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14th May 2016

Deputy Director of Customs
Preventive Directorate,
Customs House,
No. 40, Main Street,
Colombo 11.

Through : Dean, Faculty of Agriculture, University of Peradeniya, Peradeniya.

Dear Sir/Madam,

Report on Samples Declared as Crude Palm Fatty Acids

1.0 General Description about palm oil, lipid composition and refining of palm oil

Crude palm oil is obtained from the thick fleshy mesocarp of oil palm fruit (*Elaeis guineensis*) whereas the palm kernel oil is derived from the kernel of the same fruit. It has semisolid consistency at ambient temperature (20-30 °C).

Major constituents or lipid classes of fresh palm oil are triacylglycerols (Figure 1) (over 90-95% also known as triglycerides) and rests of the minor constituents are diacylglycerols (DAG), monoacylglycerols (MAG) and free fatty acids (altogether 5-10%). Triacylglycerol is a glycerol molecule esterified with three fatty acids (structure is given below). Palmitic (44-45%, C16:0), Oleic (39-40%, C18:1) and linoleic acid (10-11%, C18:2) are major fatty acids that can be found in acylglycerol molecules (TAG, DAG and MAG).

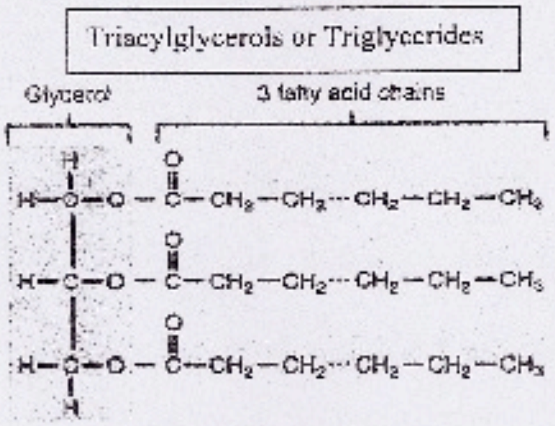

Figure 1. Structure of a triacylgycerol molecule

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Free fatty acids and glycerol are formed from the acylglycerols (TAG, DAG and MAG) with the help of the enzyme lipase in the presence of moisture (Figure 2). Due to formation of free fatty acids, oil becomes more acidic and quality is impaired. Therefore, often maximum allowable limits are set by various regulatory agencies (CODEX, Sri Lankan Food Act, Agri Food Canada, USDA etc.). Nevertheless, the acid content of edible oils is given by the quantity of free fatty acids deriving from the hydrolytic reactions of acylglycerols. As this alteration occurs in unsuitable conditions for the processing and preservation of oils, free fatty acids represents a basic indicator of the genuineness of the product.

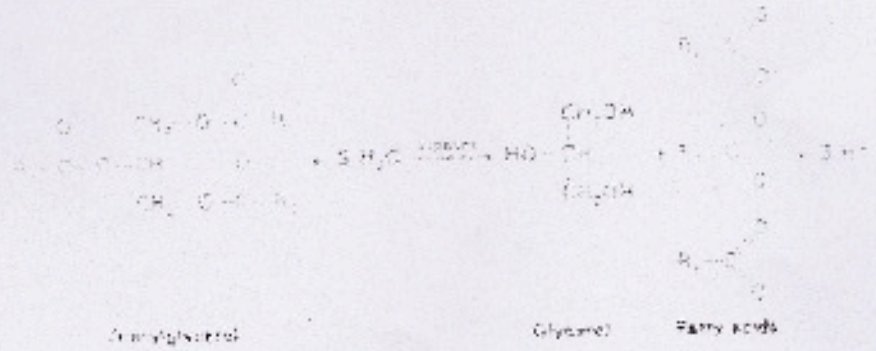

Figure 2. Hydrolysis of triacylglycerol molecule to produce free fatty acids

Crude palm oil is mainly produced from palm fruit by cooking, pressing and clarification. To become acceptable for human consumption, crude oils must be further purified. Nevertheless, a light color, a bland taste and a good oxidative stability are expected in the refined product usually known as refined bleached deodorized oil (RBD oil). Therefore, the main objective of the refining is to remove objectionable constituents such as free fatty acids, pigments, other volatile substances from the oil while maintaining least possible damage and minimal losses of the desirable components (TAG, DAG, MAG).

The maximum free fatty acids content set by the Palm Oil Refiners Association of Malaysia in crude palm oil and refined bleached deodorized oil are 5% and <0.1%, respectively. According to the Food Act No. 26 of 1980; Food (Standards) Regulations of 1989 in Sri Lanka, edible palm oil which is recommended for human consumption should not contain more than 0.1% free fatty acids.

