

Comparison of Corn Cob Charcoal and Lamtoro (*Leucaena leucocephala*) Wood as an Adsorbent for Used Cooking Oil

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Diserahkan: 30 Agustus 2022; Direvisi: 23 Februari 2023; Diterima: 23 Februari 2023

Abstract

The background of this research is the lack of utilization of corncob waste and lamtoro wood. The purpose of this study was to determine the adsorption ability of corn cob activated charcoal and Leucaena leucocephala wood to used cooking oil in reducing free fatty acid levels. The research method used in this research is experimental. This study consisted of four stages, namely the manufacture of activated charcoal, purification of used cooking oil, determination of free fatty acid levels, and calculation of viscosity values. 1.2%, decreased viscosity value from 1.68 Ns/m² to 1.63 Ns/m², and color change from blackish brown to slightly brownish yellow. Meanwhile, purification of used cooking oil using activated charcoal Leucaena leucocephala decreased FFA levels from 1, 58% to 1.4%, a decrease in the viscosity value from 1.68 Ns/m² to 1.3 Ns/m², and a color change from blackish brown to brownish yellow. This shows that the purification of used cooking oil using activated charcoal from corn cobs is considered more effective than using activated charcoal from lamtoro wood. This is because the FFA levels of used cooking oil purification using corncob activated charcoal are of lower value, clearer color after purification, and higher viscosity value.

Keywords: activated charcoal, cooking oil, free fatty acids, viscosity

INTRODUCTION

Cooking oil is a necessity that cannot be separated for most people. In addition to functioning as a heat conductor, cooking oil also functions as an enhancer for the savory taste of food and improves the taste of food by forming a brownish yellow color when frying. The need for cooking oil often makes people use the cooking oil repeatedly. Continuous and repeated use of cooking oil at high

temperatures accompanied by air and water contact can result in a hydrolysis reaction. The product of the hydrolysis reaction can reduce the quality of the oil and cause rancidity (Angelia, 2016).

After repeated use in a frying pan, the oil will change color. This is due to the oxidation and polymerization processes. This process will damage some of the vitamins and essential fatty acids in cooking oil, causing poisoning in the body (Rahayu, Purnavita, & Sriyana, 2014).

The process of high heating of the oil can produce harmful compounds such as free fatty acids, carbonyl compounds, and peroxides that can cause chronic poisoning in humans. In general, the main component that really determines the quality of the oil is the fatty acid, because fatty acids determine the chemical properties and stability of the oil (Fitri et al, 2016).

Waste cooking oil is also said to be used cooking oil which contains compounds that are carcinogenic. Where the sustainable use of used cooking oil can damage human health, cause cancer, deposition of fat in blood vessels, and the subsequent consequences can reduce intelligence (Muhammad et al, 2017).

Processing of used cooking oil needs to be done to improve the quality and reduce the health impacts caused by the use of the oil. One way of processing used cooking oil is to use an adsorbent so that the used cooking oil is clear again so that its quality can be maintained (Muhammad et al, 2020).

Currently, adsorbents are widely developed using natural materials because of their abundance in nature and relatively cheap and affordable prices. In addition, natural adsorbents derived from nature also have biodegradable properties that are easily degraded naturally so that the resulting waste is not harmful to society and the environment. The most widely used adsorbent is to process a material into charcoal.

Apart from being used as fuel, charcoal can also be used as an adsorbent (absorbent). The absorption is determined by the surface area of the particles and this ability can be higher if the charcoal is activated with chemical activators or by heating at high temperatures. Thus, the charcoal will experience changes in physical and chemical properties. Such charcoal is referred to as activated charcoal (Leily et al, 2013).

Activated charcoal is charcoal that has a configuration of carbon atoms that are freed from their bonds by combining with other elements or by inserting impurities (impurities), so that the carbon surface becomes clean or active (Nasir et al, 2014).

Materials that can be used to make activated charcoal are lamtoro wood and corn cobs. The use of activated charcoal from corn cob waste is considered to be a new breakthrough for purifying used cooking oil (Fitri et al, 2016).

