THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212
Dec 2023 3(12) 4126-4129

Popular Article

Refining Process of Palm Oil and Palm Kernel Oil

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https://doi.org/10.5281/zenodo.10305124

Summary

Palm oil is one of the basic edible vegetable oils which is used in almost every food processing industry. The palm oil is derived from the oil palm. Globally, about 80% fractions of oil palm are used for edible purposes. Therefore, for a healthy life, the quality of palm oil should be good. The process of palm oil manufacturing is same as other vegetable oil manufacturing. Both palm oil and palm kernel oil are rich sources of saturated fatty acids esterified with glycerol, around 50% and 80%, respectively. To become tolerable for human consumption, palm oil and palm kernel oils should be refined/purified. As other vegetable oils, palm oil refining involves four major steps which are neutralization, degumming, bleaching and deodorization. These four steps were jointly known as the refining process.

Introduction

The palm oil is derived from the oil palm (*Elaesis guinensis* Jacq.). Oil is the basic fraction of oil palm which gives commercial value to this crop. Palm oil can be achieved both from mesocarp of fruit and kernel of nuts. The oil obtained from mesocarp of fruit is known as palm oil whereas the oil obtained from kernel of nuts is known as palm kernel oil. Crude palm oil is extracted from oil palm by series of unit operations like pressing, crushing, etc. Palm oil constitutes unsaturated (Oleic acid) and saturated (Palmitic acid) fatty acids. About 80% of products formed from palm oil are used as edible intension. Food products processed using palm oil have long shelf life than the food products processed from other vegetable oils because palm oil contains higher amounts of unsaturated fatty acids such as oleic acid which is responsible for oxidative stability. Both palm oil and palm kernel oil are rich sources of saturated fatty acids esterified with glycerol, around 50% and 80%, respectively. Palm kernel oil is also acquired from oil palm and has a very different chemical composition, physical properties and applications than

palm oil. Palm oil is generally used in some food applications, such as cooking oil, shortening, and margarine. To become tolerable for human consumption, most edible oils should be purified. Due to the high requirement of palm oil, it is necessary to refine the oil to get quality product to meet a healthy life. Crude palm oil may contain phosphatides, colour compounds, peroxides and other contaminants which affect human health when consumed. The refining process is one of the basic and most convenient processes to remove such types of contaminants from oil. Production of vegetable oil comprises various manufacturing steps, among these, refining is the most crucial step.

Crude palm oil is refined to eliminate unacceptable substances before consumption. Minor components including oxidation products, free fatty acids, phospholipids, pigments, trace metals and other impurities are discharged during refining. Most of edible oils are refined in two ways physically and chemically. Chemical refining is also called as alkali refining in which the degummed palm oil is treated with alkali (mainly sodium hydroxide) before bleaching. This process is called as neutralization. Chemical refining of palm oil involves four major steps degumming, neutralization, bleaching, and deodorization. Whereas physical refining of palm oil comprises three steps degumming, bleaching, and deodorization. The many edible oils were processed by removing unwanted components which can affect taste, appearance, shelf stability, safety, and consumer acceptance.

Palm Oil and Palm Kernel Oil Refining Process

As palm oil is derived from fruits of oil palm, palm oil is produced at oil mill by pressing, striping, sterilization and clarification. The crude palm oil is extracted from oil palm by series of unit operations like pressing, crushing etc. which will result in the formation of free fatty acids (FFA), phosphatides, pigments, sterols, traces of pesticides, hydrocarbons, etc. Such components may affect the quality of finished product as well as productivity and yield of processing. To eliminate such unwanted components and make finished product suitable for human consumption, crude palm oil must be refined. As earlier discussed, there are two methods of refining of palm oil which are physical and chemical refining. Physical refining involves three main steps degumming, bleaching and deodorization while chemical refining involves one additional step *i.e.*, neutralization.

