

Characterization of Palm Kernel Oil as Raw Material for Transparent Soap

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Abstract

Soap is a product of a saponification reaction involving oil/fat and alkali which functions to decrease the surface tension so as to help clean dirt. Palm kernel oil with the main fatty acid content in the form of lauric has good properties for making solid type soap, namely hardening, cleaning and producing abundant foam. The purpose of this study was to analyze the characteristics of palm kernel oil as a raw material for transparent solid soap and to test the quality of the resulting soap. In this study, transparent soap was made with glycerin, sucrose and 96% ethanol as a transparent agent that met the requirements for quality testing and organoleptic testing. The method of making soap using the semi-boiled method is mixing palm kernel oil with stearic acid which has been melted at a temperature of 60°C, then added 30% NaOH carried out with stirring at a temperature of 70-80°C.

Keywords : soap, crude palm kernel oil, saponification.

1. Introduction

Soap is a product that is needed in human life. Soap can be found in various types of products such as bath soap, laundry soap, dish soap, shampoo, toothpaste, facial soap, hand soap, and so on. In principle, soap contains surfactant active ingredients that lower the surface tension of water so that it is easy to dissolve dirt. The selection of the type of soap is of course adjusted to the needs of the customer. This encourages research to create various types of soap with different characteristics from each other. Several things that affect the characteristics of the soap produced are the raw material for oil/fat, the type of alkali, additives, the production process and others.

Two main material on soap making are fatty acid and alkali. The fatty acid required for soap factory were supplied by tallow, grease, fish oil and vegetable oil (Enon et al., 2012). The use of palm kernel oil as a raw material for making soap has several advantages, compared to the use of palm oil (CPO) which is more commonly used on a factory scale.

The purpose of this study was to analyze the characteristics of palm kernel oil and its use in making transparent soap. The characterization of palm kernel oil was indicated by water content (moisturizer), dirt content, color and pH. While the quality of the soap produced is measured by visual tests and physicochemical tests. Visual tests include transparency, amount of foam, and soap texture. While the physicochemical test includes pH, water content and free fatty acid.

1.1 Objectives

The objectives of this research was to analyze the characteristics of palm kernel oil and its use in making transparent soap. The characterization of palm kernel oil was indicated by water content, dirt content, color and pH. While the quality of the soap produced is measured by visual tests and physicochemical tests. Visual tests include transparency, amount of foam, and soap texture. While the physicochemical test includes pH, water content and free fatty acid.

2. Literature Review

The palm oil industry is a rapidly growing industry in Indonesia today, where every year Indonesia produces tens of millions of tons of CPO from millions of hectares of oil palm plantations (Febrina & Fitriana, 2022; Rahmad et al., 2020). Data from Biro Pusat Statistik in 2019 states that the plantation area in Indonesia has reached 14.32 million hectares, of which 8.51 million hectares, and people's plantations 5.81 million hectares. Meanwhile, CPO production for 2021 is 46.88 million tons, or 0.31% lower than the production in 2021 of 47.03 tons.

To increase the economic value of palm oil, it is necessary to manufacture derivative products that can increase the selling value of palm oil. As the largest CPO producing country in the world, Indonesia is still unable to maximize the potential of CPO as the largest source of income because we are still focused on making cooking oil and biodiesel products. In fact, there are still many derivative products whose prices are much higher whose production has not been maximized, such as oleochemicals, margarine, soap, cocoa butter substitute, and others.

Palm kernel as a by-product of CPO production has high potential because of the lauric acid content in it. Currently, most of the palm kernels have not been properly processed domestically and are still exported to other countries (Febrina et al., 2021).

Palm kernel oil (PKO) is one type of lauric oils which is produced by extraction of palm kernel. PKO has been widely used for food and non-food products. For the purpose of a particular product, PKO was fractionated into liquid fraction (palm kernel olein, PKOI) and semi-solid fraction (palm kernel stearin, PKSt). The all types of PKO have different physical and chemical characteristics which are indispensable for its application to the downstream products (Hasibuan & Siahaan, 2012).

In chemistry, soap is a salt of fatty acid. Soap is mainly used for washing and cleaning, also an important component of lubricant (Enon et al., 2012). In soap making, fatty acids are reacted with strong base, known as saponification reaction.

Soap is a sodium or potassium compound with fatty acids from vegetable oils or animal fats obtained by hydrolysis of oil, which is then followed by a saponification process under alkaline conditions. Saponification is a fatty acid hydrolysis process.

