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REVIEW: THE POTENTIAL FOR DEVELOPMENT OF RED PALM OIL INDUSTRY IN EAST KALIMANTAN

Hamka[1], Bernatal Saragih[2], Deny Sumarna[3], Krishna P. Candra[4], Sukmiyati Agustin[5], Marwati[6]
Politeknik Pertanian Negeri Samarinda, Kalimantan Timur, Indonesia[1]
Universitas Mulawarman, Kalimantan Timur, Indonesia[2,3,4,5,6]
Program Studi Doktor Ilmu Pertanian Fakultas Pertanian Universitas Mulawarman, Kalimantan Timur, Indonesia[1,2,3,4,5,6]

hamka@politanisamarinda.ac.id[1], bernatalsaragih@faperta.unmul.ac.id[2], dsumarna@faperta.unmul.ac.id[3], candra@faperta.unmul.ac.id[4], sukmiyati.agustin@faperta.unmul.ac.id[5], marwatiwawa.unmul@gmail.com[6]

ABSTRACT
Food security is a critical aspect of development, especially in regions like East Kalimantan, Indonesia, where per capita food availability has declined since 2016. The oil palm industry, particularly Crude Palm Oil (CPO), plays a significant role in addressing food security issues by providing a major agricultural commodity that can be processed into various products including red palm oil, which is rich in nutrients like carotenoids, vitamin E, and essential fatty acids. This study aims to explore and analyze the potential development of the red palm oil industry in East Kalimantan. The research utilizes a literature review method, involving the analysis and synthesis of various sources such as scientific journals, reports, and statistical data to assess the potential and opportunities for developing the red palm oil industry in East Kalimantan. The findings indicate that red palm oil, with its high concentrations of beta-carotene and tocopherol, presents a significant opportunity for development in East Kalimantan. Red palm oil can serve as a nutritious alternative to traditional cooking oils and margarine. Despite its potential, the utilization of red palm oil in Indonesia remains limited, mainly restricted to cooking oil production. The study suggests that the development of the red palm oil industry could enhance food security and nutritional intake in East Kalimantan. By promoting red palm oil as a functional food and a nutraceutical product, it could offer a viable solution to improve the health and well-being of the community while also supporting sustainable agricultural practices.

Keywords: Red Palm Oil, Carotenoids, Tocopherols, Cooking Oil, East Kalimantan.

Corresponding Author: Hamka
E-mail: hamka@politanisamarinda.ac.id

INTRODUCTION

Food security is one of the most important aspects of a country's development, and Indonesia is no exception. Despite Indonesia's vast agricultural potential, food security challenges remain, especially in the East Kalimantan region. The region's ethnic and geographic diversity challenges maintaining a stable and diverse food supply for its population. As a developing country, one of the primary agricultural commodities and supporters of food security is oil palm, the fruit of which is processed into crude palm oil (CPO). Indonesia is the world's largest producer of palm oil or CPO, with output reaching 46.73 million tons in 2022, according to data from the Indonesian Palm Oil Association (Gapki) in 2023. CPO produced in Indonesia is then processed into food products such as cooking oil and margarine, as well as non-food products such as biodiesel.

East Kalimantan Province is one of the largest CPO-producing regions in Indonesia; most of this CPO production is exported abroad to be further processed into cooking oil and its derivatives. One alternative to fulfil the community's basic needs for food processing, namely cooking oil, can be met from palm oil (CPO) itself. Besides being processed into cooking oil and margarine, CPO can be processed into other food products, such as red palm oil. As the name implies, red palm oil is a derivative of CPO in the form of oil. It has a reddish-yellow colour, which results from being extracted from the oil palm fruit (Elaeis guineensis). Red palm oil contains essential nutrients, including carotenoids, vitamin E, and essential fatty acids (Wu et al., 2018), (Purnama et al., 2020), (Tan et al., 2021), (Gao et al., 2023). However, the use of red palm oil in Indonesia is still limited, primarily in cooking oil production. It has yet to be fully utilized utilized as a source of nutrition.

