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Refining Used Cooking Oil Using Kepok Banana Stems as an Absorbent

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Abstract— *Used cooking oil is increasing as a result of the increasing level of cooking oil consumption. To allow used cooking oil to be reused, a purification process must be carried out using activated charcoal adsorbent. After being purified with activated charcoal from kepok banana (Musa paradisiaca) stem, the damaged oil can still be clarified again using activated charcoal from kepok banana (Musa paradisiaca) stem and H_3PO_4 activator. The purpose of this study was to determine the carbonization time, the percentage of FFA changes, and the amount of free fatty acids. The levels of free fatty acids and the amount of peroxide were calculated in this study using titration techniques. The carbonization time ranged from 30 to 150 minutes, 60 to 90 minutes, and 120 to 150 minutes. The results showed that the best absorption analysis showed a percentage of free fatty acid absorption of 0.136% and a percentage of peroxide value absorption of 31.9416% during 120 minutes of the carbonization process. These results meet the SNI standard, N0.06-3730-1995.*

Keywords— *Adsorbent, activated charcoal, kepok banana stem, used cooking oil.*

I. INTRODUCTION

According to 2024 Statistics Indonesia (BPS) data, the banana area in Samarinda City covers 33,209 hectares, and the total banana production in East Kalimantan Province is 1,528,285 hectares. East Kalimantan's banana production reached 95,500 tons in 2020, the largest of all fruit crops in East Kalimantan, according to Monavia Ayu Rizaty. However, despite East Kalimantan's largest banana production, other fruit crops, with 1.5 million clumps, are the most abundant in the province.

Although bananas are a fruit, banana plants also have various usable parts, such as stems, leaves, hearts, and tubers. Banana tubers, the underground stems rich in carbohydrates, nutrients, and crude fiber, are useful as fertilizers, bioremediation, and raw materials for the pharmaceutical industry. Banana tubers, also known as Musa paradisiaca, are a type of organic waste from food processing that can still be utilized (Ni'maturrohmah et al., 2014). Banana stems have a high organic carbon content of 41.37% (Mopoung, 2008). Due to their high organic carbon content, banana stems can be used as an absorbent or as a raw material for the production of activated carbon.

One of the most widely used organic materials in both large and small industries is activated carbon. Activated carbon is commonly used as a catalyst, odor remover, and color absorber. Activated carbon, also known as activated carbon, is a powdered or granular material derived from carbon-containing materials (Tadda et al., 2016).

II. RESEARCH METHODS

A. Tools and Materials

The equipment used in this study included: an analytical balance, jerry cans, knives, an oven, baking pans, porcelain cups, a blender, a 100-mesh sieve, a desiccator, an Erlenmeyer flask, a magnetic stirrer, a burette, aluminum foil, clamps, and a stand. The materials used in this study included: Kepok banana stems, 1M H3PO4 reagent, 16% NaOH solution, 0.1N Na2S2O3 solution, 96% ethanol, 1% starch solution, acetic acid-chloroform solution, saturated KI solution, distilled water, filter paper, and used cooking oil.

B. Research Procedures

Making Activated Carbon from Kepok Banana Stems (Suartini Nyoman et al., 2019)

1. Clean the waste from the Kepok banana stem.
2. Cut the Kepok banana stem and dry it in an oven at 105°C.
3. Place it in a furnace for 30, 60, 90, 120, and 150 minutes at 400°C until it becomes activated carbon.
4. Cool the resulting activated carbon in a desiccator.
5. Grind the charcoal using a mortar and pestle and sieve it using a 100-mesh sieve.
6. Weigh 12.5 grams of the charcoal into a 500 mL beaker, add 50 mL of 1 M H3PO4 solution, and let it soak for 24 hours.
7. Filter the charcoal and wash it with distilled water until it reaches a neutral pH.
8. Then, place it in an oven at 100°C for 2 hours.
9. This produces activated carbon from the kepok banana stalks.