Transparent soap is a type of solid soap that is widely used for face soap and bath soap, with a relatively more expensive price than ordinary solid soap because of its luxurious appearance and abundant foam. (Hambali et al., 2005).

2.1 Palm Kernel Oil (PKO)

Refers to Badan Standarisasi Nasional dalam SNI 01 0002 1987 (Badan Standarisasi Nasional, 1987), palm kernel is part of the fruit of the *Elaeis Guinnueensis* Jacq plant that has been separated from the fruit and shell and has been dried.

Palm kernel Oil is an edible oil which yellowish in color and it's obtained from palm fruit's kernel, which scientifically kow as *Elaeis Guinnueensis* (Asadu & Okolo, 2021). The palm fruit originates from tropical country in Africa, dan menyebar ke Indonesia dan Malaysia pada masa pemerintahan Belanda. Palm kernels are essential by-products obtained during the palm oil milling and processing. It makes ups about 45%-48% by weight of the palm nut. The oil yield of palm kernel is about 47%-59% by weight. Lauric acid being the predominant fatty acid in PKO, makes up 48,53% of the fatty acid composition (Asadu & Okolo, 2021).

Quality test requirements for palm kernel oil regulated in SNI 01 0002 1987 (Badan Standarisasi Nasional, 1987) are shown in table 1:

No	Test	unit	standard
1	Oil content (w/w) dried	%	min 46
2	Free fatty acid content (w/w), count as lauric acid	%	max 3
3	Water content, (w/w)	%	max 8
4	Dirt content (w/w)	%	max 6

Palm Kernel Oil and its fractions can be used as raw materials for food products such as margarine, cocoa butter substitute, shortening, and others. PKO can also be used as non-food raw materials, such as fatty acids, fatty alcohol

and fatty ester alcohol (Hasibuan & Siahaan, 2012). In food products, PKO must be fractionated into Refined Bleached Deodorized Palm Kernel Oil (RBDKO), Refined Bleached Deodorized Palm Kernel Olein (RBDPKOI) and Refined Bleached Deodorized Palm Kernel Stearin (RBDPKS).

Compared to Malaysia, Indonesia is lagging behind in characterizing palm kernel oil and its derivatives, so that PKO producers in Indonesia find it difficult to meet the demands of the export market. Currently, some factories adopt the quality standards issued by Malaysia for PKO products and their derivatives. These quality standards are issued by the Malaysia Edible Oil and Manufacture's Association (MEOMA).

The quality of raw materials is an important thing that must be met to be able to produce quality products as well (Rachmad et al., 2022). As a raw material for soap making, the palm kernel oil used must meet the quality standards set out in SNI 01-0002 1987 above (Sarumaha et al., 2021). In real conditions in the field, there are still many palm kernel oil processing factories that have difficulty meeting quality standards. This makes it difficult for Refined Bleached Deodorized Palm Kernel Oil produced in Indonesia to meet export requirements.

Table 2. Fatty Acid Content in PKO

Fatty Acid	Content (%)
Lauric acid	46-52
Oleic acid	13-19
Miristic acid	14-17
Palmitic acid	6.5-9
Caproic acid	3-7
Caprylic acid	3-4
Stearic acid	1-2.5
Linoleic Acid	0.5-2

3. Methods

Palm kernels were obtained from perkebunan rakyat in Dumai, Riau Province Indonesia. PKO making, soap making and analyzing was done at chemistry laboratorium Sekolah Tinggi Teknologi Dumai, during February-March 2022. Oil extraction was carried out using schlet extractor unit with particle size of 0.5 mm. Oil extraction was performed at temperatur of 55°C-60°C using solvent n-hexane for 150 minutes to obtain optimum oil yield. The oil yield obtained at the end of the 150 minutes extraction timewas calculated and recorded.

The oil yield of sample was calculated using equation below :

$$\%Oil\ Yield = \frac{weight\ of\ oil\ extracted(g)}{weight\ of\ sample(g)} \times 100\% \quad (1)$$

In this study, transparent soap was made with glycerin, sucrose and 96% ethanol as a transparent agent that met the requirements for quality testing and organoleptic testing. The method of making soap using the semi boiled method is mixing palm kernel oil with stearic acid which has been melted at a temperature of 60⁰ C, then added 30% NaOH carried out with stirring at a temperature of 70-80⁰ C. Transparent agents and other additives are mixed into the soap mass obtained from the saponification process.