Red palm oil's specialty is its high concentrations of beta-carotene and tocopherol. The beta-carotene content in red palm oil is higher than in other plants such as papaya, mango, sweet potato, pumpkin, and carrot. Beta-carotene is one of the vitamin A components that maintains eye health and promotes growth. It also acts as an antioxidant that can maintain the health of other organs in the body. Beta-carotene is essential for growing children. Tocopherol, or vitamin E, is an antioxidant that improves female fertility. Looking at the compounds contained in red palm oil, red palm oil can be classified as a functional food product because it contains biologically active ingredients that are beneficial in maintaining body health. Seeing the potential possessed by red palm oil as a functional food associated with food security in East Kalimantan Province will provide a solution that red palm oil can be an alternative to cooking oil for the community.

This paper aims to analyze and analyze opportunities and explore the potential for the development of the red palm oil industry in East Kalimantan. In addition to providing information on the potential development of red palm oil in East Kalimantan, it also provides an understanding of the role of red palm oil as a source of nutrition, functional alternative cooking oil, and nutraceutical products that can improve the community's health.

METHOD

The writing method is a literature search involving analysis and synthesis of various sources, including scientific journals, reports, and statistical data, to get a clear picture of the potential development opportunities for the red palm oil industry in East Kalimantan.

RESULTS AND DISCUSSION

Food Security of East Kalimantan Province

The term food security simply refers to the availability of sufficient food for humans obtained from sustainable food systems. According to the FAO, food security is a situation in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious quantities of food that meet their dietary needs and food preferences to lead active and healthy lives (Zuhra, 2019).

From the above definition, it is clear that sufficient food does not automatically mean food security, as it depends not only on quantity but also on quality. Food must be safe and nutritious to fulfil needs and ensure human health, and a sustainable food system is a critical component that must be implemented across the board (Zuhra, 2019).

In East Kalimantan Province, food security is an important aspect of maintaining a stable food supply for the population. East Kalimantan's Pola Pangan Harapan (PPH) score in 2020 reached 85.9 but decreased to 82.6 in 2021, below the target of 89.0. This reflects the challenges in maintaining food security in the region (East Kalimantan, 2022)

Data on food availability per capita in East Kalimantan Province for 2016-2020 is an important indicator. The Food Crops and Horticulture Agency monitors this data, which provides an overview of the extent to which food availability can meet the per capita needs of the East Kalimantan population (Data.kaltimprov.go.id, 2023). (*Data-Availability-Food-Percapita-and-Consumption-Province-Kaltim-Year-2016-2020*, n.d.).

Table 1. Data on Food Availability Per Capita in East Kalimantan Province 2016-2020

No.	Data List	2016	2017	2018	2019	2020	Unit
1	Food availability per capita	113	114	90	90	90	Kg/Capita/Year
2	Energy Availability Level	2,400	2,445	2,537	2,462	2,492	Kcal/Kap/Day
3	Protein Availability Level	95	88	90	89	86	Gr/Kap/Day
4	Energy Consumption Level	2	2	2	2	0	Kcal/Kap/Day
5	Protein Consumption Level	58	58	58	64	0	Gr/Kap/Day

Source: Data.kaltimprov.go.id, (2023)(*Data-Availability-Food-Percapita-and-Consumption-Province-Kaltim-Year-2016-2020*, n.d.)

Food security in East Kalimantan Province is closely related to the yield of oil palm plantations, especially Crude Palm Oil (CPO) and its derivative products. Oil palm development in East Kalimantan began in 1982 through the People's Nucleus Plantation Project (PIR) managed by PTP VI. The oil palm area reached 1,374,543 ha in 2020, with 373,479 ha as plasma or community crops, 14,402 ha as a nucleus by private companies, and 986,662 ha as large private plantations. In 2020, 17,721,970 Fresh Fruit Bunches (FFB) or 3.8 million tons of CPO were processed. Three hundred ninety-three companies from various large private plantation companies that have obtained reserve permits (location permits) have temporarily started plantation development on a broader scale (Disbun kaltim, 2023).

