Chapter 1

Introductory Chapter: Multifaceted Perspectives of Palm Oil

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Additional information is available at the end of the chapter

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1. Introduction

Palm oil is extracted from the ripened mesocarp of the fruits of the oil palm tree *Elaeis guineensis*. The oil palm can produce two types of oil: (1) palm oil from the fibrous mesocarp (which has a brilliant, deep red-orange pulp) and (2) palm kernel oil (which resembles coconut oil) from the kernel [1–3]. Crude palm oil (CPO) can be processed into various downstream products; however, most of the phytonutrients are partially removed during the processing steps involved. The major processed product of CPO is deodorised palm oil which involves refining and bleaching. It is during this refining process that the carotenes which give CPO its characteristic red-orange colour become decomposed, resulting in refined, bleached, and deodorised palm oil, which has a slight yellow colour [1].

The five leading producers of palm oil around the world are Indonesia, Malaysia, Thailand, Colombia and Nigeria [4]. According to Mba et al. [4], the oil palm tree gives the highest yield of oil per unit area of cultivated land, at an estimated 58.431 million metric tons per year. It is estimated that 1 ha of oil palm plantation is able to produce up to 10 times more oil than other types of leading oilseed crops [4]. The refining process of CPO through chemical and physical refining is shown in the schematics as per **Figures 1** and **2**.

Bearing these in mind, this book primarily focuses on various aspects of the palm oil industry, principally its impact on the current consumer market as a crop of agricultural and industrial value and effects on the environment. The sections which follow in this introductory chapter give brief overviews on other aspects which may or may not be covered in the rest of the content chapters, so that the voids and gaps are ideally filled. It is of importance to see the food technological and health aspects of palm oil as well, and thus, this chapter covers a certain amount of content on the food value of this product too.

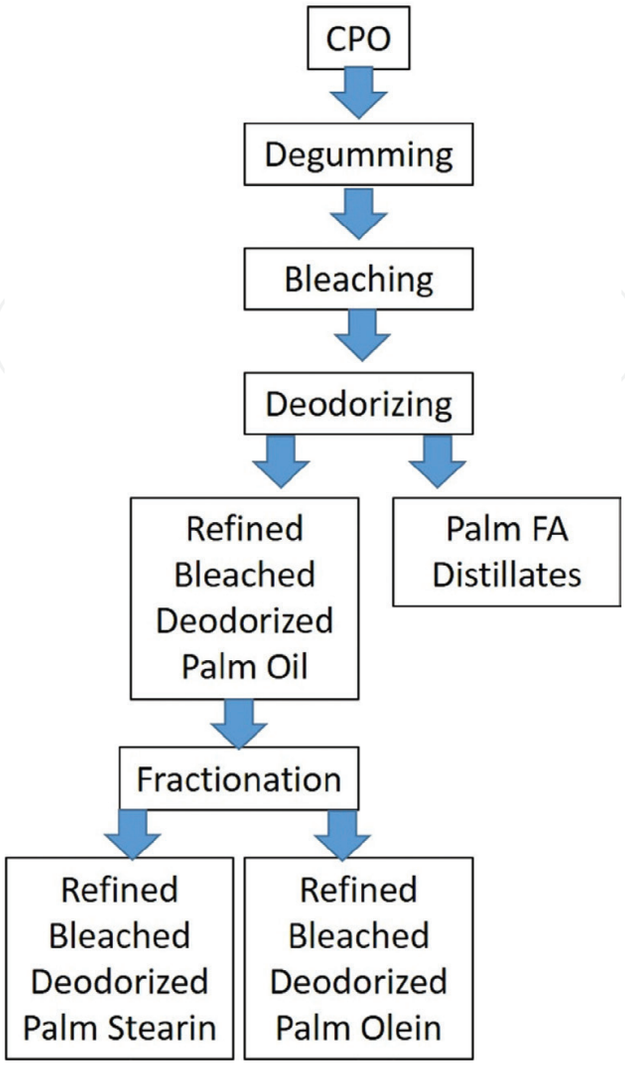

Figure 1. Refining process of CPO through physical processes.