The transparent solid soap formula consists of stearic acid, fatty acids, NaOH, NaCl, glycerin, ethanol and sucrose. (Prasetyo et al., 2020). The method of making soap uses the semi-hot method, carried out with 5 variations of raw materials. Palm kernel oil and stearic acid melted using an evaporating dish at a temperature of 60°C above the water bath. Poured the palm kernel oil and stearic acid that had been melted into the glass beaker above the heater on temperature 70-80 °C, then stirred until homogeneous. Added the solution of 30% NaOH which has been heated. The solution was stirred for 15 minutes until a thick mass is formed viscous to produce a soapy mass. Then added 96% ethanol at 60 °C, stirred for 5 minutes. add glycerin to the mixture, then add the dissolved sucrose with aquadest added, stirred for 5 minutes. Add Citric Acid, NaCl and stired again for 5 minutes. Add colour and fragrance, stirred until homogeneous. The mixture was poured into a soap mold, then stand it at room temperature for several days until hardened.

3.1 Tools

The tools used in this research was:

- Breaker glass
- Breaker glass
- Magnetic Stirrer
- Erlenmeyer
- Electric scales
- Thermometer
- Water bath
- grinder
- sieve 1mm diameter hole
- socket
- porcelain mortar and pestle
- electric oven
- desicator

3.2 Materials

Material used in this researches was :

- crude palm kernel oil
- sodium hydroxide
- stearic acid
- Ethanol 70%
- Aquadest
- Glycerine
- n-hexane

3.3 pH test

pH testing was done by using pH meter for chemical laboratory.

4. Data Collection

Table 3. Characteristics of palm kernel oil

Characteristics	Test value			Standard value
Water content	7,23%	7,35%	7.30%	Max 8 %
Dirt content	4.45%	4.67%	4.58%	Max 6 %
colour	yellowish	yellowish	yellowish	yellowish
pH	10.32	10.44	10.39	

Table 4. Visual observation of the soap produced

Characteristics	1	2	3	4	5
Transparency	++	++	++	++	++
Foam	++	++	+++	+++	++
Teksture	+++	++	+++	+++	++

Note :

- : not good
- + : fair
- ++ : good
- +++ : very good

Table 5. Characteristics of the soap produced

Characteristics	1	2	3	4	5
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pH	8.28	8.30	8.43	8.34	8.46
Free fatty acid	0.90%	0,92%	0.89%	0.90%	0.95%
Water content	32.4%	34.2%	33.5%	32.9%	35.1%

5. Results and Discussion

Selection of raw materials is an important factor in the characteristics of the soap produced. In addition to the main raw materials, supporting raw materials also have an important role in improving the quality of the product. The added glycerin has a function as a humectant. The addition of sugar and DEA serves to increase transparency and as a surfactant.

Table 3 is a table of the results of testing the characteristics of palm kernel oil used as raw material in the manufacture of this soap, namely: water content, PH, color, dirt content and density. The results are compared with the standards set in SNI 01-0002 1987 in Table 1. The results obtained are the characteristics of the palm kernel oil used in this study are in accordance with the quality standards set out in SNI 01-0002 1987.

Table 2 is a test of the levels of fatty acids contained in palm kernel oil. A high level of lauric acid is a requirement that must be met so that PKO is feasible to be used as raw material for making transparent soap.

Furthermore, the resulting transparent soap must undergo a visual test, which includes transparency, the amount of foam formed and the texture of the soap. As a test standard, soap is said to be good if it is transparent (translucent), the amount of foam formed is large, and the texture is soft and soft. Visual testing was carried out by the research team, and the values presented in table 4 are the average values of the observations.

The next step is to test the physicochemical characteristics of the soap, including pH, free fatty acid content and water content. The results is presented on Table 5.

6. Conclusion

Characterization of palm kernel oil as a raw material for the manufacture of several derivative products needs to be done to see if the physical and chemical properties of PKO meet the criteria for suitable raw materials, so that the production process of these products can be maximized. PKO contains large amounts of lauric acid, making it suitable for use as raw material for transparent soap. Lauric acid is proven to produce a good transparent soap, has abundant foam and a soft texture. From the research conducted, the characteristics of PKO are in accordance with the SNI 01-0002 1987 standard. Meanwhile, the soap produced has also met the quality standard of transparent soap. The soap produced has good transparency, a lot of foam and a soft texture.

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