East Kutai, Kutai Kartanegara and Paser have sizable oil palm farming areas. In contrast, several other districts and cities still have smaller areas. The following figure and table show the development of statistical data, production, productivity, and labour of oil palm plantations in East Kalimantan from 2011 to 2020.

Table 2. Recapitulation of Oil Palm Acreage, Production & Labor

Year	TM Area (Ha)	Total Area (Ha)	Production (Ton)	Productivity (Kg/Ha)	Number of Farmers (KK/TKP)
2020	1.020.468	1.374.543	17.721.970	17.367	218.023
2019	882.949	1.228.138	18.343.852	20.776	220.055
2018	806.930	1.199.407	13.398.348	16.604	232.111
2017	788.311	1.192.342	13.164.310	16.699	234.063
2016	763.896	1.150.078	11.418.110	14.947	231.100
2015	621.777	1.090.106	10.812.893	17.390	284.959
2014	500.512	1.020.413	9.628.072	19.236	264.246
2013	397.635	944.826	6.901.602	17.357	309.370
2012	335.904	824.413	5.221.016	15.543	284.876
2011	279.568	716.320	4.081.782	14.600	277.382

Source: (Disbun kaltim, 2023).

Palm Oil Industry Opportunities in East Kalimantan

East Kalimantan's palm oil industry still has many opportunities. The East Kalimantan Provincial Government sees the palm oil industry as a substitute for an economy dependent on natural resources. The East Kalimantan Provincial Government intends to make it a pillar of a sustainable economy. The East Kalimantan government, through the East Kalimantan Plantation Agency, continues to expand the area of oil palm plantations, which currently stands at 1.3 million hectares out of a total of 2.8 million hectares of licenses that have been granted. The area of oil palm plantations will continue to increase by the number of licenses granted. The Plantation Agency targets that in 5-10 years, East Kalimantan will have 2.5 million hectares of oil palm plantations (disbun.kaltimprov.go.id, 2019).

In addition, the East Kalimantan Provincial Government, through the Plantation Office, encourages palm oil plantation companies to implement the Indonesia Sustainable Oil Plan (ISPO) as a form of sustainable palm oil management. ISPO is the main standard and work indicator in the palm oil industry, and in East Kalimantan, 65 companies have received ISPO certificates (disbun.kaltimprov.go.id, 2019).

Based on the potential of agriculture and plantations in East Kalimantan, the Government of Indonesia has designated East Kalimantan as an agricultural and oleo chemical-based industrial cluster zone, which is located in Maloy, East Kutai Regency, East Kalimantan, under the name Maloy International Port and Industrial Estate (KIPI). By considering the potential of palm oil *(crude palm oil* and *kernel palm oil*) in East Kalimantan, there are opportunities for the development of downstream industries, especially olein, stearin, and other industries, as shown by the CPO industry tree (disbun.kaltimprov.go.id, 2019).

East Kutai district in East Kalimantan has many opportunities and potential to develop the plantation business. East Kutai Regency has much potential in the plantation subsector, including oil palm plantations spread across 18 sub-districts. East Kutai Regency attracts investment because it has comparative advantages and competitive advantages compared to other regions. In addition, the potential land area is still quite large and needs to be utilised appropriately. The East Kutai community development and independence movement, known as Gerbang Taman Makmur, is expected to reduce the unemployment rate in East Kutai Regency. The recapitulation of oil palm area and productivity by city district in 2022 shows that East Kutai Regency has a production of 6,452,834 tons and a productivity of 18,770 kg/ha, while in the private plantation pattern in 2020, East Kutai Regency has a total area of 357,059 ha and a production of 5,287,325 tons (Jiuhardi et al., 2023)..

In East Kutai, oil palm plantations are proliferating. Oil palm plantations now reach more than 300 thousand hectares and are spread across all sub-districts, showing the nature of itü. The area of oil palm plantations in East Kutai is the most significant contributor to achieving the target of one million hectares of oil palm launched by the East Kalimantan Provincial Government. About 30% of the target comes from oil palm plantations in East Kutai (Disbun kaltim, 2023).