2. Applications in the food industry

Palm oil has a very unique fatty acid (FA) and triacylglycerol (TAG) profile which makes it ideal for numerous food applications. It is the only vegetable oil presently available in the consumer market with an almost 1:1 composition of saturated and unsaturated FAs. CPO is primarily used in household and food retail outlets for cooking, frying and as a source of vitamins. Fractionation of CPO yields mainly palm olein as the liquid fraction and palm stearin as the solid fraction [4]. These fractions have distinct physico-chemical features. CPO, palm olein and palm stearin are important constituents of several food and industrial products such as shortenings and ice cream [4].

Palm oil is top prime among frying oils. Refined, bleached and deodorised palm oil is a versatile oil widely used in more than 150 countries worldwide [5]. In addition to its unique FA

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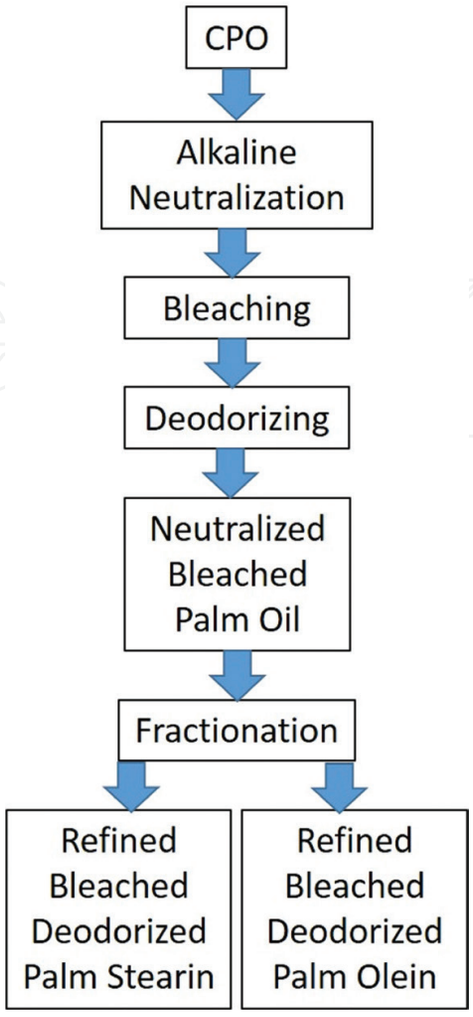

Figure 2. Refining processes of CPO through chemical processes.

composition, it has a high smoke point of about 230°C [4, 6]. The process of frying heats the food right through to the middle, cooking its interior and creating a 'crust' on the surface of the food plus a characteristic fried food flavour, which has resulted in the popularity of such food products among consumers in both household as well as fast-food applications [7]. The hot oil serves as a medium of heat and mass transfer, while some of the oil is absorbed by the product and moisture in the form of vapour is given off [4]. Thus, frying could be considered as a processing method which combines cooking and drying. Given the importance of frying, palm oil has become an essential component in many food preparations, resulting in a high placement of value in the modern consumer market.

3. Palm oil-based biodiesel

It is a well-known fact that there is a rapid depletion of crude oil reserves, increasing oil prices along with growing concerns about emission of greenhouse gases. This phenomenon

has resulted in an increasing need for the adoption a global energy economy based on renewables. The usage of renewable energy technologies (RETs) are set to increase in future, directly influencing public opinion and the energy policies of governments around the world [8].

Biodiesel is an amber-yellow, liquid-based mono alkyl ester which is derived primarily from plant and animal oils [8]. The properties of biodiesel are nevertheless similar to petroleum-based diesel, although biodiesel is biodegradable, non-explosive and non-toxic which significantly reduces toxic emissions when burned [8–11]. Currently biodiesel is produced primarily from edible oils such as rapeseed oil, sunflower oil, soybean oil, tallow and palm oil [12, 13]. However, the fraction of palm oil which is being used for biodiesel production has increased from 3.2 to 8.3 million tonnes from 2009 to 2014, while Malaysia accounts for 40% of total global demand for strategically positioning the nation as a significant player in the global dynamics of biodiesel production [14]. CPO has the highest average oil yield of any oil-extracting crop, hence, its utilisation for biodiesel production offers many advantages over other crops used for the same purpose [15, 16].

