Bagasse charcoal optimization based on different concentration and immersing time to stabilize quality of cooking oil

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Abstract. Sugar cane is a raw material for making sugar which can only be grown in tropical regions. Sugarcane bagasse generally consist of cellulose sugar groups such as hemicellulose, lignocellulose, and lignin. Other than that it contains hydroxyl groups to absorb colours and free fatty acids. The purpose of this study was to measure bagasse charcoal optimization based on different concentration and immersing time to stabilize cooking oil quality. CRD (Complete Randomized Design) was applied with 3x3 factors. Bagasse charcoal was activated using KMnO4 1N for 2 days. Variation of bagasse charcoal concentration are (5%, 10%, 15%) and variation time to optimization for 4, 5, and 6 days. The result showed that bagasse charcoal can affect the turbidity, smell, and colour from cooking oil that has been used repeatedly. The most effective concentration and immersing time is from sample 5% on 6 day. It can be concluded that re-used cooking oil applied with bagasse charcoal was clearer that those didn’t. The organoleptic assay also showed better profile on cooking oil.

1. Introduction

The main ingredients used by almost all Indonesian people are cooking oil [1]. Cooking oil is commonly used by Indonesian people compared to coconut oil because ordinary people believe using cooking oil will provide a savory and delicious effect on fried foods. But if oil is used continuously it will reduce the quality that causes a bad influence on health [2]. In addition, the nutritional value of fried foods will be affected and produce color in food becomes unattractive, followed by unpleasant taste due to repeated use of cooking oil [3].

The use of cooking oil repeatedly or often called used cooking oil is used oil which is seen from the composition of its chemical ingredients containing carcinogenic ingredients during the frying process [4]. Cooking oil used continuously at 160° C-180° C followed by contact with water and air when the frying process takes place can cause a degradation reaction in cooking oil. Darkening of the color is an effect of repeated use. The decrease in the quality of cooking oil is the effect of the degradation reaction which results in cooking oil being unable to be used again [2]. The longer the frying process in cooking oil, the amount of oil in fried foods will increase due to various kinds of chemical reaction processes such as oxidation and hydrolysis reactions so that free fatty acids are formed [5].

One parameter in determining the quality of oil is the level of free fatty acids. The value of acid numbers becomes the amount of free fatty acids. The number of acids that have a high value will produce low quality in cooking oil [6]. Fatty acids are formed in cooking oil which is used repeatedly because...
when frying with a high temperature is at a temperature of 160° C-200° C the hydrolysis process [7]. The method used to reduce the high value of fatty acid numbers is by using adsorption [8].

Activated charcoal is one of the adsorbents derived from natural ingredients [9]. Charcoal that undergoes changes in chemical and physical properties with its absorption power is determined on the surface area of the particles by activating by activators on chemicals or by heating at high temperatures referred to as activated charcoal. Besides being used as fuel, charcoal can also be used for adsorbents because of its high absorption capacity [10]. The active charcoal raw materials come from plants, animals, and carbon-containing wastes such as soft wood, husks, corn cobs, and sugarcane grinding pulp [11].

The use of bagasse waste is currently lacking because people only treat waste as animal feed, sugar factory boiler fuel, fertilizer making, particle board, and pulp. For this reason, the process of developing technology is needed in the utilization of waste from bagasse [12].

This study aims to provide alternative solutions to the community in overcoming economic health problems arising from the use of recurrent cooking oil.

2. Material and method

2.1. Place and time
The research was conducted at the A Biochemical Laboratory campus of the Jakarta State University on April 20 - May 9, 2019.

2.2. Tools and materials
The tools needed are, oven, furnace, Falcon tube, mortar, spatula, beaker glass, aluminum foil, filter paper, funnel, Turbidimeter TN-100 and sieve. The materials used for bagasse, activators in the form of KMNO3, neutral alcohol, phenolphthalein (PP) indicators, 0.1 N NaOH, glacial acetic acid, chlorophorme, aquades, saturated KI, silica gel, and consumable cooking oil.

2.3. Work procedures
Material preparation. First, the bagasse drying process is carried out for a day. The dried bagasse is then purified at 250° C for 2 hours. After the furnishing or carbonization process is carried out the filtering process with a sieve.

