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PROCESS OF PURIFICATION OF WASTE COOKING OIL USING MONITORING (MORINDA CITRIFOLIA) AND KAOLIN AS ADSORBENT

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ABSTRACT

The use of cooking oil repeatedly at high temperatures will cause the quality and nutritional value of fried foods to decrease, which can have a negative impact on consumer health. Repeated use will increase the levels of free fatty acids (ALB) in cooking oil so that it will have a negative impact on the health of people who consume it or use it as a heating medium (frying). The adsorption process is carried out by contacting used cooking oil and adsorbent in the composition Because of this, the idea arose to use noni as an adsorbent for refining used cooking oil by means of adsorption using a mixture of noni (M) and kaolin (K) by varying the composition and contact time. The function of this adsorbent is generally to absorb impurities, odors and chemical substances that are toxic in used cooking oil. Ascorbic acid contained in noni fruit also functions as an anti-oxidant, namely a substance that is able to neutralize the peroxide groups contained in used cooking oil. The function of this adsorbent is generally to absorb impurities, odors and chemical substances that are toxic in used cooking oil. Ascorbic acid contained in noni fruit also functions as an anti-oxidant, namely a substance that is able to neutralize the peroxide groups contained in used cooking oil. The adsorption process is carried out by contacting used cooking oil and adsorbent in the composition Ascorbic acid contained in noni fruit also functions as an anti-oxidant, namely a substance that is able to neutralize the peroxide groups contained in used cooking oil. The adsorption process is carried out by contacting used cooking oil and adsorbent in the composition (100:0 ; 75:25 ; 50:50 ; 25:75 ; 0:100) for 30, 60, 90 and 120 minutes respectively with activated and unactivated kaolin as the control variable. The oil after adsorption was then observed for changes in acid number, peroxide value, moisture content, impurities content and color intensity. In several studies, the quality of oil recovered from used cooking oil showed a slightly blackish color, making the oil look less attractive. The use of kaolin as a bleaching earth in refining used cooking oil is due to the high SiO2 content in kaolin, which is expected to improve the color of used cooking oil, especially to improve the color of the recovered oil, so that it approaches the quality of standard cooking oil used in the market.

***Keywords**: adsorbent; free fatty acids; noni; used cooking oil; kaolin*

1. INTRODUCTION

Cooking oil is commonly used in home industries, restaurants and the food industry because of its superiority in food processing. The need for cooking oil is increasing marked by the large number of people both in the household and industry using cooking oil repeatedly (3). As a result of repeated heating, various kinds of damage arise due to oxidation, hydrolysis, polymerization and reactions with metals causing the oil to turn brown, thicker, foamy, smoky and leave an unpleasant odor in fried foods (4). Oil damage will affect the quality and

nutritional value of fried foods. The main damage to the oil is the emergence of a rancid smell and taste, while other damages include an increase in free fatty acids (FFA), peroxide number (PV), and a change in the color of the oil to a darker color (5). Cooking oil that has experienced a decrease in quality is characterized by a dark color change, a smelly aroma, high levels of free fatty acids and peroxide numbers. In addition, there will also be a decrease in the nutritional value of the fried ingredients. This is because when heated at high temperatures accompanied by contact with air it will cause the oil to undergo chemical changes such as hydrolysis, oxidation, polymerization and browning reactions. Oxidation and polymerization processes can damage some of the vitamins and essential fatty acids contained in the oil, which can lead to poisoning in the body and various diseases, such as diarrhea, deposition of fat in blood vessels, and cancer (6).One effort that can be done to purify used cooking oil is through the adsorption process using noni.Noni has long been used as a traditional medicine. The important chemical constituents of noni juice are fatty acids which include: caproic acid, caprylic acid, palmitic acid, stearic acid and oleic acid. The nutritional content contained in noni fruit is protein, mineral Se, vitamin C and short chain fatty acids which cause a pungent odor. The level of vitamin C in noni fruit is 12.24%. Noni fruit also produces several antioxidants, namely: scopoletin, nitric oxide, vitamin C and vitamin A (7).

Research Urgency

The antioxidant content in noni fruit which consists of xeronin, proxeronin and ascorbic acid can purify used cooking oil from free fatty acid content and peroxide value due to repeated use of cooking oil at high temperatures. In addition, noni is also believed to be able to purify used cooking oil because it has antioxidants that can capture free radicals and prevent chain reactions from occurring (8). So that used cooking oil that has been processed using noni adsorbent is safe to use and its quality can return to (at least close to) the quality of new cooking oil (2).