Degumming: Degumming is the initial step of the refining process which decreases the amount of phospholipids. Phospholipids are responsible for the disintegration of oil which results in low grade finished product. Phospholipids are responsible for white precipitation in oil which causes difficulties during hydrogenation. Oxidation reaction in oil tends to the formation of dark-colored

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Published 08.12.2023

compounds from phospholipids during storage and processing. A degumming process is necessary in physical refining of oils but it is elective in chemical refining process. It comprises the treatment of crude oil, with water, salts, enzymes, caustic soda, or dilute acids to remove phosphatides, waxes, pro-oxidants, and other impurities. The degumming process transforms phosphatides to gums. These gums are insoluble in oil and can be separated from oil by filtration, centrifugation or settling. The crude oil can be degummed to discharge impurities by different types of degumming methods which are water degumming, acid degumming, dry degumming and enzymatic degumming. Water degumming is the simplest process among other degumming processes in which the hydratable phosphatides are removed by mixing water with crude oil. In acid degumming, the crude oil is treated with phosphoric acid or citric acid at a temperature of about 80°C-95°C, and then 2-5% water is mixed to it. In dry degumming, crude palm oil is mixed with 0.05-0.1% concentrated phosphoric acid and heated at a temperature of about 80-110°C. Similarly, an enzyme for example phospholipase is used in enzymatic degumming.

Neutralization*:* Neutralization is the chemical refining process frequently employed to lower free fatty acids from the degummed oil in the form of soap. The main byproduct of chemical refining is called as soap stock, which is a mixture of fatty acid soaps, salts, phospholipids, impurities, and entrained neutral oil. In neutralization, the oil mass from degumming process is neutralized with alkali or caustic soda mainly sodium hydroxide (NaOH), potassium hydroxide (KOH), sodium bicarbonate (NaHCO3) and sodium carbonate (Na2CO3) for elimination of free fatty acids in the form of soap stock. This soap solution is then separated from neutralized oil by gravity settling. The residues of alkali are removed by washing the oil with hot water. The reaction takes place in neutralization is as follows:

$$R\text{-}COOH + NaOH \rightarrow R\text{-}COONa + H2O$$

Bleaching*:* Bleaching is the process in which the degummed oil or neutralized oil is treated with bleaching earth under the vacuum and heat to remove trace metal complexes, pigments, phosphatides and other impurities by absorptive effect of bleaching earth or clay. Compounds such as phospholipids, colorants, soaps, contaminants etc are expelled out to obtain acceptable characteristics in edible oils during bleaching. In the purification, discoloration, and stabilization of vegetable oils, the bleaching step is a key step. Bleaching is a process where the degummed oil or neutralized oil is heated to high temperature (85-110°C) with bleaching clay under vacuum (720-760mmHg). The equipment where bleaching is to be done is called as bleacher. In bleaching various types of bleaching clays or earths are used such as acid activated bleaching earth, fuller's earth, activated charcoal etc.

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Published 08.12.2023

Deodorization*:* Deodorization is a vacuum-stripped and steam distillation method operated at high temperature (220°C-260°C), during which odoriferous components and free fatty acids are removed to obtain odourless oil. It is important to consider that during the deodorization, there are some possibilities of occurrence of some other reactions such as thermal decomposition of triglycerides into free fatty acids, formation of trans isomers, and loss of tocopherols and sterols. The bleached oil may contain minute quantities of odoriferous compounds and residues of chemicals from neutralization process. This bleached oil is deodorized in a distillation column called as deodorizer to eliminate odour and free fatty acids from oil. The deodorizer is kept under a high vacuum (720-760 mmHg) and bleached oil is heated at temperature of about 220°C -260°C and the steam is injected in deodorizer. During deodorization, free fatty acids are discharged as refining waste from upper section of deodorizer. The deodorized oil is then cooled and filtered to obtain sparkling oil.

Conclusion

Crude oils contain non-triacylglycerol components that must be partially or totally removed to become acceptable for human consumption. Crude oils are therefore submitted to several treatments, the objective being to remove the objectionable minor components with the least possible damage to the oil fraction and minimal losses of desirable constituents (tocopherols, tocotrienols, sterols, etc.). There are two major processing methods, known as chemical and physical refining. In chemical refining, the free fatty acids and most of the phosphatides are removed during alkali neutralization; during physical refining, the free fatty acids are distilled during deodorization. Advantages of physical refining lie in higher overall yield, use of less chemicals, and production of less effluent.

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Published 08.12.2023