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Quality Test of Palm Cooking Oil Used Repeatedly Based on Free Fatty Acid Content, Moisture Content, Peroxide Number

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ABSTRACT

Background: Cooking oil used repeatedly can increase levels of free fatty acids and the number of peroxides in the blood, so that the risk of heart disease and diabetes.

Aim: The purpose of the study was to find out the quality of palm cooking oil used repeatedly in tempeh mendoan against organoleptic, moisture content, free fatty acid content and peroxide number content.

Method: Samples of palm cooking oil are used to fry tempe mendoan at 105oC for 10 and 60 minutes as much as 1 frying pan per day for 3 days, then the oil is cooled at room temperature and filter the oil so that it does not mix from the rest of the fried tempeh mendoan. Filtered oils are tested for quality with test parameters including organolepty including shape, color, odor, moisture content, peroxide levels, and free fatty acid levels. The data results were compared with sni 01-3741-2002 cooking oil quality standard and each level was analyzed using nonparametric statistics (Kruskall-Wallis) with a confidence level of 95%.

Result: Organoleptic test results obtained the form of cooking oil in light yellow to yellow gold at the 10th minute on the 2nd day after 2 frying pans and orange in the 60 minutes after 3 frying pans for 3 days. Moisture content obtained results 2,086± 2,142 (10th minute) and 0.369± 0.304 (60th minute), free fatty acid content obtained results 0.317± 0.044 (10th minute) and 0.337± 0.076 (60th minute), the rate of peroxide numbers obtained resulted in 0.281± 0.090 (10th minute) and 0.386±0.158 (60th minute). Based on statistics tests there are significant differences (<0.05) to the decrease in water content quality, free fatty acid content and peroxide levels in palm oil cooking oil used repeatedly in tempe mendoan.

Keywords: Cooking oil, tempe mendoan, moisture content, peroxide number, free fatty acids.

BACKGROUD

Cooking oil consumed daily is used for frying foods such as tempe mendoan often found used repeatedly, thus causing changes in its quality from color, smell, as well as the chemical and physical properties of good cooking oil. During the frying process cooking oil undergoes various chemical reactions including hydrolysis, oxidation, isomeration, and polymerization reactions. Repeated heating of cooking oil at high temperatures and for a long time, will produce solid polymer compounds in oil (akrolein) (Ketaren, 2005). The formation of polymer compounds during the frying process occurs due to the polymerization reaction of unsaturated fatty acids. In addition, cooking oil contains small amounts of carotene, tocopherols, and alcohol. This compound can make levels of Free Fatty Acid (FFA) to be high (Tudisco et al, 2015) and according to Rifki et al. (2013), states that jelantah oil contains peroxide compounds that can increase the risk of some diseases, including carcinoma.

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Good quality palm oil needs to be maintained quality and based on the quality standard of cooking oil SNI 01-3741-2002 the moisture content of cooking oil is less than 0.1%, the content of free fatty acids 2% or less and the level of peroxide number below 2% and free of color from red and yellow (must be pale) is not green and clear (Ketaren, 1986). Quality testing of cooking oil used repeatedly in this study with organoleptic test parameters include shape, color and smell by the five-sense method while determining the moisture content by oven method, peroxide number content using Iodometric titration method as well as testing of free fatty acid levels by spectrophotometry method with a maximum λ of 434.4 nm.

Based on research conducted by Fanami and Ningsih (2018) stated that the quality of cooking oil used by traders has decreased water content and fatty acid content and does not match the quality of cooking oil based on SNI 01-3741-2002 and is no longer suitable for consumption. According to Adrian (2015) and Suroso (2013) stated that, high acid levels also contain high free fatty acids, so it can be risky to consumers. The color of cooking oil will increase with the longer the oil is used for frying, as well as the higher the heating, the more peroxide compounds formed also the more so that the oil gets darker (Winarno et al, 1997). According to Adrian (2015) states that, free fatty acids consumed in excess will increase the levels of Low Density Lipoprotein (LDL) in the blood which is a nasty cholesterol. According to Susinggih (2005) stated that, damaged oil can decrease the nutritional value and affect the quality and value of fried foodstuffs and have a structure and appearance that is less attractive and taste and smell is not good. Based on the above, research on the quality of cooking oil used repeatedly is important to do because cooking oil is often used by the public. Researchers hope the results of this study can be a reference and education to the public in order to maintain health by not using cooking oil repeatedly more than 3 times. The purpose of the study was to find out the quality of palm cooking oil used repeatedly in tempeh mendoan against organoleptic, moisture content, free fatty acid content and peroxide number content.