Putra et al. (1) purified used cooking oil by adsorption process using noni fruit. The research results obtained, there was a decrease in free fatty acid levels up to 83% from the fatty acid content of pure oil with a stirring speed of 90 rpm in 300 ml of oil and 50 grams of noni powder addition, the peroxide group level was reduced to 71%. The dirt content decreased by 99% and the water content decreased by 74%. In a study conducted by Barau (2) with a stirrer speed of 100 rpm and variations in the addition of noni powder, the result was a decrease in free fatty acid levels to 0.2% from 10 grams of adsorbent in 100 ml of used cooking oil with a stirring time of 60 minutes, water content 0.02% of 15 grams of adsorbent and 0.09% of impurities from 15 grams of adsorbent. Whereas in Rizky's research (9) an organoleptic test was carried out to determine the level of preference (color, smell and taste) for used cooking oil that had been purified with noni which was represented by 7 panelists. From the results of the most preferred formulation of the noni simplicia was the 50 gram noni simplicia with a color yield of 100% which was liked by 7 panelists, odorless 85.71% which was liked by 6 panelists and tasteless 71.42% which was liked by 5 panelists.

From the results of research that has been done, the color of the oil is still not good. The oil obtained after processing is brownish yellow in color. Although it was able to significantly reduce the levels of Free Fatty Acids (ALB) using adsorbents and noni, this still affected the quality of the oil in terms of appearance and economy. Therefore it is necessary to make efforts to improve the color quality of used cooking oil by carrying out a bleaching process using kaolin which is widely available in the province of Aceh. The product from this research will later become a solution to problems for repeated oil users, especially

fried food traders and can be applied on a larger scale.

Research Objectives, Benefits and Limitations

Used cooking oil (waste cooking oil) is oil derived from plants such as corn oil, vegetable oil and ghee which has been used as cooking oil. This oil is used for household needs. When viewed from its chemical composition, used cooking oil contains carcinogenic compounds that occur during the frying process. As a result of using used cooking oil, it can damage health, cause cancer, and can reduce the intelligence of the next generation. Economically, used cooking oil is still suitable for use, so many consumers of cooking oil use it repeatedly. For this reason, it is necessary to have an alternative processing of used cooking oil that is cheap, economical and easy to obtain. One of the processing alternatives is to use noni as an absorbent, besides being easy and relatively inexpensive. One effort that can be done to overcome this problem is by purifying used cooking oil so that it produces oil that is suitable for reuse. This purification can be done through the adsorption process from natural materials.Clarification is a stage of the purification process to remove unwanted dyes in oil. This clarification is carried out by mixing oil and a small amount of adsorbent. Bleaching of palm oil in the palm oil processing industry, is generally done with an adsorbent in the form of bleaching earth. Commercial bleaching of palm oil with bleaching earth is carried out at a temperature of 100-130°C for 30 minutes, with a bleaching earth content of 6-12 kg/tonne of palm oil or around 0.6-1.2% (11).

In this study, kaolin adsorbent was used which was mixed (modified) with noni fruit. The reason for using noni is because of the nutritional content it contains such as protein, mineral Se, vitamin C. The level of vitamin C in noni fruit is 12.24%.

RESEARCH METHODS

Research methodology

The material used in this study was used cooking oil from food vendors. Noni and kaolin as adsorbents. Ethanol, phenolphthalein and KOH for free fatty acid analysis. Acetic acid, chloroform, Potassium Iodide, aquadest, Na2S2O3 and starch for analysis of peroxide numbers. N-Hexane in feces analysis.

- The test steps are as follows:

1.Noni Production

Old noni fruit is cleaned first. Then in the blender until smooth and poured into a dry container. The paste was dried using an oven at 60°C for 3 hours to remove the water content. After that, the dried noni was crushed and sieved with a particle size of 80/100 mesh.

2. Kaolin activation

Kaolin is heated at 105°C to dry. Then the kaolin was crushed and sieved using a 100/120 mesh sieve. The citric acid that escaped from the sieve was mixed with 5 N citric acid and allowed to stand for 30 minutes. Then washed with distilled water and dried in an oven at 105°C for 90 minutes. After drying, cool in a desiccator.

3. Water content

The analytical method used to analyze the amount of water contained in the sample.

4. Dirt level

The analytical method used aims to analyze the amount of impurities in the sample.5. Color Test

The color test uses a UV-VIS spectrophotometer with the aim of knowing the ability of the absorbent in absorption by looking at the absorbance value.

