells with a beneficial effect on the health or well-being of the host. (Salminen S., Ouwehand A., Benno Y. *et al* “Probiotics: how should they be defined”, Trends Food Sci. Technol. 1999:10 107-10).

10 “MCPD” for the purpose of the present invention the term “MCPD” means “monochloro propanediol” and any of the molecule known under the chemical name 3-monochloro-1,2-propanediol and/or 2-monochloro-1,3-propanediol and/or 1-monochloro-2,3-propanediol. Three isomers of MCPD are known in theory and are comprised in the general term “MCPD” : 3-MCPD, 2-MCPD, 1-MCPD. The 3 isomers have the chloride molecule on respectively the *sn*-3, *sn*-2
15 and *sn*-1 position of the glycerol backbone. 3-MCPD (3-monochloro-1,2-propanediol) (MW 110.54) is a colourless, slightly oily liquid with a boiling point of 213 °C. It is soluble in water and miscible in ethanol, acetone and diethyl ether. 1,3-DCP (1,3-dichloro-2-propanol) (MW 128.99) is a liquid with a boiling point of 174.3°C. It is soluble in water and miscible with ethanol and
20 diethyl ether.

“bound MCPD”: for the purpose of the invention “bound MCPD” corresponds to the MCPD residues that are esterified to fatty acids. It is corresponding to the amount of MCPD which can be released from any type of MCPD esters by
25 hydrolysis. The quantity of bound MCPD is conventionally differentiated through the measurements between bound 2-MCPD and bound 3-MCPD.

“MCPD esters” are molecules comprising bound MCPD residues.

“Bound 3-MCPD”: for the purpose of the invention “bound 3-MCPD” corresponds to the amount of 3-MCPD that can be released from 3-MCPD esters (3-monochloro-1,2-propanediol esters) by hydrolysis.

- 5 Bound MCPD can be determined by any described method and in particular by the method described below.

All references to percentages are percentages by weight unless otherwise stated.

10 Process of the invention :

The process of the invention is aimed at purifying a vegetable oil or fat. The oil or fat of the invention can be intended for human or animal consumption. The oil or fat of the invention is preferably palm-derived oil. Indeed such oil source has been shown to both (a) comprise a relatively high level of bound MCPD when
15 processed conventionally and (b) be of significant economical value as palm oil and its derivatives are widely used in a number of food and feed products. Particularly suited for the invention is palm oil, palm olein and palm-stearin: They have been shown to exhibit an elevated level of bound MCPD in conventional processes. The inventors have shown that various sources of oil are
20 susceptible to lead to various content in bound MCPD. It is hypothesized that some vegetable oils contain impurities or contaminants in higher amount that can be precursors of MCPD or can enhance their formation during conventional processes. Fats and oils of various sources (vegetal or animal) have been shown to be of interest in the context of the present invention: The list of oils and fats of
25 interest for the present invention comprises Palm Oil, Palm Olein, Palm Stearin, Palm Kernel, Medium Chain Triglyceride Oil (MCT), Anhydrous Milk Fat, Butteroil, and Fish Oil. On the contrary other oils are relatively low in bound MCPD after conventional processes: for example some animal fats extracted from tissue, Borage Oil, Blackcurrant Seed Oil, Butteroil, Cocoa Butter, Corn

Oil, Cottonseed Oil, High Oleic Sunflower Oil, Mid Oleic Sunflower Oil, Peanut Oil, Rapeseed Oil (low erucic acid), Low Linolenic Acid High Oleic Acid Rapeseed Oil, Olive Oil, Rice Bran Oil, Safflower Oil, High Oleic Safflower Oil, Sesame Seed Oil, Sunflower Oil, Coconut Oil, Soybean Oil, and Wild Fats used
5 for manufacturing cocoa butter equivalents.

The purification process of the invention comprises a step of stripping the oil with an inert gas. Stripping conventionally consists of contacting the oil with a gas, usually steam, in such a way that the gas can extract or entrain the most
10 volatile components and/or impurities and/or contaminants from the oil. A typical stripping is made by bubbling / injecting a gas under pressure under the surface of the oil. Conventionally pressure, time of stripping, design of equipment and temperature are key process parameters. Stripping is usually performed at relatively high temperature. Oil stripping can be performed at temperature above
15 140 °C, above 180 °C, above 200 °C, 240 °C or 270 °C in order to remove specific undesired molecules or impurities from the oil. It is usually performed at a temperature below 270°C.