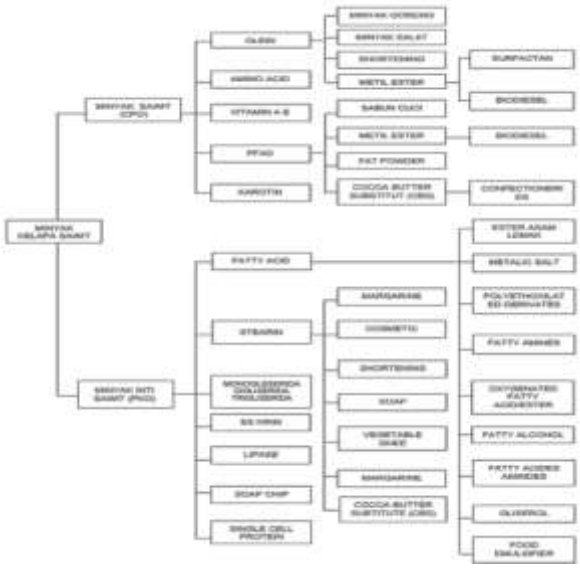

Figure 1. CPO Industry Tree (Ministry of Industry of the Republic of Indonesia, n.d.)

Table 3. Recapitulation of Area, Production & Labor in Palm Oil Industry by District/City in East Kalimantan Province in 2020

District/City	Total Area (Ha)	Production (Ton)	Productivity (Kg/Ha)	Number of Farmers (KK/TKP)
Kutai Kartanegara	255.343	3.110.111	14.510	30.738
East Kutai	459.541	6.452.834	18.770	75.413
West Kutai	153.870	877.789	17.749	19.933
Mahakam Ulu	25.096	127.323	6.964	3.260
Penajam Paser Utara	47.084	399.987	10.573	12.824
Paper	178.328	2.014.529	13.988	36.243
Berau	257.318	4.729.880	22.324	38.993
Samarinda	1.209	8.719	10.581	583
Balikpapan	41	487	17.393	22
Bontang	52	311	9.147	14
Total Year 2020	**1.374.543**	**17.721.970**	**17.367**	**218.023**

Source: (Disbun kaltim, 2023)

Table 4. Recapitulation of Area, Production & Labor By Large Private Plantation Pattern (PBS)

District/City	Total Area (Ha)	Production (Ton)	Productivity (Kg/Ha)	Number of Farmers (KK/TKP)
Kutai Kartanegara	227.539	2.839.095	17.311	17.898
East Kutai	357.059	5.287.325	19.008	40.625
West Kutai	145.318	870.384	20.240	17.175
Mahakam Ulu	21.640	127.323	6.964	3.210
Penajam Paser Utara	29.674	321.487	13.441	6.240
Paper	86.714	1.163.984	14.383	13.875
Berau	118.698	2.516.700	26.401	27.062
Bontang	20	272	13.600	2
Total Year 2020	**986.662**	**13.126.570**	**17.747**	**126.087**

Source: (Disbun kaltim, 2023)

Red Palm Oil

Palm oil contains many phytonutrient compounds such as carotene (as provitamin A) 500-700 ppm, tocopherols 500-600 ppm, tocotrienols 1000-1200 ppm (as vitamin E), phytosterols 326-527 ppm, phospholipids 5-130 ppm, squalene 200-500 ppm, ubiquinone 10-80 ppm, aliphatic alcohols 100-200 ppm, triterpene alcohols 40-80 ppm, methyl sterols 40-80 ppm, and aliphatic hydrocarbons 50 ppm (Mba et al., 2015a). As antioxidants, anticancer, anti-hypertension, anti-diabetes, and cholesterol-lowering, these phytonutrient compounds are very beneficial for health (May & Nesaretnam, 2014). In contrast, these compounds have yet to be fully utilized utilized.