Used Cooking Oil Refining

1). Despicing Process (Widyaningsih. A, 2010)

a. Weigh 265 ml of used cooking oil.
b. Then, add water with a ratio of oil:water (1:1) and pour it into a 1000 ml beaker.
c. Next, heat until the water in the beaker is reduced by half.
d. Let it settle in a separating funnel for 1 hour.
e. Filter with filter paper to remove any remaining impurities.

2). Neutralization Process (Widyaningsih. A, 2010)

a. Take 53 ml of despicable oil and heat it to 35°C.
b. Then add 6 mL of 16% NaOH solution and stir for 10 minutes at 40°C.
c. Next, cool until soap forms.
d. Then filter using filter paper.

Bleaching Process (Widyaningsih, A, 2010)
1. Weigh 10 ml of neutralized cooking oil and heat it to 70°C.
2. Add 0.2% of the oil weight of activated charcoal powder from kepok banana stems and activated charcoal.
3. Then, increase the temperature to 100°C for the first 5 minutes and stir with a magnetic stirrer for 60 minutes.
4. Next, filter using filter paper.

Peroxide Value Analysis Procedure (Rohman and Sumantri, 2007)
1. Weigh 2.5 grams of oil sample and place in a 250 mL Erlenmeyer flask.
2. Add 15 mL of acetic acid-chloroform solution (3:2) = (9 ml:6 ml).
3. Next, shake the solution until all the material is dissolved, then add 0.25 mL of saturated KI solution.
4. Let the solution stand for 1 minute, shaking occasionally, and then add 15 mL of distilled water.
5. Titrate with 0.1 N Na2S2O3 standard solution until the yellow color almost disappears, then add 0.25 mL of 1% starch solution.
6. Continue titration until the blue color disappears.
7. Perform a blank titration using the same method (the volume of standard thiosulfate solution for the blank titration should not exceed 0.1 mL).

Free Fatty Acid Analysis Procedure (Anonymous, 2012)
1. Weigh 5 to 50 grams of sample (W) into an Erlenmeyer flask.
2. Dissolve in 25 mL of warm ethanol and add 5 drops of phenolphthalein solution.
3. Titrate the solution with 0.1 N KOH until a pink color forms (the pink color persists for 30 seconds).
4. Record the volume of 0.1 N KOH solution used format without disturbing rest of the content.

III. Results and Discussion

Research Results

TABLE 1. Peroxide Value Analysis Data

No	Temperature (oC)	Time Variation (Minutes)	Peroxide Number (meq O_2/kg)		
			Before Purification	After Purification	Absorption Capacity (%)
1	400°C	30	9.9888	9.982	0.0544
2		60	9.9888	7.9792	10.0148
3		90	9.9888	9.9772	0.0928
4		120	9.9888	5.9961	31.9416
5		150	9.9888	7.9872	16.0128

TABLE 2. Free Fatty Acid Analysis Data

No	Temperature (oC)	Time Variation (Minutes)	Free Fatty Acids (%)		
			Before Purification	After Purification	Absorption Capacity (%)
1	400°C	30	0.0958	0.0845	0.0904
2		60	0.0958	0.0789	0.0169
3		90	0.0958	0.0845	0.0904
4		120	0.0958	0.0788	0.1360
5		150	0.0958	0.0619	0.2712

This study aims to determine the carbonization time and FFA percentage, changes in free fatty acid levels, and peroxide value in oil after being purified with one type of absorbent commonly used, namely activated carbon. The raw material for making activated carbon in this study is the stem of the kepok banana (Musa paradisiaca). This is used to improve the quality of used cooking oil using the adsorbent method. This study was conducted by first carbonizing it at a temperature of 400°C using variations in carbonization time of 30, 60, 90, 120, and 150 minutes, and activating it using H3PO4 for 24 hours. The mass used for activated carbon was 12.5 grams. The results of observations in this study consisted of peroxide value data (Table 1) and free fatty acids in Table 2.

