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UTILIZATION OF BANANA KEPOK AS ACTIVE CHARCOAL FOR THE PROCESS OF PURIFICATION OF USED COOKING OIL USING THE ADSORPTION METHOD

Sariadi[1]*, Zulkifli[1], Salmyah[1], Adriana[1], M. Yunus[1], Ridwan[1], Een Setiawati[1], Isra Adelya Izzati[1]
[1]Chemical Engineering Department, Lhokseumawe State Polytechnic, Jl. Banda Aceh-Medan Km. 280, Buketrata, Punteut Mosque, Blang Mangat, Lhokseumawe City, Aceh 24301, Indonesia
* Email: sariadi.kimia@gmail.com

ABSTRACT

Used cooking oil or often referred to as used cooking oil is one of the needs for food processing for humans. Repeated processing of cooking oil in the frying process can reduce the quality of the cooking oil. Therefore, one of the efforts to process used cooking oil is adsorption using activated charcoal from kepok banana peels. The use of activated charcoal as an adsorbent can be beneficial because activated carbon can absorb some unwanted odors and reduce the amount of free fatty acids, thereby improving the quality of the oil. The purpose of this study was to study the addition of the amount of kepok banana skin size of activated charcoal (mesh) with adsorption time on the quality of used cooking oil. The variables used were varying the size of the activated carbon particles of 100 mesh, 120 mesh, 140 mesh and 160 mesh with adsorption times of 3 hours, 5 hours and 7 hours. The refined oil will be analyzed for oil density, fatty acid content in the oil, and water content. From the research results it is known that the best particle size is 160 mesh. The density value is 0.889 g/ml. The results obtained are that the density value still does not meet the SNI (2002) cooking oil quality standard requirements, namely 0.900 g/ml. FTIR analysis shows that there is an increase in wave number which is the peak of the OH (hydrogen bond) structure using purified chorcoal. The C=O (carboxylate) FFA molecule is shown around the wave number 1060 cm-1 increasing to 1070 cm-1.

Keywords: *Adsorption, activated charcoal, kepok banana, free fatty acid (FFA), water content, density*

INTRODUCTION

Cooking oil is widely used by the community because it is one of the basic human needs as a food processing ingredient. Many people use cooking oil because cooking oil is able to conduct heat, gives a taste (savory), texture (crispy), color (brown), and can increase nutritional value (9 kcal/gram) [1]. Oils and fats are solvents for vitamins A, D, E and K which the body really needs. Thus oil and fat have an important role for the health of the human body. Used cooking oil (used cooking oil) is waste that comes from types of cooking oil such as corn oil, vegetable oil, and ghee. This oil can be reused, but judging from its chemical composition, wet oil contains compounds that are carcinogenic, therefore it must be cleaned first [2]. As a result of heating and frying more than once, some of the double bonds become saturated and oxidize to form peroxide groups and cyclic monomers. The peroxide value is the most important value for determining the degree of breakdown of an oil or grease. Unsaturated fatty acids can increase oxygen in the double bond to form peroxides [3]. Therefore purification of used cooking oil needs to be pursued with the aim of saving but not endangering health and easy to do. Efforts to process used cooking oil can be done in various ways, one of which is by adsorption. Adsorption was chosen because it is easy to implement and economical. The peroxide value is the most important value for determining the degree of breakdown of an oil or grease. Unsaturated fatty acids can increase oxygen in the double bond to form peroxides [3]. Therefore purification of used cooking oil needs to be pursued with the aim of saving but not endangering health and easy to do. Efforts to process used cooking oil can be done in various ways, one of which is by adsorption. Adsorption was chosen because it is easy to implement and economical. The peroxide value is the most important value for determining the degree of breakdown of an oil or grease. Unsaturated fatty acids can increase oxygen in the double bond to form peroxides [3]. Therefore purification of used cooking oil needs to be pursued with the aim of saving but not endangering health and easy to do. Efforts to process used cooking oil can be done in various ways, one of which is by adsorption. Adsorption was chosen because it is easy to implement and economical. Efforts to process used cooking oil can be done in various ways, one of which is by adsorption. Adsorption was chosen because it is easy to implement and economical. Efforts to process used cooking oil can be done in various ways, one of which is by adsorption. Adsorption was chosen because it is easy to implement and economical.