Palm oil naturally contains many carotenoids, especially beta carotene, which is provitamin A. Palm oil that has been specially processed to keep carotenoid levels high is known as red palm oil or MSM (Maryuningsih et al., 2021). MSM contains between 15 and 300 times the retinol (provitamin A) compared to carrots and tomatoes. In contrast, the retinol from MSM is 44 times more than green vegetables (Hasibuan & Meilano, 2018). As it is a provitamin A and vitamin E transporter, MSM can be used as a functional food ingredient. In addition, MSM's oxidation stability is higher than other vegetable oils, thanks to the combination of 50% unsaturated fatty acids, tocopherols, tocotrienols, and carotenes (A. et al., 2012). (Perdani et al., 2016) stated that consumption of palm oil containing high carotene can lead to an increase in blood retinol concentration and a decrease in the activity of the enzymes Aspartate Transaminase (AST), Alanine Transaminase (ALT) and Alkaline Phosphatase (ALP).

MSM can be used as a frying medium. However, the recommended temperature is at most 150 degrees Celsius as carotene compounds are easily degraded during heating (Hasibuan & Siahaan, 2014). Therefore, MSM is an ideal frying medium for sautéing fish, vegetables, chilli sauce, and other foods (Hasibuan & Meilano, 2018)..

Red Palm Oil's Role in Nutrition

MSM is one of the palm oil products that contains the most phytonutrients (Ayeleso et al., 2012). The Palm Oil Research Center (PPKS) can produce MSM with the highest carotene content of 500 ppm (Hasibuan, 2021b). Crude palm oil that is neutralized neutralized to reduce the amount of free fatty acids and then deodorized deodorized is the raw material for MSM. Heating and leaching are thought to reduce some phytonutrients. The application of MSM (especially carotene) is still limited due to its low stability during storage. Encapsulation can improve the stability of MSM. In a study conducted by (Lee et al., 2018), they demonstrated the microencapsulation of MSM as an oil-in-water emulsion consisting of the following ingredients: water, sodium caseinate, MSM, maltodextrin, and soy lecithin. It was made through dispersion using supercritical carbon dioxide. In addition, (Sathasivam et al., 2018) reported that the MSM microencapsulation process uses carboxymethyl cellulose as encapsulating material and polyethylene glycol as a plasticizer plasticizer.

Red Palm Oil as a Functional and Nutraceutical Food

Functional food originated from the idea of FOSHU (Food for Special Health Purposes), first popularized popularized by Japanese researchers in 1984. The concept emerged when the Japanese government began to consider a government-borne budget for the health of the elderly. Consumption of nutritious food is expected to prevent various diseases and improve quality of life as the elderly population increases (Hasibuan, 2021a). Functional foods positively affect a person's health beyond basic nutritional needs, helping to improve ideal health conditions and reduce the risk of non-communicable diseases (Granato et al., 2017). A functional food product is defined as a

food product (not a capsule, tablet, or powder) that is derived from natural ingredients, is suitable for consumption (sensory acceptability in terms of colour, appearance, and taste) as a daily menu item, and performs certain functions when ingested, such as increasing immunity and preventing certain diseases (Bidlack, 1995).

Functional foods are divided into two groups based on their source (e.g. plant and animal) and processing method (e.g. natural, traditional or modern functional foods). The components of functional foods consist of nutrients (macro- and microelements) and non-nutrients (microorganisms or plant chemicals). Bioactive nutrients include amino acids, several types of proteins, PUFAs, vitamins, minerals, and enzymes (Hasibuan, 2021a). Adding functional foods is essential for health due to consumers' increasing concerns about health and understanding that diet directly affects their health. Consumers' views on functional foods also directly impact their desire to consume them. The food industry has many opportunities to grow with functional foods. However, in the future, stakeholders from various groups, such as scientists, food ingredient suppliers, food industry companies, and food retailers, should strive to capitalize capitalize on these opportunities (Küster-Boluda & Vidal-Capilla, 2017).