4. Health benefits and safety of palm oil consumption

The current demand for functional foods is attracting a wide range of customers around the world. In response, supermarkets and producers are adapting their products and have identified the growth potential of products which bear a 'free from' claim in their packaging [17]. Despite various statements against the consumption of palm oil, up to now there is no substantiated indication that consumption of palm oil in a balanced diet is related to any specific health concern. In fact, it has been shown that replacing palm oil in food products or diets with fats higher in saturated FAs or with added sugar to compensate for the palatability and taste, will not provide a health benefit [17].

The safety of both CPO and refined, bleached and deodorised palm oil has been studied extensively in mutagenicity, nutritional and toxicological studies, with no adverse effects reported [1]. In general, fats are subjected to heat, thermal oxidation occurs and mutagens are formed; this is a common occurrence to all fats and oils, and heating can also lead to deterioration of the nutritional quality of the oil. Repeatedly, heated CPO and refined palm oil have been tested for mutagenicity to determine the safety of edibility, and no adverse effects have been identified to date [1].

Cardiovascular diseases (CVD) are responsible for 31% of global deaths [18]. This disease is a group of diseases of the heart and blood vessels including coronary heart disease (CHD), cerebrovascular disease, peripheral arterial disease, rheumatic heart disease, congenital heart disease, deep vein thrombosis and also pulmonary embolism [19]. The high proportion of saturated FAs, especially palmitic acid, in palm oil has been linked to the increased risk of atherosclerosis [20, 21]. However, findings of the systematic review by Ismail et al. [19] indicated that there is no evidence of a clear association between palm oil consumption and risk

or mortality of CVD. Furthermore, Ismail et al. [19] observed that the effect seen between association of palm oil consumption and risk of coronary heart disease were not unique to only palm oil, especially since other food items were also included in the analysis, therefore rendering the association to be insignificant.

5. Impact of oil palm on forests and climate change

According to Shahputra and Zen [22], conversion of forests and peat lands for oil palm cultivation is considered by many to be the largest source of greenhouse gas emissions. According to Agus et al. [23], oil palm plantations are estimated to be responsible for substantial and increasing of total carbon emissions in Indonesia, Malaysia and Papua New Guinea. Recent statistics indicate that while some provinces with large expansions in oil palm plantations have had an increase in deforestation, others have not [24]. For where the instance of deforestation has not taken place, this indicates that plantation land previously used for food crops including rice, is being converted into oil palm plantations, since the previous crops may have become less attractive due to poor irrigation infrastructure and falling terms of trade.

Shahputra and Zen [22] recommend that given the environmental impacts of destroying intact forest and peat lands, a key development strategy which could be adopted to support rural communities is to implement sustainable land use planning, involving expanding oil palm into degraded land mostly covered by grass such as *Imperata cylindrica* which is commonly found in countries such as Indonesia. Additionally, Shahputra and Zen state that a large-scale oil palm expansion programme driven by estate companies needs to be accompanied by a well thought and effective smallholder development programme. Overall, if land issues could be resolved and local landowners included, oil palm acreage could be increased up to two-fold, without having to convert additional new forest land and peat lands, thus saving the environment from having to undergo negative effects.

6. Conclusions

The palm oil industry remains vital to many countries where it is grown in bulk, since its cultivation has led to socio-economic advancements and growth in gross domestic product. From the perspective of consumers, the palm oil is a good source of nutrients, functional bioactives, cooking media as well as a product to be consumed for health benefits. It has to be borne in mind though that there are environmental impacts in the mass cultivation of oil palm, and thus, the effects on farming practices resulting in deforestation and climate change need to be taken into account. Also, development of biofuel products and technologies based on the palm oil industry is heartening from the point of future sustainability. From this perspective, support should be rendered towards usage of different feedstocks and enhancing the efficiency of the production line to shift from petroleum to palm oil.

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