METHODS

Tools

Spectrophotometer (Shimatzu 1800), cuvette (Helma), glassware (Pyrex), pipette volume 10.0 mL(Pyrex), burette (Pyrex), analytical scale (Ohauss), oven (memmert), micro pipette (Socorex) pumpkin measuring 100 mL and 250 mL (Emerck), brown bottle, filter paper, water handler.

Material

Samples of palm cooking oil (Tropical), tempeh, wheat flour (Rosebrand), alcohol p.a 96% (Emerck), sodium thiosulfate solution ($Na_2S_2O_3$) 0.1 N, hydrochloric acid (HCl) 2 N, hydrochloric acid (HCl) 37%, Chloroform p.a (Emerck), glacial acetic acid p.a (Emerck), saturated solution Potassium Iodide (KI), aquades and amyloid indicators 1% and Potassium dichromate ($K_2Cr_2O_7$) 0.1 N.

Preparation of cooking oil samples

Samples of cooking oil were analyzed before and after use for frying tempeh given wheat flour dough to make tempe mendoan made every day before frying. Then the cooking oil is cooled at room temperature and separated from tempe mendoan. Then cooking oil was observed organoleptic color and smell and tested water content, free fatty acid content and the number of peroxides in the 10th and 60th minutes every 1 frying pan per day and carried out for 3 days.

Organoleptic test

Samples of cooking oil are taken to taste and placed on a clean and dry porcelain glass, then kiss to know the smell by 3 people. Samples of cooking oil taken adequately and placed on a clean and dry poeselin glass, Then

observed the color with five senses by 3 people (SNI 01-3741-2002). Observations are made every day for 3 days after cooking oil is used to fry tempe mendoan.

Water content test

The clean weigh bottle is heated in the oven at 105^{o}C for 30 minutes, then cooled in an excavator, then weighed until the constant weight of the empty bottle is obtained dry. The cooking oil sample weighed 2 grams in the weigh bottle, then heated in an oven at 105°C for 4 hours. The sample is cooled in an excavator for approximately 15 minutes and weighed back. Drying is carried out until a constant weight is obtained (the difference in consecutive weighing is less than 0.2 mg). Weight reduction is the amount of water in the oil (Suroso, 2013). 3 times repeated and calculated its content in percent with the formula namely:

$$\% \text{ moisture content} = \frac{\text{BM Weight (g)} - \text{BK Weight (g)} \times 100\ \%}{\text{Sample weight (g)}}$$

Standard curves of oleic acid

Oleic acid made series concentration of 0,1 % ; 0,2 % ; 0,3 % ; 0,4 % ; 0,5 % ; 0.6 % of the concentration of stock solution 90%. The stock solution is taken as much as 0.01 mL; 0.02 mL ; 0.03 mL ; 0.04 mL ; 0.05 mL ; 0.06 mL is then inserted into each 10.0 mL mustard flask adding p.a chloroform to the limit mark and read its absorbance at a wavelength of 434.4 nm (Suroso, 2013).

Fatty levels acids test

The sample was taken as much as 1 ml and put in a 10.0 mL mustard flask then added chloroform p.a ad to the limit mark. Then the solution is read absorbance at a maximum wavelength of 434.4 nm. The determination was repeated 3 times (Suroso, 2013). Free fatty acids are expressed in percent obtained from the standard curve equation that has been obtained from linear regression analysis which is 0.98518 x + 0.12175.

Amount of peroxide test

Cooking oil as much as 5.0 grams weighed then put in a lidded erlenmeyer 250 mL pumpkin. Next into the erlenmeyer flask, added a mixture of glacial acetic acid and chloroform as much as 30 mL using a measuring cup 50 mL then a homogeneous solution until the material dissolved all. After that is added 0.5 mL of saturated KI solution. After one minute add 30 mL aquadest and 0.5 mL amlum indicator 1%. Then the solution is titrated with a raw solution of $Na_2S_2O_3$ 0.1 N until the titration end point. Entitlement is done with repetition 3 times. The number of peroxides expressed in mg is equivalent to peroxide in every 100 g of the sample (Suroso, 2013). The formula is:

$$\text{Number peroxide (meq O2/100 gram)} = \frac{\text{V } Na_2S_2O_3 \text{ (mL)} \times \text{N } Na_2S_2O_3 \times 1000}{\text{Sample weight (gram)}}$$

RESULTS AND DISCUSSION

Organoleptic test

This test was conducted to determine the quality of oil seen color and smell that can be analyzed with the five human senses found in table I and Figure 1.