The adsorbent commonly used is activated charcoal. Activated charcoal is usually made from carbon-based materials, such as coal, lignin, lignocellulosic materials, synthetic polymers, and carbon waste. Activated charcoal is a material in the form of granules or powder derived from carbon-containing materials such as bones, softwood, husks, corn cobs, coconut shells, coconut coir, sugarcane milling waste, paper-making waste, sawdust, hard wood, coal and so on [4] . Activated carbon is a carbon activating agent whose adsorption power has been activated by the activation method, which can be done by two methods: chemical and physical activation. Chemical activation, using chemical activators such as: alkali metal hydroxide carbonate salts, chlorides, sulfates, alkaline earth metal phosphates and especially inorganic acids ZnCl2 such as H2SO4 and H3 PO4. Physical activation by breaking the carbon chain of organic compounds with the help of hot steam and CO2. The absorption capacity of activated carbon can be affected by, from the nature of the adsorbent, absorption properties, temperature, pH and contact time [5].

Banana (Musa paradisiaca) is a plant that is very popular in Indonesia. However, banana cultivation has not been carried out efficiently because it has not been cultivated in a profitable plantation. Kepok banana belongs to the Musaceae family originating from South India. This plant is more resistant to environmental conditions such as drought or other environmental problems. Banana is a plant that grows in the tropics because it is suitable in hot climates and requires sufficient sunlight. This plant can grow in soil with sufficient water at an altitude of up to 2,000 meters above sea level [6]. Bananas are widely used as food ingredients such as banana flour, chips, fried bananas, sale, and other preparations. Banana kepok is a type of thick banana. with an attractive yellow color when ripe.

Table 1.Nutritional Content of Bananas Based on the Level of Maturity

Chemical Analysis (%)	Treatment			
	Young	Old	Mature	Cook
Moisture Content	2.42	4.74	8.18	9.94
Ash content	1.36	2.08	3.46	3.34
Starch Content	51.05	53.12	21.31	15.49

Source: Harefa and Pato, 2017

Table 2. Chemical / Nutritional Composition of Banana Peel Per 100 g of Ingredients

Element	Amount %)
Water	68.90
Carbohydrates	18.50
Fat	2.11
Proteins	0.32
Calcium	715/100 gr
Phosphorus	117/100 gr
Iron	1.60 mg/100 gr
Vitamins B	0.12 mg/100 gr
Vitamins C	17.50 mg/100 gr

Source: Indonesian Center for Research and Development, East Java, Surabaya, 1982

EXPERIMENTAL

Materials and Methods

Used cooking oil is used cooking oil which is fried around Alue Awe, Lhokseumawe City, with three frying times. Banana peels used for making activated charcoal are also collected from fried food vendors in the surrounding areas. Before being made into activated charcoal, the kepok banana peel is cut into dimensions of ± 1-1.5 cm, to make it easier for the water to dissolve in the material. Evaporation of water is carried out for 2-3 days using solar heat. Furthermore, heating is carried out at a temperature of 150°C-200°C in a heating furnace, after which the charcoal is removed and cooled. Banana peel charcoal was then mashed with sizes of 100 mesh, 120 mesh, 140 mesh and 160 mesh with the amount of adsorbent used 36 grams each and adsorption process for 3 hours, 5 hours and 7 hours. And another chemical to be analyzed is NaOH 1 N.

CHARATERIZATION TECHNIQUE

Characterization of free fatty acids

A total of 3 grams of cooking oil sample was put into a 250 mL Erlenmeyer. Then it was dissolved in 50% ethanol solvent as much as 50 mL then heated at 40°C, then 5 pt indicator pp was added. Then stirred with a magnetic stirrer until dissolved and then titrated with 0.1 N NaOH solution. The titration was stopped if the color of the solution turned pink which lasted not less than 30 seconds.

Characterization of moisture content using Moisture Analyzer MX-50

Open the tool cover, then press the reset button to make a hole. Put a 5 gram sample into the sample container and level it, then close it, and press the start button to start the measurement. The measurement results shown on the display are marked with the tool light off.

RESULTS AND DISCUSSION

Oil quality analysis was carried out by examining free fatty acid levels and characterizing the water content in the oil. Such tests are sufficient to determine the quality of the oil. However, for physical examination it would be better if it is done by testing the water content. The water content in the oil can damage the quality level of the oil, because the presence of water in the oil will more easily experience hydrolysis which is the beginning of the next oil decomposition process.

Activated carbon based on its structural pattern is an amorphous carbon material which consists mostly of free carbon and has an inner surface that has high absorption [7]. Activated carbon from banana peels can be used in the quality process of cooking oil, this process uses the adsorption method. It is proven that the process of improving the quality of cooking oil used by fried traders around Alue Awe, Lhokseumawe City, has resulted in a decrease in free fat acid and water content.