Stephen DeFelice first used the term nutraceutical in 1989 (Tamboli, 2021); (Santini et al., 2017), which was also based on the assumptions of Hippocrates (Cardenas, 2013). Nutraceuticals are food-derived commodities used as pill, capsule, or liquid medicines. The term is derived from the words "nutrition", which denotes a nutritious food or food component, and "pharmaceutical", which denotes a medicine (Shahidi, 2012). Suppose a food product (from animals or plants) has pharmaceutical activity and provides medical or health benefits, such as disease prevention, treatment, and nutritional value. In that case, it is categorized categorized as a nutraceutical. Active foods can serve as a source of macro- and micronutrients and a medicine, depending on the dosage (Andlauer & Fürst, 2002); (Santini et al., 2017).

Dietary supplements, herbal products, prebiotics and probiotics, and prebiotics and nutritional supplements are usually included in the nutrition category (Khorasani et al., 2018).. Nutritional therapy is a healing mechanism that uses diet therapy or nutraceuticals as adjunctive medicine. According to this therapy, food is not only a source of nutrients and energy but can also have medicinal effects (Khorasani et al., 2018).

MSM can be used as a functional food and nutraceutical, as it contains fats and bioactive compounds with the following functions:

1) MSM is a source of essential nutrients. MSM is a fat that provides benefits as an energy source to fulfil human energy needs. MSM contains saturated fatty acids (such as palmitic acid and stearic acid) and unsaturated fatty acids (such as oleic acid and linoleic acid) that are relatively balanced,
2) MSM as a source of carotene. Carotenes contained in MSM are β-carotene (41.0%), α-carotene (41.3%), cis-α-carotene (10.2%), ζ-carotene (0.6%), γ-carotene (0.8%), δ-carotene (0.8%), lycopene (1.0%), *neurosporene (0.*2%), β-zeacarotene (1.3%), *α-zeacarotene (0.*5%), *phytoene (*0.2%), and *phytofluene (0.*6%) (Loganathan et al., 2017),
3) MSM is a source of tochromanols (tocopherols and tocotrienols): The tochromanols contained in MSM are α-tocopherol (19%), α-tocotrienol (29%), γ-tocotrienol (41%), δ-tocotrienol (10%) (Loganathan et al., 2017).

4) MSM is a source of phytosterols. Phytosterols contained in MSM are cholesterol (6.6-11.5 ppm), campesterol (76-83 ppm), stigmasterol (59-64 ppm), β-sitosterol (187-218 ppm), and unknown compounds (<6 ppm) (Loganathan et al., 2017).
5) MSM is a source of squalene. Squalene has cardioprotective, radioprotective, anticancer, and inhibiting cholesterol synthesis activities (Loganathan et al., 2017).
6) MSM as a source of ubiquinone. Ubiquinone can enhance cellular energy production, antioxidant properties, and cardioprotection (Loganathan et al., 2017).

The description above shows that MSM qualifies as a raw material for functional and nutraceutical foods because it is safe for consumption and does not contain allergenic and toxic compounds.

Red Palm Oil as a Functional Cooking Oil

Beta Carotene

Carotenoids are organic pigments that give palm oil its orange colour. Significant functional life that is beneficial to the health of the body. Carotenoids are used because they have bonded, unsaturated hydrocarbons. A double is formed between two conjugated carbon atoms and is usually (Maryuningsih et al., 2021). Although measured as non-saturated fatty acids, carotenoids, tocotrienols, and tocopherols are potent antioxidants and make palm oil a good vegetable for health (Ajuwon et al., 2022). Carotenoids function as anticarcinogens and highly potent antioxidants because they can quench molecules or radicals with oxygen. The only carotenoids found in red palm oil (MSM) are the best source of provitamin A used to address problems with VAC (Manorama, 2014).