- Trial Treatment

1) Fixed variable

- Used cooking oil 300 ml
- The mass of the adsorbent is 100 grams

- The kaolin activation process uses 5 N citric acid
- Stirrer speed 90 rpm

2) Independent variable
- Comparison of kaolin and noni (100:0 ; 50:50 ; 75:25 ; 25:75 ; 0:100) gr
- Adsorbent contact time: 30, 60, 90, 120 and 150 minutes
- Activated and unactivated kaolin

3) Dependent variable
- Free Fatty Acid (ALB)
- Peroxide number
- Water content
- Dirt level
- Color

RESULTS AND DISCUSSION

Reduction of Free Fatty Acids in Used Cooking Oil

Free fatty acids are the basis for determining the condition or condition of an oil whether it is still suitable or not for consumption. The acid number in the oil indicates the fatty acid in the oil. If the acid number is too large, the free fatty acids are also large and this means that the quality of the oil is getting lower. Acid numbers come from oil hydrolysis or poor processing.

This study used noni which was dried into powder and kaolin which was not activated and activated with citric acid solution with a concentration of 5 N for 24 hours. The composition of the two adsorbents was varied and contact was carried out with used cooking oil for various times. The results obtained can be seen in Figure 4.1 and Figure 4.2 which are the relationship between composition variations and concentration reduction

ALB. (noni: kaolin is not activated) and contact time to decrease free fatty acid levels 30 minutes

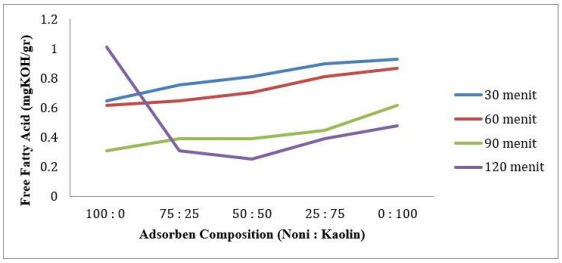

Figure 4.1 Adsorbent composition relationshipFigure 4.1 Correlation between adsorbent composition (noni: kaolin not activated) and contact time on the decrease in free fatty acid levels.

The figure above shows the effect of the adsorbent composition and contact time on the levels of free fatty acids in used cooking oil. From the figure it can be seen that the best absorption occurs at contact time of 120 minutes and composition of 50:50 which means 50% noni and 50% kaolin are not activated with a total of 100 grams when contacted. The best results for free fatty acids were at 0.253 mgKOH/gr from the initial free fatty acids of 2.9172 mgKOH/gr, which means that the composition of 50:50 for 120 minutes of contacting can reduce free fatty acids up to 2.66 mgKOH/gr.

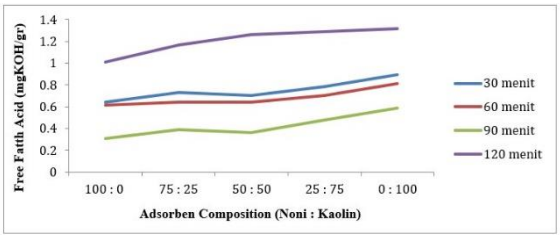

Figure 4.2 Correlation between adsorbent composition (noni: activated kaolin) and contact time on the decrease in free fatty acid levels.

Onfigure 4.2showed the effect of activated noni and kaolin adsorbent composition and contact time on free fatty acid levels in used cooking oil. From the picture it can be seen that the best absorption occurs at 90 minutes contact time and the composition of 100 grams of noni. The best results were at 0.308 mgKOH/gr, which means reducing free fatty acids to 2.61 mgKOH/gr.

From datait can be seen that the levels of free fatty acids decrease if the contact time is longer (Hermawati and Purnavita, 2014). Free fatty acids are also affected by the speed of stirring (Putra et al., 2012). However, from the data in table 4.1 it can be seen that the value of free fatty acids at 120 minutes contact time is higher than the previous contact time. This is due to the unstable temperature and stirring during the operation of the tool. High temperatures result in free fatty acid levels being formed again so that the value obtained increases (Lucia, 2014). Unstable stirring also affects the levels of free fatty acids because there is little contact between the adsorbent and the oil, so that a small amount of free fatty acids is absorbed by the adsorbent (Putra et al, 2012).