Peroxide Absorption Capacity with Variation of Carbonation Time

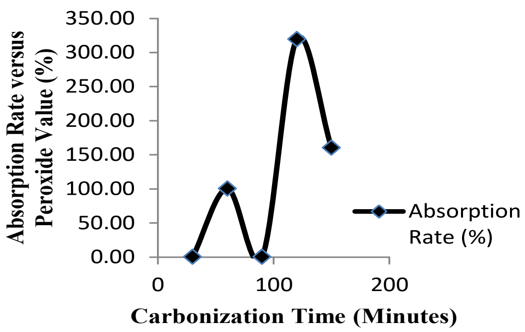

Figure 1. Peroxide Number Absorption Capacity with variations in carbonation time

Figure 1 shows that the optimal carbonization time is 120 minutes. This is due to an increase in the carbonization time between 30 and 60 minutes. This indicates that the refining process of used cooking oil is increasingly significant, and deviations occur at 90 minutes. Meanwhile, at carbonization times of 120 minutes to 150 minutes at a temperature of 400°C, there is a decrease in the peroxide value. This is because the longer the carbonization time, the more peroxide compounds formed have decomposed into volatile substances (aldehydes, ketones, and organic acids), resulting in a decrease in the peroxide value. Because active peroxides are unstable, if the oxidation process continues, the peroxide will decompose into volatile substances when there is contact between a certain amount of oxygen and the oil. The oxidation process can occur at room temperature and during processing using high temperatures. Factors that can accelerate oxidation in oil are temperature, light, the availability of oxygen, and the presence of metals that act as oxidation catalysts (Nurhasnawati et al., 2015).

Absorption Capacity for Free Fatty Acids with Variation in Carbonization Time

Figure 2, shows a graph of the adsorption capacity of free fatty acids and carbonization time during the production of activated carbon from kepok banana stems (Musa paradisiaca). The figure shows that the carbonization time of 30 to 60 minutes tends to decrease along with the saturation of the adsorbent process, which results in a decrease in its adsorption capacity and the adsorbate desorption process, as indicated by an increase in the concentration of free fatty acids. The longer the carbonization time used, the lower the FFA adsorption capacity compared to the carbonization time, which means that more free fatty acids are absorbed by the activated carbon. Furthermore, there was an increase in carbonization time between 90 and 120 minutes. This is a result of the desorption process, in which adsorbates (acidic compounds) that had been adsorbed on the surface of the activated carbon powder from the banana stem are released. The long interaction time during the carbonization process is what affected this.

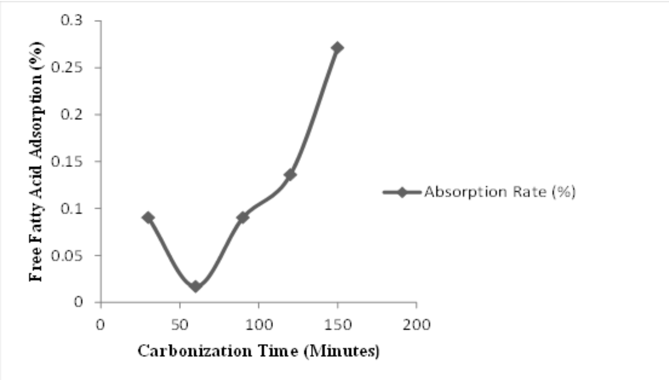

Figure 2. Absorption capacity for free fatty acids with varying carbonization time

IV. CONCLUSION

In this study, used cooking oil was refined using kepok banana stems as raw material and activated with H3PO4 at various carbonization times. The results showed that after the despacing (removal of seasoning), neutralization, and bleaching processes, the refining process showed that the refining process had a significant impact on the quality of the oil after going through the refining process. The best results from the absorption analysis were the percentage of free fatty acid absorption of 0.160 percent at the 120th minute of carbonization and the percentage of peroxide number absorption of 31.9416 percent at the 120th minute of carbonization. Meets the requirements of SNI, N0.06-37301995.

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