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Table 1. Organoleptic test table of cooking oil samples before and after treatment

Sample	Frying day	Length of frying pan	Organoleptic		
			Shape	Color	Odor
1	1	0 minutes	Liguid	Light yellow	Typical cooking oil
2	2	10 minutes	Liguid	Light yellow	Typical cooking oil
3	2	60 minutes	Liguid	Light yellow	Typical cooking oil
2	3	10 minutes	Liguid	Light yellow	Typical cooking oil
3	3	60 minutes	Liguid	Light yellow	Typical jelantah tempe
2	4	10 minutes	Liguid	Light yellow	Typical cooking oil
3	4	60 minutes	Liguid	Light yellow	Typical jelantah tempe

According to SNI Standard 01-3741-2002 for odor results are declared normal when smelling typical cooking oil. If smell other than cooking oil is declared abnormal. As for the pale-yellow color (young) adjusted for the type of oil is declared normal. For colors other than those colors are declared abnormal.

Figure 1. Palm oil before and after the treatment for frying tempeh mendoan (a) before frying (b) replication 1 time 10 minutes (c) replication 1 time 60 minutes (d) replication 2-time 10 minutes (e) replication 2 time 60 minutes (f) replication 3 time 10 minutes (g) replication 3 time 60 minutes

Based on the results of color organolepty test in table I compared to sni standard 01-3741-2002 can be known that the color produced from the frying process tempe mendoan before and after there are differences. Cooking oil initially looks light yellow with a distinctive smell of cooking oil is different from cooking oil that has undergone various frying processes such as in the first 60 minutes whose color has turned to yellow gold in which there is already contamination of fried ingredients. The cooking oil used for the frying process in the 10th minute of both the first, second, and third frying pans did not show a significant difference because the resulting color did not change so much. The color of the oil can be seen from the figures 1 point b, d, and f. In used cooking oil in the third frying pan 60 minutes there is an intense discoloration that is from yellow gold to yellow orange which means there is more contamination, in addition to the change can be caused by heating, storage, and frequency of frying. The color of cooking oil can be seen in the 1 point g image. Repeated use of cooking oil at high temperatures (100 -180°C) accompanied by contact with air and water in the frying process will result in a complex degradation reaction in the oil and produce various reaction compounds. Cooking oil also changes color from yellow to orange color. This degradation reaction degrades the quality of the oil and eventually the oil can no longer be used and must be disposed of. Degradation reaction products contained in

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this oil will also decrease the quality of fried foodstuffs and cause adverse effects for health (Yustinah, 2011). From the results above shows that, the oil that is still allowed to be used is the oil in the 10th minute frying pan on the first and second day. As for the length of frying 60 minutes can not be used anymore because the color requirements are not met menrut standard SNI 01-3741-2002 which is light yellow to bright yellow.

Moisture test

The yield of water content in 10-minute LP is 2,086± 2,142 % (b/b), while in LP 60 minutes is 0.369± 0.304 % (b/b). A graph of the increase in moisture content based on the day and length of frying can be seen in figure 2. Based on the moisture content obtained only the length of frying sixty minutes in the first frying pan is still safe to fry tempe mendoan because the content is still included in the sni range, 2002 the moisture content is 0.01 - 0.03%. One of the factors that influence this is the amount of water contained in cooking oil as a result of foodstuffs contaminated by air and water. Cooking oil containing high water content has a decrease in quality because the higher the moisture content in cooking oil, the lower the quality of the cooking oil. This can affect the taste and shelf life of cooking oil (Angga, 2012).

Free fatty acid content test

In the test of free fatty acid levels can be seen in figure 2 shows that, the longer the use of cooking oil and the more cooking oil is used then the content of free fatty acids calculated as unsaturated fatty acids (oleic acid) is increasing when compared to the table SNI 2002 fatty acid content should not be more than 0.30% (b/ b) then the level that is still eligible is the level on the sample before use for frying and after frying the first 10 minutes on the 2nd day which is 0.270 – 0.288 % (b/b). The average value obtained from free fatty acid levels was 0.317 % (b/b) on a frying pan length of 10 minutes and 0.337% (b/b) at a frying pan length of 60 minutes. As for the elementary school on the length of the frying pan 10 minutes obtained ± 0.044 % (b / b) and ± 0.076 (b / b) on the length of the frying pan 60 minutes. From the SD value is known if all the data on LP 10 and 60 minutes are still close to the number 0, then shows the data point is close to the average value. If the standard deviation number is equal to 0 then all the data in that set is the same. Frying frying on the first 60 minutes on the 1st day of free fatty acid levels is no longer eligible for SNI 2002 which is 0.315%. Increased levels of free fatty acids due to the increasing use of oil and the presence of water in the oil so that hydrolysis occurs in the oil. This is in accordance with the fact Sulieman et al. (2001) that the increase in levels of free fatty acids because at the beginning of the frying, the moisture content in the oil is not too much, but in the process of frying further the moisture content in the oil is increasing. The presence of water in the oil will accelerate the hydrolysis process of the oil. The longer the use of oil for frying the higher the content of free fatty acids formed.