This is because corn cobs are one of the agricultural wastes with abundant quantities, easy to obtain, cheap, not harmful to health and can be naturally degraded (biodegradability). Activated charcoal from lamtoro wood can reduce levels of free fatty acids and peroxide number of cooking oil before and after frying repeatedly so that used cooking oil can be reused (Hafidzi et al, 2020).

These two natural adsorbents have been widely used, but there has been no study comparing the improvement of oil quality with the 2 adsorbents above. Therefore, this study aims to compare the color, free fatty acid values, and viscosity values of the used cooking oil immersion with lamtoro charcoal and corn cob charcoal as adsorbents.

METHOD

This type of research is an experiment where the focus of the description is on the comparison of the use of corn cob activated charcoal and Lamtoro activated charcoal adsorbents against used cooking oil. Due to the nature of the activated carbon in charcoal, which can bind fatty acids, it helps purify used cooking oil. This study aims as an alternative to reuse used cooking oil according to SNI quality standards, with free fatty acid test, color test, and viscosity test on used cooking oil.

This research was conducted in the chemistry laboratory of SMA Trensains Sragen with the following tools and materials:

Table 1. Tools and Materials

No.	Tools and Materials	Quantity
1.	Corn Cobs	10 pieces
2.	Lamtoro Branch	18 gram
3.	Spoon	According to the needs
4.	Used Oil Cooking	1 Liter
5.	Erlenmeyer Tube	2 pieces
6	Oven	1 set
7	Mortar and Pestle	1 set
8	Measuring Cup	5 pieces
9	Scales	1 set
10	Filter Paper	According to the needs
11	Stopwatch	1 set
12	NaOH 0,3 M	2 liter
13	Na OH 0,1 N	100 ml
14	Etanol 95%	500 ml
15	Phenolphthalein Indicator	10 ml
16	Funnel glass	2 pieces
17	Titration tool	1 set
18	Hotplate thermo stirrer	1 pieces
19	Beaker	5 pieces
20	Stirring Rod	2 pieces
21	Viscosity test equipment	1 set
22	Srew micrometer	1 set

The making process of product:

A. Manufacture of activated charcoal

1. Material preparation
 - a. Looking for raw materials for corn weevil and lamtoro wood
 - b. Cleaning raw materials
2. Stage of dehydration
 - a. Breaking raw materials into small parts
 - b. Drying raw materials in the sun
3. Carbonization stage
 - a. Burning raw materials to charcoal
4. Activation stage
 - a. Soaking charcoal using a 0.3 M NaOH solution for 5 hours
 - b. Drying charcoal in the oven at 150°C for 1 hour
 - c. Pounding activated charcoal until smooth

B. Refining used cooking oil

1. Refining used cooking oil using activated charcoal from corn weevils
Put corn weevil activated charcoal in 100 ml of used cooking oil. Then let it stand for 12 hours and filter it.
 2. Refining used cooking oil using activated charcoal from lamtoro wood
Put lamtoro wood activated charcoal in 100 ml of used cooking oil. Then let it stand for 12 hours and filter it.
- C. Determination of free fatty acid levels
An oil sample is fed into erlenmeyer 100 ml with a weight of 10 ml. To the sample is added 95% hot ethanol and the phenolphthalein indicator is then shaken. The solution is titrated with a standardized 0.1 N NaOH solution.
- $$\text{Free fatty acids (\%)} = \frac{\text{ml NaOH} \times \text{N} \times \text{BM}}{g} \times 100\%$$
- where,
- N = Normality of NaOH
 - BM = Molecular weight of lauric acid
 - g = Weight of the sample tested
- D. Calculation of the viscosity value of cooking oil The viscosity value of cooking oil is calculated by the formula $\mu = \frac{2r^2g}{9v}(\rho' - \rho)$ where,
- μ = viscosity coefficient (Ns/m^2)
 - r = radius of the sphere (m)
 - g = gravitational acceleration (m/s^2)
 - v = maximum velocity of the sphere (m/s)
 - ρ' = density of the sphere (kg/m^3)
 - ρ = density of the fluid (kg/m^3)

RESULT AND DISCUSSION

RESULT

The main component of oil that greatly determines the quality of cooking oil is its fatty acid, because fatty acids determine the chemical properties and stability of the oil. The process of heating the oil continuously can cause the oil to break down and increase the amount of free fatty acid content.