Table 3. Characteristics of used cooking oil observed included free fatty acids, oil specific gravity and water content

Sample	Fatty Acid Spesific Gravity Moisture Content Free (%) Oil (%0
Traders of used cooking oil around Alue Awe	2.9 - 0.72
SNI, 2002	Max 0.3 0.900 g/ml Max 0.3

From the results of the analysis, the calculation of the characteristics of used cooking oil before being purified with an adsorbent is shown in Table 3.

a. Effect of Activated Carbon Particles and Adsorption Time on Reduction of Free Fatty Acids in Oil

This free fatty acid analysis was carried out using NaOH to neutralize the free fatty acids contained in the oil. Excessive free fatty acids in cooking oil can cause rancidity. In Figure 1 it can be seen the results of the analysis of free fatty acids after the adsorption process using activated charcoal adsorbent.

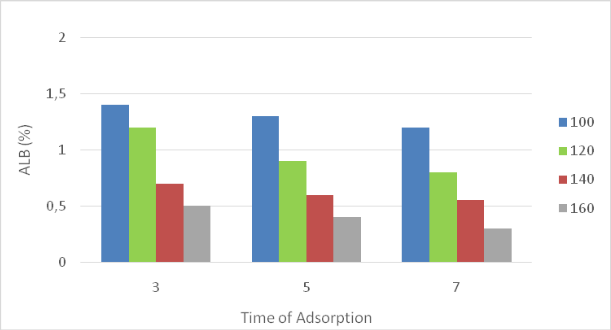

Figure 1. Effect of absorption time and particle size on the reduction of Free Fatty Acids (ALB)

From Figure 1 it can be seen that the longer the absorption time, the greater the decrease in Free Fatty Acids, at 7 o'clock the decrease in Free Fatty Acids was highest. This also affects the use of adsorbent particles, this is because the surface of activated charcoal is non-polar. In addition to composition and polarity, particle and pore size are also important factors that we must pay attention to. Particle size is related to surface area, the smaller the particle size of activated charcoal, the greater the surface area, so that the adsorption speed increases and can absorb better. 160 mesh particle size is more efficient than 100 mesh, 120 mesh, 140 mesh and 160 mesh sizes. The highest percentage of Free Fatty Acid reduction of 80.37% was obtained at the adsorbent particle size of 160 mesh.

From the data obtained the highest Free Fatty Acid value is 1.40 and the lowest is 0.35. The results obtained are that the Free Fatty Acid value still meets the requirements of SNI (2002) for cooking oil quality standards of a maximum of 0.3% [8]. In another study conducted by [9], using activated charcoal from banana peels as an adsorbent without using an activated adsorbent as a control, a free fatty acid analysis of 0.55% was obtained, in this study the results obtained were higher.

b. Effect of Activated Carbon Particles and Adsorption Time on Reducing Moisture Content in Oil

The banana stem peel adsorbent used in this study was able to absorb the water content in cooking oil, the finer the adsorbent used, the lower the water content in the oil. Absorption time also affects the decrease in water content, the longer the absorption time, the higher the decrease in water content. Based on the Indonesian National Standard SNI (2002) good cooking oil must contain a maximum moisture content of 0.3%. Water is a constituent whose presence in oil is highly undesirable because it hydrolyzes oil to produce free fatty acids which give rise to a rancid odor in oil [10, 11].

The high water content in oil can be obtained from fried foods, the frying process, or humidity during storage. During the frying process, the water in the food will come out and be filled with cooking oil, thereby increasing the water content in the oil [12].

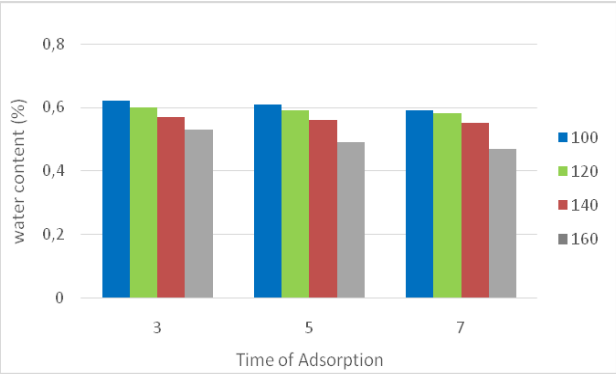

Figure 2. Effect of Absorption Time and Particle Size on Reducing Moisture Content