Peroxide number test

The result of the peroxide number at the length of the 10th minute frying is 0.281± 0.090 (Meq/100g), while at the length of the 60th minute frying is 0.386±0.158 (Meq/100g). The increase in the number of peroxides by the day and length of frying can be seen in figure 2.

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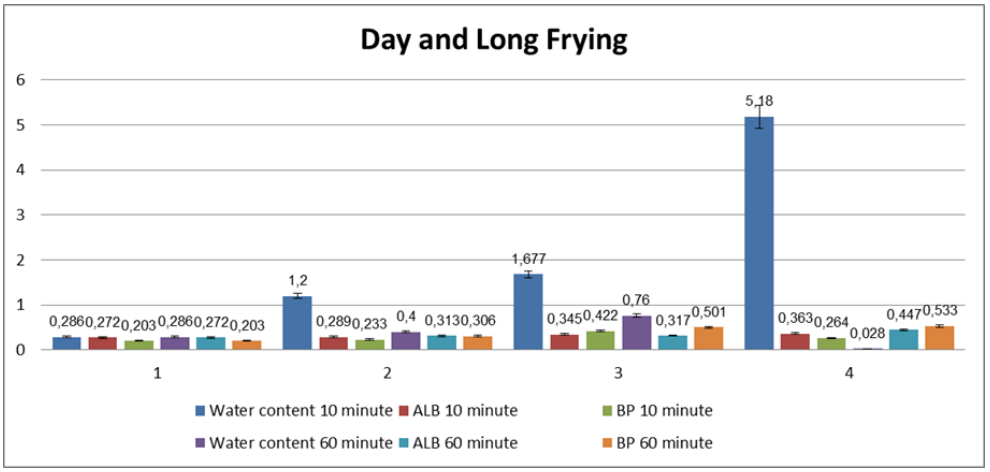

Figure 2. Increased levels of free fatty acids, moisture content, and peroxide numbers by day (frying replication) and length of frying time of 10 and 60 minutes

Figure 2 shows that the longer the moisture content, the free fatty acid content, and the number of peroxides increases. But at the water content of 60 minutes on the fourth frying day the value drops. The number of frying frequencies and the length of time the frying pan can decrease the quality of cooking oil. Based on the analysis of the number of peroxides that have been done the longer the time used for frying and the more frequency of frying can damage the composition of the oil. According to Ketaren (1986) peroxide in cooking oil will increase when the oil already used is cooled and the peroxide will decompose again after the heating process. And based on different tests to find out the influence of the length of frying minutes 10 and 60 minutes and the day (frequency) of frying on the quality of palm cooking oil used frying tempe mendoan repeatedly based on water content, free fatty acid content and the number of peroxides the result gives a significant influence < 0.05 there is a meaningful difference. Based on the results of this study shows that repeated use of cooking oil is not good for health. Unstable peroxide content in deep drying frying pans at the time of hydroperoxide frying decomposes to form carbonyl and aldehyde compounds that cause peroxide values to decrease (Shahidi and Wanasundara, 2002). In addition, heating cooking oil with high temperatures and used repeatedly is able to produce aldehyde compounds, ketones, as well as aromatic compounds that have a rancid odor and can result in increased systemic inflamation characterized by the emergence of interleukin-6 and C-reactive proteins that have an impact on heart failure, sudden death and diabetes, due to insulin becoming insensitive (Mozzaffarian et al, 2004; Fan et al, 2013; Felix et al, 2009; Tsuzuki et al, 2010; Sartika, 2009).

CONCLUSION

Cooking oil used repeatedly there is a decrease in quality in organoleptis color and odor changed from light yellow to yellow orange with a distinctive smell of cooking oil jelantah and there are significant differences in the increase in water content, free fatty acid content and the number of peroxides, so it is not worth consuming after the use of more than 2 frying pans repeatedly at the 60th minute. Mamfaat from this study as a reference and education to the community of cooking oil users so as not to use it repeatedly to prevent diseases such as heart disease and diabetes.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORS' CONTRIBUTION

Providing ideas and analysis on goring oil used repeatedly can have an effect on health.

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