Alkali refining, physical refining (steam distillation) and membrane filtration (microfiltrated using a microfilters) are the major methods that have been used for edible oil refining purpose. In alkali refining process, free fatty acids are converted into water soluble soaps which are removed by separators. Physical Refining method is employed to remove free fatty acids using steam distillation technique at warm temperature and under high vacuum. In all these methods free fatty acids are removed from the crude palm oil and remaining oil is subjected to further purification steps in order remove substances which are responsible for colour, odour etc.,

2.0 Incorrect nomenclature given for the imported product (which is claimed as "Crude Palm Fatty Acid")

According the importer, this product has been claimed as "Crude Palm Fatty Acid (CPFA)" and general analysis report supplied by the ABLE PERFECT SDN BHD indicated that CPFA contains 20.2% free fatty acids. Moreover, the importer had claimed that CPFA was recovered from the top of the distillation column during the distillation process. This is scientifically not acceptable and during physical distillation process, free fatty acids is removed from the crude palm oil and separated as **Palm Fatty Acids Distillate** (PFAD). Such kind of Palm Fatty Acid Distillate usually contains minimum amount of 70% free fatty acids. The remaining refined palm oil is further purified to produce Refined Bleached Deodorized (RBD) palm oil. Hence, claiming the product as CPFA is not acceptable.

3.0 Incorrect analytical report submitted by the ABLE PERFECT SDN BHD, Malaysia

According the "General Analysis of Crude Palm Fatty Acid" report, the product contains 20.2% free fatty acids and again item numbers 5-9 listed as various kinds of fatty acids. Usually in an analytical report it could indicate the composition of various lipid classes such as triacylglycerols, diacylglycerols and monoacylglycerols, free fatty acids and phospholipids or else total fatty acid composition as individual fatty acids (percentage each fatty acid). It is unclear how this particular report was generated by indicating incompatible components. Items 2-4 are listed as tri- **unsaturated** esters of fatty acids, di-**unsaturated** esters of fatty acids and mono-**unsaturated** esters of fatty acids. Such kinds of lipids do not exist and only possible way to report them could be triacylglycerols (could contain both saturated and unsaturated fatty acids), diacylglycerols (could contain both saturated and unsaturated fatty acids) and monoacylglycerols (could contain both saturated and unsaturated fatty acids). More importantly, it also reports that product contains 10.05% palm oil. Such kind of unrealistic breakdown components would not be included in any analytical report. Although the total of the different components indicated in the report added up to 100%, such components are unrealistic and the report could be considered as a fabricated document.

4.0 Possible reasons for having high level of free fatty acids in vegetable oils

Naturally very low amount of free fatty acids could be presence in vegetable oils. However, as explained above due to enzymatic (lipase) or chemical (acid or alkali) hydrolysis it could generate free fatty acids in oils. During refining process of oils, free fatty acids are removed due to undesirable effects cause by them. There is a possibility that microbial lipolysis (breakdown of ester bonds in acylglycerols such as TAG, DAG or MAG) of acylglycerols presence in the palm oil may generate somewhat high amount free acids. Nevertheless, such products which made under very unhygienic conditions (microbial contaminations) would not be recommended for human consumption.

5.0 Health implications of any edible oil which contains unacceptable level of free fatty acids

The maximum free fatty acids content set by joint FAO/WHO Food Standards Programme CODEX Committee on Fats & Oils and the Palm Oil Refiners Association of Malaysia in crude palm oil and refined bleached deodorized oil are 5% and <0.1%, respectively. Furthermore, according to the Food Act No. 26 of 1980; Food (Standards) Regulations of 1989 in Sri Lanka, edible palm oil which is recommended for human consumption should not contain more than 0.1% free fatty acids. Any vegetable oil which contains high amounts of free fatty acids (as in the case of this particular product) is highly liable for oxidation and could generate various oxidized products that could harm human health. For instance, end-products of lipid oxidation could be mutagenic and carcinogenic. Many reports and scientific communications indicate that lipid oxidation has a role in the pathogenesis of several pathologies such as neurodegenerative, inflammatory, infectious, gastric and nutritional diseases in humans. Therefore, the particular product that has been claimed by the exporter as "Crude Palm Fatty Acid" is not suitable for human consumption.

Thanking you.

Sincerely,

Dr. J.K. Vidanarachchi (B.Sc, Sri Lanka; M.Sc, Canada; PhD, Australia)
Senior Lecturer
CC: Dean/Faculty of Agriculture, University of Peradeniya: for your information please.