From Figure 2 it can be seen that the highest decrease in water content was at an absorption time of 7 hours and in the form of particles with a size of 160 mesh with a reduction of 32.75%. The best water content value obtained was 0.3%, based on the 2002 SNI for cooking oil, the water content obtained met the requirements. From this research it is known that the adsorbent from kapok banana peel can absorb the water content in cooking oil well. From these data, the highest water content value was 0.62 and the lowest was 0.47. The result obtained is that the water content value meets the requirements of the SNI (2002) cooking oil quality standard.[13]

c. FT-IR analysis

This test was carried out to identify the functional groups contained in Free Fatty Acid (FFA) using the Shimadzu IR Prestige-21 (Fourth Transform Infrared) (FT-IR) Spectrophotometer (Serial No. A210048 02519). FTIR analysis can also determine whether there is an effect on the value of functional groups by saponification loss.[14]

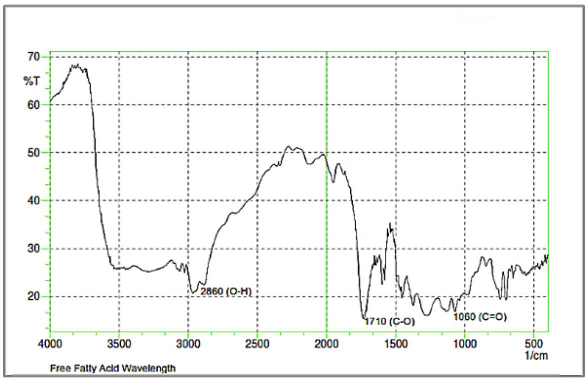

Figure 3a. FT-IR FFA Results Before

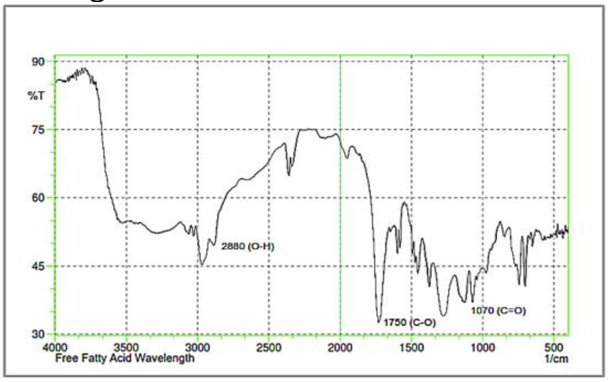

Figure 3b. FT-IR FFA Results After Purification

FFA infrared spectroscopy was obtained in the mid-infrared section (400-4000 cm-1).-1) at room temperature. The results of the FTIR spectral analysis show that in general the FTIR spectra produced before and after FFA purification are almost the same. Figure 3 shows the absorption band in FFA around 2860 cm-1-1 increasing to 2880 cm-1-1 wave number which is the peak of the OH (hydrogen bond) structure using purified chorcoal. The C=O (carboxylate) band of the FFA molecule is shown around the wave number 1060 cm-1 increasing to 1070 cm-1-1. In addition, CO (alcanoate) vibrations appear at wave numbers 1710 cm-1-1 increasing to 1750 cm-1-1. From the results of the visible FTIR spectra, it can be said that there is a significant effect on the FFA base group between before and after the chorcoal purification process.

d. Density

Density measurements were carried out on oil that had not been heated and after it had been heated. From these data obtained a density value of 0.889 g/ml. The results obtained are that the density value still does not meet the SNI (2002) cooking oil quality standard requirements, namely 0.900 g/ml. From this oil, the highest density value was obtained for cooking oil that had not been heated. This is because palm cooking oil has been used for heating so that the intermolecular bonds are reduced and causes the density of the oil to decrease. Unprotected palm oil has the highest density value because the oil has not been heated so that the molecules have not been stretched. [15].

CONCLUSION

The adsorbent ability of banana shell charcoal is better than the commonly used charcoal, both particle size and adsorption time affect the decrease in the value of free fatty acids, FTIR, water content and oil density. The longer the absorption time, the longer the contact time between the adsorbent and the oil. The best adsorption process occurred at a particle size of 160 mesh and an absorption time of 7 hours. The water content obtained meets the SNI (2002) quality standard for cooking oil. So that kepok banana stems can be used as adsorbents because they can absorb free fatty acids, FTIR, water content and density contained in cooking oil.

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