One of the main carotenoids that can be obtained from food is beta-carotene. Beta carotene and provitamin A function as antioxidants in the body, both independently and in combination with lycopene, lutein, and other carotenoid compounds (Mueller & Boehm, 2011); (Rodrigo-Baños et al., 2015). In addition, MSM contains many antioxidant vitamins, one of which is a source of vitamin A (carotene), which positively affects human health (Ayeleso et al., 2012) and can optimise immune function. In addition, the natural antioxidants in MSM can capture free radicals and help protect cells from damage.

The beta carotene content of MSM far surpasses carrots, tomatoes, papaya, and spinach leaves, according to some research results (Akinola, 2014); (Dong et al., 2017). The beta carotene content of MSM is 23.7 mg/g (You et al., 2002) and 22 mg/g (Ayeleso et al., 2012).

MSM has been used as a food product in several countries (Mba et al., 2015b). This condition depends on the quality and nutritional content of the MSM fraction (Che Idris et al., 2014). Many studies have published results on its nutritional content in humans and animals. These studies have shown that MSM and its products have sufficient amounts of nutrients and expanded our understanding of the physiological and nutritional effects of its nutrient content and minor components, such as β-carotene.

The study of carotenoid sources is of great interest. Several epidemiological studies have found that consuming foods high in carotenoids is associated with a lower risk of several degenerative disorders, including various types of cancer and cardiovascular disease. There is a link between preventive effects and antioxidant activity, which protects tissues and cells from oxidation damage. Carotenoids may also cause redox-sensitive regulatory pathways to affect cellular signalling (Stahl & Sies, 2003). The food matrix determines the bioactivity of these ingredients. Oils have six

times more bioactivity than vegetables containing beta-carotene (Anna Marliyati et al., 2021). The beta-carotene content of MSM in foods in the literature ranges from 220 mg/kg to 237 mg/kg (You et al., 2002). This may depend on the selected variety, maturity level, agronomic elements and extraction technique.

Fatty Acids

Palm oil consists mainly of a mixture of triglycerides (Akinola, 2014). More than 95% of triglycerides are composed of fatty acids such as myristic, palmitic, stearic, oleic, and linoleic. Palm oil's saturated and unsaturated fatty acids are almost equal, with palmitic acid (44%) being the primary saturated fatty acid and the rest being stearic acid (5%) and myristic acid (1%), and this is balanced by almost 39% monounsaturated oleic acid (MUFA), 11% polyunsaturated linoleic acid (PUFA) (Salhin et al., 2013).

Palm oil is rich in the hypocholesterolemic monounsaturated fatty acids oleic (18:1, ώ-9) and linoleic (18:2, ώ-6) acids. It contains less than 1.5% lauric acid (12:0) and myristic acid (14:0), which are thought to raise cholesterol levels. However, palmitic acid (16:0) is neutral against blood cholesterol. Oleic acid performs various structural tasks on cell membranes, including signal transduction and regulation of membrane moisture. By doing this, oleic acid can maintain the function of LDL receptors present on the cell membrane. It can accelerate the cholesterol uptake cycle, potentially reducing cholesterol (Innis, 2000). (Innis, 2000).

Table 5. Fatty acid composition of Red palm oil

Fatty Acids	MSM (%w/w)
Lauric Acid (C12:0)	0.12
Miristic Acid (C14:0)	0.61
Pentadecanoic Acid (C15:0)	0.03
Palmitic Acid (C16:0)	34.05
Palmitoleic Acid (C16:1)	0.09
Heptadecanoic Acid (C17:0)	0.06
Stearic Acid (C18:0)	2.87
Oleic Acid (C18:1)	36.39
Linoleic Acid (C18:2)	9.13
Arachidic acid (C20:0)	0.22
Linolenic Acid (C18:3)	0.26
Cis-11,14-Eicosedienoic Acid (C20:2)	0.03
Behenic acid (C22:0)	0.03
Lignoseric Acid (C24:0)	0.06
Σ Saturated	37.83
Σ Single Unsaturated (MUFA)	36.48
Σ Polyunsaturated (PUFA)	9.64

Source: (Anna Marliyati et al., 2021)