In one embodiment of the invention the stripping is performed by nitrogen as the
20 inert gas. Other inert gases are contemplated within the scope of the invention (such as Argon or Xenon).

The invention comprises a step of deodorization. Deodorization can be considered as a particular way of stripping an oil: the deodorization is made with
25 the specific aim of reducing off-tastes, off-odors, free fatty acids and certain environmental contaminants. Conventionally deodorization of oils or fats is performed by a flow of steam (water in gaseous form). Deodorization with nitrogen has been described with the specific intend to have mild deodorization conditions. However deodorization with nitrogen has not been described together

with the specific action of preventing the formation of bound MCPD in the processed oil or fat. Also the described nitrogen deodorization does not maintain process parameters that are sufficiently stringent to enable an efficient deodorization. In the process of the invention the stripping step limits the formation of bound MCPD in the oil or fat, such as the oil or fat, after the process, comprises an amount of 1500 µg or less, 1000 µg or less, 800 µg or less, 750 µg or less, 500 µg or less, 250 µg or less, 100 µg or less, of the bound MCPD per kg of oil or fat (weight/weight). Specifically the bound 3-MCPD in the oil or fat, after the process, comprises an amount of 1450 µg or less, 950 µg or less, 800 µg or less, 700 µg or less, 500 µg or less, 250 µg or less, 100 µg or less, of the bound MCPD per kg of oil or fat (weight/weight). The inventors believe that while the lower the MCPD the better, achieving a level of 1000 µg or less per kg of oil represents a good compromise between the various quality parameters of the processed oil (low free fatty acid content, no off-flavors or off-odors, low impurities, *etc.*....).

While the stripping step with an inert gas and the deodorization step can be performed in 2 separate process steps under different process conditions (temperature, duration, pressure,...), one preferred embodiment of the present invention combines stripping and deodorization in one single unique step: the stripping with the inert gas, preferentially nitrogen, and the deodorization occur concomitantly under the same process conditions (duration, temperature, pressure,...). In that embodiment the deodorization is made under the (same) inert gas, preferentially nitrogen. The deodorization thus occurs due to the stripping with the inert gas.

In one embodiment one step of the process of the invention (*i.e.* the stripping steps and/or the deodorization step) is operated at a temperature of more than 140 °C, preferentially more than 180 °C. The temperature must be sufficiently

high to allow for (a) low viscosity and (b) a efficient removal of contaminants, impurities and/or undesired compounds from the oils. These compounds or molecules will in most instances been removed according to their volatility.

5 In one embodiment the whole process, the stripping step and/or the deodorization step is performed for a duration of less than 5 hours, less than 2 hours or less than 1 hour. Mild process conditions and/or fast process may help to prevent the formation of undesired compounds such as bound MCPD.

10 The bound MCPD can be present in the crude oil before the refining process, can have been formed during a previous process such extraction, purification, storage, *etc.*... . Additionally the inventors have found that bound MCPD are mainly formed during the deodorization process, in particular conventional steam deodorization process. Without being bound by the theory, it has sometimes been
15 hypothesized that the chloride present in water (regular industrial water) used for the conventional steam deodorization can, under adequate pressure and temperature, trigger the formation of bound MCPD. This may however not be the only cause of formation of MCPD esters. It is indeed hypothesized that the formation of MCPD esters is governed by at least 4 variables:

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- The mono- and diglyceride content
 - The chloride content
 - The proton activity
 - Carriers, e.g. carotenoids, tocotrienols, tocopherols, to bring the chloride in close contact with precursors to form bound MCPD during
25 processing.

It is believed that the rate of formation will be based on the energy brought. If enough energy is brought, the reaction can take place as the 4 variables will get enough energy to interact together to form MCPD esters. Energy is brought according to the deodorisation temperature. Protons are certainly liberated by the

steam, or when the steam is getting in contact with the oil at high temperature. The use of an inert gas could allow to decrease the proton activity and as a result to limit the MCPD ester formation.