2.3.1. Activation. In this process the bagasse is activated by the addition of an activator, namely KMNO3. The results of bagasse which have been given activators are filtered and washed with distilled water. The washing results are then filtered again. The results of the laundry are put into the oven. After several hours the results are filtered back using a sieve.

2.3.2. Cooking oil preparation. Cooking oil used is cooking oil, used to fry catfish. Consumable cooking oil is put into a 100 ml falcon tube.

2.3.3. Testing. Effect of concentration and duration of immersion. Activated bagasse added to cooking oil consumes 0.5,1.0 and 1.5 g. Each concentration is left for 4, 5 and 6 days.

2.3.4. Determination of the number of free fatty acids. The consumable cooking oil samples before and after being treated were weighed as much as 28.2 ± 0.2 g of the sample into Erlenmeyer. Added 50 ml of hot neutral alcohol and 2 ml of phenolphthalein (PP) indicator. Titrated with 0.1 N NaOH solution until the pink color is reached and does not disappear for 30 seconds. Determination of the levels of free fatty acids (Free Fatty Acid) as follows:

\[
\%FFA = \frac{m N}{S_t \times w} \times 100
\]
2.3.5. Determination of peroxide numbers. In the 30 ml erlemeyer mixed with glacial acetic acid and chlorophome (3: 2), then a sample of consumable oil before and after the treatment of 5 g was put into the solution. Then add 0.5 ml saturated KI and shake until clear. After 2 minutes 30 ml of distilled water is added. The released iodine is titrated with 0.01 N thio sulphate. Determination of the levels of peroxide number as follows:

\[
\text{Peroxide number} = \frac{m_{\text{Th}} x N_{\text{Th}} x 1}{s \times \text{w} \times h(x)}
\]

2.3.6. Organoleptic analysis of cooking oil. Organoleptic analysis includes analysis of physical quality in the form of color and smell. Analysis is done using the five senses, namely smell (smell) and vision (color).

2.3.7. Turbidity of cooking oil. Number of turbidity measure with Turbidimeter TN-100.

3. Results and discussion

3.1. Clarity of cooking oil

Calibration is needed to measure the turbidity of cooking oil treated in the sample. The samples needed were 30 pieces with 3 samples as controls. Cooking oil that has been given an adsorbent in the form of activated charcoal from bagasse is then allowed to stand for 4 days, 5 days and 6 days as the treatment parameters in this study.

![Figure 1.](image)

The results showed that the lowest cloudy point value was on the 5th day of activated charcoal with a concentration of 5% with an average number of 0.96 NTU. Whereas for the highest cloudy point value found on day 4 on activated charcoal the concentration of 10% with an average number of 8.67 NTU. Seen with the lowest muddy point value at a concentration of 5% on day 5 being the clearest oil among all the samples available. Based on the results obtained, activated charcoal is able to influence the clarity of cooking oil that has been used repeatedly [12]. The ability of bagasse shows that turbidity in used cooking oil is reduced because particles that cause turbidity in used cooking oil can be absorbed by bagasse even though it is not optimal.

3.2. Organoleptic of cooking oil

Organoleptic analysis results in each concentration and duration of immersion with activated carbon (Table 1).
Table 1. Appearance of the results of organoleptic cooking oil analysis.

|        | Color          | Smell  |
|--------|----------------|--------|
| 4D     | 5D             | 6D     | 4D | 5D | 6D |
| 5%     | Murky          | Almost clear | Clear | +  | +  | +  |
| 10%    | Murky          | Almost clear | Clear | ++ | ++ | ++ |
| 15%    | Almost clear   | Murky   | Clear | +++| +++| +++|

Information: + = rancid
++ = moderate
+++ = not rancid

The colour change that was very murky when not soaking with activated carbon is quite good. Judging from the higher concentration of activated carbon used and the longer the duration of immersion there is a correlation, namely the colour produced is clearer. However, at a concentration of 15% on day 5 the immersion is not too influential because the absorption of colour is not so optimal by activated carbon.

Changes in smell also occur with the high concentration of activated carbon used and the time of immersion. Activated carbon is used effectively to remove rancid odors in used cooking oil.

4. Conclusion
Result of this research revealed that bagasse can affect the turbidity, smell, and color from cooking oil that has been used repeatedly. The most effective concentration and immersing time is from sample 5% on 6 day.

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