Tocopherol

One type of fat-soluble vitamin is vitamin E, which functions as an antioxidant. Some isomers of vitamin E include tocotrienol, tocopherol, tocopherol, tocopherol, and alpha-tocopherol (Gliszczyńska-Świgło et al., 2007). The main sources of vitamin E are fat-rich plants or vegetable oils, such as palm oil, wheat, and natural rice. Olive, nut, cereal, and sunflower oils are additional sources of tocopherols (Tay & Choo, 2000). Tocopherol has vitamin E activity and many double bonds that are easily oxidized oxidized. As a result, tocopherols protect fats from oxidation (Swarni et al., 2022). Vitamin E has many benefits for human health. Besides being a supplement, vitamin E is known to be active as an anticancer compound, prevent premature aging, and prevent cardiovascular disease

and other degenerative diseases (Hilma et al., 2018). Its activity is also an inhibitor of free radical formation, known as an antioxidant (Sebayang et al., 2016).

Red palm oil (MSM), or RPO, is a by-product of crude palm oil processing that contains high levels of vitamin E and carotene (Ooi et al., 1994). (Nagendran et al., 2000) found that the vitamin E isomers in red palm oil are α-tocopherol (α-T), α-tocotrienol (α-T3), α-tocotrienol (α-T3), and α-tocotrienol (α-T3). (Dauqan et al., 2011) found that red palm oil contains 171 ppm of vitamin E, 294 ppm of α-tocotrienol (α-T3), 367 ppm of α-tocotrienol (α-T3) and 126 High-Performance Liquid Chromatography (HPLC) and Uv-Vis spectrophotometer can be used to identify vitamin E (Viera et al., 2019).

Red Palm Oil Potential in East Kalimantan

As the world's largest producer of crude palm oil (CPO), Indonesia can produce new healthy edible oil products as advancements in the palm oil industry point to new business prospects in the health sector from producing red palm cooking oil containing vitamins A and E. A press release on Thursday, March 17, marked the launch of the social program cooperation of the Eka Tjipta Foundation (ETF), owned by the Sinar Mas business group. G. Sulistiyanto, Chairman of ETF, Daud Dharsono, President Director of PT SMART Tbk, and Sam Herodian, Dean of the Faculty of Agricultural Technology, Bogor Agricultural University, were present at the event. Vitamin A, which benefits the eyes, maintains cell regeneration and immunity and lowers the risk of cancer and lupus, is still lacking in millions of children and millions of poor people in Indonesia. Initially, the red cooking oil produced by PT SMART Tbk will be used by IPB to provide vitamin A to the poor population in west Bogor, West Java. This is part of spreading the benefits of red cooking oil from palm oil (Kompas.com, 2011)

On the other hand, East Kalimantan province as one of the highest sources of crude palm oil (CPO) production after West Kalimantan province is a challenge where the scarcity of cooking oil some time ago due to increased exports and biodiesel uptake has increased in recent years as a result of increased domestic demand to meet the ambition of B30, which is a mixture of FAME and diesel. The solution is that the supply of CPO for oleochemicals must be well prepared so that the world's largest CPO producer no longer experiences the problem of cooking oil scarcity. On the other hand, the plantation sector in East Kalimantan (Kaltim) continues to face obstacles in increasing downstream and reducing dependence on raw product exports by processing them into derivative products such as Red Palm Oil, cooking oil, soap and others (Bisnis.com, 2023).

CONCLUSION

The development of the red edible oil industry in East Kalimantan, Indonesia, has significant potential in improving local food security. Per capita food availability in East Kalimantan Province has declined since 2016, reflecting challenges in maintaining food security. Palm oil, including Crude Palm Oil (CPO), is a critical agricultural commodity that can be processed into various products, including cooking and red palm oil. Red palm oil, which contains nutrients such as carotenoids, vitamin E, and essential fatty acids, has the potential to be a better source of nutrients than cooking oil. Thus, the development of the red edible oil industry can be a healthier and more sustainable alternative to cooking oil for the people of East Kalimantan.

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