5 In one embodiment of the invention the stripping or deodorization conditions (temperature, duration, time, pressure, equipment design,) are sufficiently stringent to form, at least partially, the bound MCPD identified in the processed oil. In one embodiment the bound MCPD is formed, at least in part, during the deodorization step.

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In one embodiment the process of the invention is characterized by a reduction of bound 3-MCPD of at least 2 folds, at least 3 folds, at least 5 folds or at least 10 folds, when compared to a conventional purification process (of the same oil) that comprises a conventional steam deodorization but does not comprise the step of stripping with an inert gas.

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In one embodiment of the invention the stripping step (and/or the deodorization step) comprises a step of contacting the vegetable oil with the inert gas under a vacuum of less than 50 mbar, preferentially less than 10 mbar, less than 5 mbar or less than 2 mbar.

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In one embodiment the invention relates to a process wherein the stripping and/or deodorization is operated at a temperature sufficient to induce the formation of bound MCPD in the oil or fat. Preferably said step(s) is/are performed at a temperature between 140 °C and 270 °C, most preferably between 180 °C and 250 °C. The correct balance in the process conditions have indeed to be found for eliminating the undesired compounds (*i.e.* temperature and/or other process conditions sufficiency stringent), while minimizing the formation of other

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undesired compounds such as bound MCPD (that formation being usually correlated with temperature or stringency of the process).

In one embodiment the flow of inert gas enables to establish a balance in the process conditions that would not be otherwise possible (by lowering the formation threshold of bound MCPD). Indeed the inert gas is believed to suppress one source of possible formation of the bound MCPD in comparison to the steam deodorization (*i.e.* the formation intermediated by the presence of chloride in steam water).

10 Edible oil or fat of the invention :

By some aspects the edible oil or fat of the invention relates to an oil or fat that is deodorized (*i.e.* that exhibits the intrinsic properties of a deodorized oil) and that comprises less than 1000 µg of bound MCPD per kg of deodorized oil or fat, preferentially less than 750 µg of bound MCPD per kg, most preferably less than 500 µg, less than 250 µg or less than 100 µg per kg (weight/weight).

The invention also relates to an oil or fat that is deodorized (*i.e.* that exhibits the intrinsic properties of a deodorized oil) and that comprises less than 950 µg of bound 3-MCPD per kg of deodorized oil or fat, preferentially less than 700 µg of bound 3-MCPD per kg, most preferably less than 500 µg, less than 250 µg or less than 100 µg per kg (weight/weight).

It is believed that through conventional processes, the refined/purified oil or fat does most of time always inherently acquire a relatively high level of bound MCPD. Indeed their process conditions (such as the use of steam deodorization or inert gas deodorization followed by other drastic conventional process) always triggers the formation of bound MCPD at a significant rate. Further, conventional fractionation can partition MCPD esters preferably in the olein fraction.

In one embodiment the deodorized oil or fat comprises less than 0.5 g of free fatty acids per 100 g of oil or fat, preferably less than 0.25 g, less than 0.2 g, less than 0.1 g or less than 0.05 g. The presence of free fatty acids and their quantity is a good indicator of the deodorization process that the oil or fat was submitted to. It is particularly relevant for oil refined physically using for example a bleaching treatment (so-called bleached-deodorized or "RBD"). However in one embodiment using chemically refined oils (so-called "neutralized-bleached-deodorized", NBD) the reduction of free fatty acids is also of importance. Without being bound by the theory it is believed that obtaining both a low free fatty acid and a low bound MCPD content is not possible in a conventional process.

In one embodiment the oil or fat comprises less than 0.5 g of moisture per 100 g of vegetable oil, preferably less than 0.25 g or less than 0.1 g. The moisture content can also be an indicator of the stringency of the process parameters and obtaining both a low moisture content and a low bound MCPD level may not conventionally possible, even further with a low level of free fatty acid.

In one embodiment of the invention the deodorized oil is a processed vegetable oil derived from palm, preferably palm oil, palm olein and/or palm-stearin.