Based on the two figures above, it can be seen that the decrease in free fatty acids was more in the activated noni and kaolin compositions as shown in Figure 4.1. This is influenced by activated kaolin where clay activation using acid will produce clay with a larger active site, resulting in clay with a higher adsorption capacity than before activation (Hesti, 2016). The decrease in free fatty acid levels is also affected by noni where the content in the noni fruit can neutralize or stabilize the free fatty acid compounds contained in used cooking oil. There is a physical adsorption process on the noni fruit absorbent, because the noni fruit adsorbent has a larger surface area and pores, so it binds and absorbs free fatty acid compounds on its surface.

Decreasing Peroxide Numbers in Used Cooking Oil

Peroxide number is a value that indicates the degree of damage to the oil or fat. Unsaturated fatty acids can bind oxygen to their double bonds to form peroxides. Peroxide is the initial product of the oxidation reaction which is labile, this reaction can take place if there is contact between oxygen and oil (Ketaren, 2005). The process of forming peroxides is accelerated by the presence of light, acidic conditions, humidity and catalysts. Peroxides can speed up the process of causing rancid odors and unwanted flavors in foodstuffs. To determine rancidity is to measure the compounds resulting from oxidation. Peroxide number can be determined by iodometric method. The trick is that some oil is dissolved in a mixture of acetate:chloroform containing KI, then there will be a release of Iodine.

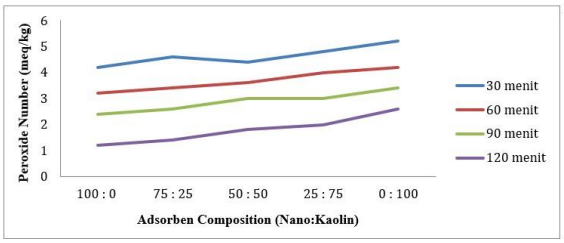

Figure 4.3 Correlation between adsorbent composition (noni: kaolin not activated) and contacting time on decreasing peroxide number.

Figure 4.3 shows that the best results are in the composition of 100 grams of noni and 120 minutes of time. In this composition, a peroxide value of 1.2 meq/kg was obtained from the initial peroxide value of 8.2 meq/kg so that the reduction reached 7 meq/kg. The increase in the peroxide value in used cooking oil occurs because during the frying process or prolonged storage the oil comes into contact with oxygen in the air, resulting in an increase in the peroxide content.

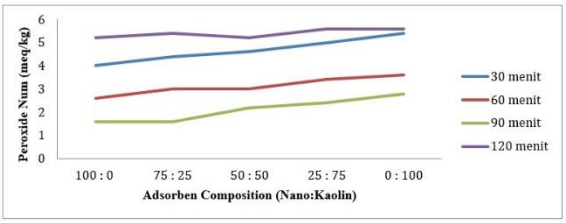

Figure 4.4 Relationship of Adsorbent Composition (Ni: Activated Kaolin) and Contact Time to Decreasing Peroxide Numbers.

Figure 4.4 shows the best results in the composition of 100 grams of noni and 50:50 of noni and kaolin activated within 90 minutes of contacting. The yield obtained

was 1.6 meq/kg so that the reduction reached 6.6 meq/kg.

The decrease in peroxide number is caused by the adsorbent that interacts with used cooking oil optimally in absorbing peroxide compounds. Noni powder contains ascorbic acid or vitamin C. It is this source of vitamin C that can help and is able to neutralize free radicals, namely harmful particles (Putra et al., 2012). The best time difference is the same as that of free fatty acids that are increasing. The operation of the tool which is not temperature stable results in a further increase in the peroxide value. The research by Hermawati and Purnavita (2014) showed that at 150°C the peroxide number increased again. The contact time also affects the peroxide value, which if it is longer it can trigger the formation of peroxide compounds in used cooking oil.

Reducing Levels of Waste Used Cooking Oil

The dirt content is the value of the impurities contained in used cooking oil which occurs as a result of using used oil repeatedly and is caused by a high heating process. Good quality oil requires a maximum impurities content of 0.3% (SNI 01-3741-2002). The level of impurities contained in the oil can reduce the quality of the oil because it can affect the taste, smell and color of fried foodstuffs. Therefore it must be avoided from the content of large impurities so that quality is maintained.