Free fatty acids are formed due to oxidation and hydrolysis processes. The heating process at high temperatures and contact with air oil can accelerate oxidation. Meanwhile, the hydrolysis process can be accelerated due to the presence of water (Fitri et al, 2016).

The experimental data for refining used cooking oil is presented in the following table:

Table 2. FFA (%b/b)

Cooking oil sample	Activated charcoal corn weevil	Activated charcoal lamtoro wood
Used cooking oil before refining	1,58%	1,58%
Used cooking oil after refining	1,2%	1,4%

Table 3. The color of used cooking oil

Cooking oil sample	Activated charcoal corn weevil	Activated charcoal lamtoro wood
Used cooking oil before refining	Blackish brown	Blackish brown
Used cooking oil after refining	Slightly brownish yellow	Brownish-yellow

Table 4. Viscosity value of cooking oil

Cooking oil sample	Activated charcoal corn weevil	Activated charcoal lamtoro wood
Used cooking oil before refining	1,68 Ns/m^2	1,68 Ns/m^2
Used cooking oil after refining	1,63 Ns/m^2	1,3 Ns/m^2

**Figure 1.** From left is used cooking oil before purified, used cooking oil purified using lamtoro wood charcoal, and used cooking oil purified using corn cob charcoal

DISCUSSION

Based on the table above, it can be seen that there is a decrease in the free fatty acids of used cooking oil after being purified using corn cob activated charcoal, which was originally 1.58% FFA content to 1.2%. Meanwhile, used cooking oil purified using activated charcoal from lamtoro wood experienced a decrease in free fatty acids, which was originally from 1.58% to 1.4% FFA. Color changes also occur in used cooking oil purified with corncob activated charcoal from blackish brown to slightly brownish yellow. Meanwhile, used cooking oil purified with activated charcoal from lamtoro wood changes color from blackish brown to brownish yellow. Used cooking oil purified using corncob activated charcoal decreased the viscosity value from 1.68 Ns/m^2 to 1.63 Ns/m^2 . Meanwhile, used cooking oil purified using activated charcoal from lamtoro wood decreased the viscosity value from 1.68 Ns/m^2 to 1.3 Ns/m^2 .

This shows that activated charcoal from corn cobs and lamtoro wood are natural adsorbents that can purify used cooking oil as evidenced by the decreased levels of free fatty acids in used cooking oil after purification, color degradation of used cooking oil that is clearer, and decreased viscosity value of cooking oil.

CONCLUSION

Purification of used cooking oil using activated charcoal from corn cobs has a better adsorption ability than purification of used cooking oil using activated charcoal from lamtoro wood. This is because the percentage of free fatty acids resulting from soaking corncob activated charcoal has decreased from 1.68% to 1.2% which indicates that the purified oil using corncob activated charcoal has an FFA presentation that is closer to the FFA of SNI cooking oil quality. The maximum

limit of free fatty acid levels in cooking oil is set according to SNI, which is 0.3% (Ramdan, 2017). In addition, the color degradation of used cooking oil after being purified using activated charcoal of corn cobs is clearer, and the viscosity value of cooking oil decreases from 1.68 Ns/m² to 1.63 Ns/m² which has a better viscosity value than the viscosity value of cooking oil. used purified using lamtoro wood activated charcoal. Because cooking oil that has the best quality is cooking oil with a large viscosity value and refractive index (Sutiah, 2008).

ACKNOWLEDGEMENTS

As a research team, we would like to express our deepest and biggest gratitude and appreciation to Ust. Agus Widayoko, Ust Untung Riyadi, Usth Suharnanik, Usth Yesi Yuliani, Pak Bagus, and Pak Warno who has supported and helped us in our research. And thank them for using some of their time to make our research easier. Your supports means the world. Especially to Ust Agus Widayoko as a teacher and mentor who has guided us and having some discussion to make this research successfully.

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