Product of the invention :

In one embodiment the invention relates to a food product that comprises the deodorized oil or fat described above. The food product is preferably an infant formula, baby food, and/or infant cereal and/or enteral nutritional composition. The food product can however be selected from any food product for which the level of bound MCPD is critical to be maintained at a low level. In one embodiment the food product comprises an amount between 0.2% and 35% (weight/weight), preferentially between 1% and 30%, or between 1% and 10%

(weight/weight) of the oil or fat of the invention. The food product according to the invention can comprise an amount of 1000 µg or less, 900 µg or less, 750 µg or less, 500 µg or less, 250 µg or less, 100 µg or less of bound MCPD per kg of extracted fat (in case of a food product, the amount of bound MCPD is calculated over the amount of fat extracted from the product to take into account that not all fat can be extracted). The food product according to the invention can comprise an amount of 950 µg or less, 850 µg or less, 700 µg or less, 500 µg or less, 250 µg or less, 100 µg or less of bound 3-MCPD per kg of extracted fat.

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Other components of the invention :

In one embodiment the food product comprises probiotics, preferably live probiotics. The probiotics can be present in the food product at a dose of from 10^3 to 10^{12} colony forming units (cfu), more preferably from 10^5 to 10^8 cfu per gram of food product. Without being bound by the theory is hypothesized that bound MCPD can affect the survival of the live probiotics in the food product. Hence there is an advantage at keeping a low bound MCPD level in food product comprising probiotics such as infant formula with probiotics. Probiotics can be those conventionally described for food products in the literature.

In one embodiment the food product comprises prebiotics. Prebiotics can synergistically enhance the survival rate of the probiotics.

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Other chloropropanols:

Monochloro propanediols (MCPD) belongs to a group of chemicals called chloropropanols. Other chloropropanols include di-chloro-propanols (DCP), such as 1,3-dichloro-2-propanol (1,3-DCP) and 2,3-dichloro-2-propanol (2,3-DCP). Without being bound by the theory it is believed that DCP can be formed in foods as a result of processing conditions when edible oils and fats are processed under stringent conditions. The mechanism for their formation is however not

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fully understood. The present invention has been described in the context of MCPD. By extension it is believed that the principle, concept, embodiments, processes and products of the present invention can apply to DCP. Indeed DCP and MCPD are chemically related and can have similar reactivity. Their formation processes can hence be closely related. Similarly their reduction or limitation in edible oils and fats or products made there from can be closely related. Similar considerations apply to bromopropanols and derivatives thereof.

The invention will now be further illustrated by reference to the following examples:

Example 1

Process:

The oil is deodorized using steam and/or submitted to a stripping using nitrogen as stripping medium. A laboratory scale deodorizer mimicking industrial scale deodorizer was used. It consists of a glass flask filled with the oil to be deodorized. With the help of a jacket heater the oil in the flask can be heated up to the required deodorization temperature. The flask is connected to a vacuum pump to provide the necessary vacuum (<4 mbar). An air-cooled glass trap is placed between the flask and the vacuum pump to hamper the volatiles entering the pump.

The gas injection device is a glass device comprising a chamber to hold water for steam supply and a long capillary protruding into the oil through which the stripping medium (steam or nitrogen) is introduced into the oil. As stripping medium steam, or nitrogen were used:

- Steam is provided through a capillary from a water reservoir also connected the deodorizer under vacuum. Due to the low absolute pressure water evaporates and is thus injected into the heated oil.

- Nitrogen is provided by a gas cylinder connected to the deodorizer.

As starting vegetable oil, crude palm oil was used (ref 701062-001 from Golden Jomalina Food Industries, Selangor Danul Ehsan, Malaysia). The Crude palm oil was conventionally bleached using:

- 0.5% Trisyl® Silica (adsorbent, W.R Grace)
- 2% Tonsil Supreme 110FF (filtration aid, Süd Chemie)

Deodorization / stripping parameters:

- Oil quantity: 350 g oil (Crude palm oil ref 701062-001 from Golden Jomalina Food Industries, Selangor Danul Ehsan, Malaysia, bleached as indicated above).
- Deodorization parameters: 235 °C, 3 h, 2-3 mbar, heating to the deodorization temperature: ca. 15 min, cooling of the stripped oil to 50 °C: ca. 45 min
- Stripping medium:
 - Steam (11 g or 0.3% based on oil), injected as long as the oil is under vacuum
 - Nitrogen, injected as long as the oil is under vacuum (low temperature liquified Nitrogen, available from Pangas, Dagmersellen, Switzerland).