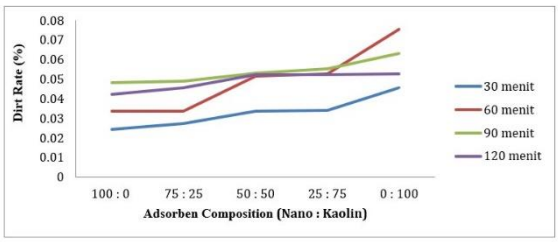

Figure 4.5 relationship between adsorbent composition (noni: activated kaolin) and contact time to decrease in dirt content

From Figure 4.5 it can be seen that the level of impurities has increased in each composition. This happens because the use of oil repeatedly causes the impurities in the fried ingredients to mix with the oil so that the level of impurities in the oil increases. After adding the adsorbents (noni and kaolin) the dirt content also increased with the highest dirt content value in the 100% kaolin composition. Separation process between oil and adsorbent which is done by precipitation is less effective. This is because there is still an adsorbent left in the oil that has not settled to the bottom of the container. The fine particle size also increases the dirt content. This can be seen in the 100% kaolin data.

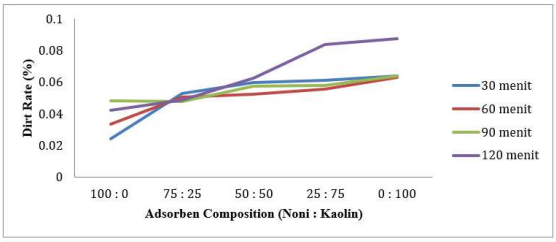

Figure 4.6 The relationship between the composition of the adsorbent (noni: kaolin is not activated)
and contact time to decrease in dirt content.

OnThe picture above also shows the same thing, namely the more kaolin composition, the greater the level of impurities because the fineness of the kaolin powder makes it difficult to settle on the surface of the container. In this study, only a few levels of impurities met the standard, namely at 30 minutes with a composition of 100% noni, 30 minutes with 75% noni and 25% kaolin.

Color Intensity

Color has been used as an index of oil quality for many years. In this study, the color testing method was carried out with a UV-VIS spectrophotometer. Measurements were made at a wavelength of 400-700 nm. The greater the absorbance at this wavelength indicates the darker the color of the oil. This means that there are more products from oil degradation (Febriansyah, 2007).

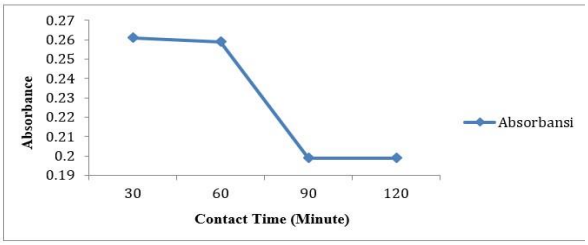

Figure 4.11 The relationship between contact time and absorbance in the best free fatty acid samples.

ProcessColor absorption consists of physical absorption and chemical absorption. The use of adsorbents with the adsorption process is a physical processing. Physical absorption is due to the contact between the grain surfaces at various times.

Figure 4.12 Display of Oil at Any Time

Based on the picture above it can be seen that there is a decrease in absorbance at any time. The greater the absorbance value, the darker the color of the oil. Conversely, the smaller the absorbance value, the brighter the color of the oil. The lowest absorbance was at 120 minutes of contacting at 0.199. The absorbance of used cooking oil is 2.078, which means the decrease is 1.879. This is influenced by the length of time of contact and heating so that the adsorbent absorption is better because more and more pollutant particles (colloids) are able to be bound by the adsorbent so that the color of the oil becomes clearer/the absorbance value gets smaller (Rosita and Widasari, 2009).

CONCLUSION

1. The optimum conditions for the ratio of adsorbents in improving the quality of used cooking oil are:
   a. In noni and activated kaolin adsorbents, the best ratio obtained was 100:0 with free fatty acids of 0.308 mgKOH/g with a removal of 89.44%., peroxide value of 1.6 meq/kg, impurities content of 0.02428% and water content. 0.0057%
   b. In non-activated noni and kaolin adsorbents, the best ratio obtained was 50:50 with free fatty acids of 0.253 mgKOH/g with an allowance of 91.33%. Meanwhile, the peroxide value is 1.2 meq/kg, the dirt content is 002428% and the water content is 0.0057% in a ratio of 100:0.
2. The effect of activated and inactivated kaolin on product yield is not too large. Among the two that produce the best value is activated kaolin.
3. The optimum time required is:
   a. The activated noni and kaolin adsorbents were 90 minutes for free fatty acids, peroxide value and water content. While the level of dirt is in 30 minutes
   b. Noni adsorbent and unactivated kaolin are 120 minutes for free fatty acids and peroxide value and 90 minutes for water content and 30 minutes for impurities content.

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