Table 1: Comparison of the content in bound 3-MCPD and bound 2-MCPD of bleached palm oil stripped with steam and nitrogen, respectively.

Stripping medium	Bound 3-MCPD (µg/kg)	Bound 2-MCPD (µg/kg)
Steam (trial n°1)	1340	660
Steam (trial n°2)	1230	510
Nitrogen (trial n°1)	780	420

Nitrogen (trial n°2)	710	500
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The “steam stripping” samples are representative of a conventional oil or fat.

The “nitrogen stripping” samples are representative of the oil of fat of the invention. The starting material is conventionally bleached palm oil, of
 5 conventional commercial source.

Resulting oil:

The oil has a clear / neutral / limpid aspect without visible inclusions or impurities. The oil has a no off-flavors or off-taste as assessed by a panel of
 10 trained experts. The free fatty acid content in the oil is less than 0.1 g FFA /100 g oil expressed as palmitic acid. The oil has a moisture content of less than 0.1 g moisture/100 g oil. The oil is according to the invention and comprises 780 µg/kg and 710 µg/kg of bound 3-MCPD. Other samples have shown values of
 220 µg/kg and 440 µg/kg of bound 3-MCPD.

Example 2

An infant formula is prepared with the vegetable oil of the invention: This composition is given by way of illustration only. The protein source is a mix of
 20 casein and whey protein (60% - 40%). The fat portion comprises 30% of palm olein.

Nutrient	per 100kcal	per litre
Energy (kcal)	100	670
Protein (g)	1.83	12.3
Fat (g)	5.3	35.7
Linoleic acid (g)	0.79	5.3
α -Linolenic acid (mg)	101	675
Lactose (g)	11.2	74.7
Prebiotic (100% GOS) (g)	0.64	4.3
Minerals (g)	0.37	2.5
Na (mg)	23	150

K (mg)	89	590
Cl (mg)	64	430
Ca (mg)	62	410
P (mg)	31	210
Mg (mg)	7	50
Mn (µg)	8	50
Se (µg)	2	13
Vitamin A (µg RE)	105	700
Vitamin D (µg)	1.5	10
Vitamin E (mg TE)	0.8	5.4
Vitamin K1 (µg)	8	54
Vitamin C (mg)	10	67
Vitamin B1 (mg)	0.07	0.47
Vitamin B2 (mg)	0.15	1.0
Niacin (mg)	1	6.7
Vitamin B6 (mg)	0.075	0.50
Folic acid (µg)	9	60
Pantothenic acid (mg)	0.45	3
Vitamin B12 (µg)	0.3	2
Biotin (µg)	2.2	15
Choline (mg)	10	67
Fe (mg)	1.2	8
I (µg)	15	100
Cu (mg)	0.06	0.4
Zn (mg)	0.75	5
<i>Lactobacillus reuteri</i> DSM 17938	2.10 ⁷ cfu/g of powder	

A comparison between some commercial infant formulae and the infant formulae A and B according to the invention is shown in the below table. The infant formulae A and B are based on the above description and differ by the commercial source of the oil. The expected values of bound 3-MCPD and bound 2-MCPD are provided in the below table.

Description	results mg/kg of extracted fat	
	Bound 3-MCPD	Bound 2-MCPD
Commercial Infant Formula 1	1.73	0.50
Commercial Infant Formula 2	2.25	0.76
Commercial Infant Formula 3	3.13	1.13
Commercial infant Formula 4	3.12	1.34
Infant Formula A according to invention	Total MCPD:	1mg/kg
Infant Formula B according to invention	Total MCPD:	0.75mg/kg

Analytical methods

Measurement of bound MCPD in fats and oils:

- 5 The quantification of bound MCPD is executed by capillary gas chromatography with mass spectrometric detection, deuterated 3-MCPD as internal standard and 1-palmitoyl-2-stearoyl-3-chloropropane as recovery. The method follows the teaching of V. Divinová, B. Svejková, M. Doležal, J. Velíšek in Czech J. Food Sci. 22(5), 182-189 (2004), "*Determination of Free and Bound 3-Chloropropane-1,2-diol by Gas Chromatography with Mass Spectrometric Detection using Deuterated 3-Chloropropane-1,2-diol as Internal Standard*".
- 10 This publication describes the hydrolysis (methanolysis) procedure of the MCPD esters. Prior to the methanolysis step the oil to be analyzed is washed with water in a liquid liquid extraction with hexane. The derivatization of the hydrolyzed MCPDs is done with heptafluoro-butyrylimidazole (HFBI) described by M-C. Robert, J-M. Oberson, R. Stadler. "*Model Studies on the Formation of Monochloropropanediols in the Presence of Lipase*", J. Agric. Food Chem. 52, 5102-5108 (2004). The accuracy of the method for dosing bound MCPD is estimated at about $\pm 15\%$. When measuring a complete food product, the
- 15 quantification of bound MCPD is made as out of the total fat extracted from said food product.
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Claims

- 5 -1- The process of purifying an edible oil or fat comprising a step of stripping said oil with an inert gas and comprising a step of deodorization for removing off-taste and off-odours, characterized by said stripping step limiting the formation of bound MCPD in said oil or fat, such as said oil or fat, after said process, comprises an amount of 1000 µg or less of said bound MCPD per kg of oil or fat.
- 10 -2- The process of claim 1 wherein said oil is an edible vegetable oil.
- 15 -3- The process of any of the preceding claims wherein said as said oil or fat, after said process, comprises an amount of 950 µg or less of said bound 3-MCPD per kg of oil or fat.
- 20 -4- The process of claim 1 wherein said stripping step and deodorization step are operated in one concomitant process step wherein said deodorization occurs due to said stripping with said inert gas.
- 25 -5- The process of any of the preceding claims wherein said stripping step and/or said deodorization step is operated at a temperature of more than 140 °C, preferentially more than 180 °C.
- 6- The process of any of the preceding claims wherein said bound MCPD is formed, at least in part, during the deodorization step.
- 7- The process of any of the preceding claims wherein said step limiting the formation of bound MCPD is characterized by a reduction of bound 3-MCPD of at least 2 folds when compared to a conventional purification process that

comprises a conventional steam deodorization but does not comprise said step of stripping with said inert gas.

-8- The process of any of the preceding claims wherein said inert gas is nitrogen.

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-9- The process of any of the preceding claims wherein said oil is palm oil or palm olein or palm stearin.

-10- The process of any of the preceding claims wherein said stripping comprise the step of contacting said edible oil or fat with said inert gas under a vacuum of less than 50 mbar, preferentially less than 10 mbar.

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-11- The process of any of the preceding claims wherein said stripping and/or said deodorization is operated at a temperature sufficient to induce the formation of MCPD in said oil or fat, preferably between 140 °C and 270 °C, most preferably between 180 °C and 250 °C.

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-12- A deodorized edible oil or fat comprising less than 1000 µg of bound MCPD per kg of said deodorized edible oil or fat, preferentially less than 750 µg of bound MCPD per kg.

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-13- The edible oil or fat of claim 12 comprising less than 950 µg of bound 3-MCPD per kg of said deodorized edible oil or fat, preferentially less than 700 µg of bound 3-MCPD per kg.

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-14 - The deodorized oil or fat of claim 12 or 13 wherein said oil or fat has less than 0.5 g of free fatty acids per 100 g of oil or fat.

-15- The deodorized oil of claims 12 to 14 wherein said edible oil comprises deodorized palm oil or palm olein or palm stearin.

5 -16- A food product comprising the deodorized edible oil or fat of claim 12 to 15 in an amount between 0.2% and 35% (weight/weight), preferentially between 1% and 30% (weight/weight), and wherein said food product comprises less than 950 µg of bound 3-MCPD per kg of extracted fat.

10 -17- The food product of claim 16 wherein said food product is an infant formula, baby food, infant cereal or an enteral nutritional composition.