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Determination of Free Fatty Acid in Frying Oils of Various Foodstuffs

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ABSTRACT

Cooking oil is one of the basic human needs as food processing media. Repeated use of cooking oil by heating at high temperature will produce free fatty acid levels. This study aim to determine the levels of free fatty acids in frying oils of various foodstuffs which were chicken, catfish, and flour with acid base titration method. The study population was frying oils of various foodstuffs of 0 up to 5th. The results of fatty acid levels in the repeated use of chiken (sample A), catfish (sample B) and flour foodstuffs shows the fatty acid levels exceed safe limits set by SNI 7709:2012. The fatty acid levels of the oil before it used was 0.24%. The increase of free fatty acid was influeced by how many the coocing oil used to frying. The highest level of fatty acid in coocing oil was reached after the fifth of friying. It happened because the level water in foodstuffs increase due to the used of coocing oil.

Keywords: *free fatty acid, edible oils, foodstuffs*

1. INTRODUCTION

Cooking oil is one of the important needs of the people in the world. One of the cooking oil is often used is palm oil. Hamburg-based Oil World Trade journal reported that the global fats and oil production were 160 million tons in 2008. From the total of oil showed that palm oil and palm kernel oil contributed about 48 million tons or 30% of the total, and then the soybean oil was 37 million tons or 23% (Akanda et al., 2012). Cooking oil serves as a medium of heat delivery and provides a tasty taste in food. The amount of cooking oil in accordance with the demand for food is fried and consumed by everyone. Cooking oil serves as a medium of heat delivery and provides a tasty taste in food.

The most popular consumed is chicken, catfish, and flour fried. This is evidenced by the number of chicken, catfish, and flour fried sellers in each place. However, after being noticed the palm oil used by sellers is not always new, even some use of used cooking oil whose color has turned into more concentrated still used for frying chicken, catfish, and flour. Whereas cooking oil that has changed color to concentrate because of cooking activity indicates that cooking oil has structural damage (Ratogi, Mathur & Rastogi, 2006)

The damage of oil structure was caused by heating at high temperature (200-250^{0}C). From the oil heating contains carcinogenic compounds such as free fatty acids whose value exceeds the standard of SNI 7709: 2012. The safe value of free fatty acid in palm oil is less than 0,3%. If the value of free fatty acid is more than 0.3% means the palm oil is carcinogenic.

The increasing free fatty acid comes from chemical reaction in the frying process. The chemical reaction is the hydrolysis reaction (Khan et al., 2008). So, this is consistent with the assertion that free fatty acids content in cooking oil will increase with time frying (Naghshineh et al., 2010) halam 261

Cooking oil used repeatedly and consumed continuously will endanger health. When people consume foods that contain high levels of free fatty acids it will result in increased levels of LDL and lower blood levels of HDL, reducing the body's ability to control blood sugar because it can reduce the response to the hormone insulin (Tripathy et al., 2003).

From the research of determining FFA from the oil after frying potatoes, the FFA was increasing (Tabee, Jagerstad & Dutta, 2009). The research was conducted on frying oil in potatoes. So this research will examine used oil from chicken, catfish, and flour frying. From this research will be known the effect of ingredients on free fatty acid content. Therefore, this study took the title of Analysis of Free Fatty Acid in Frying Oils of Various Foodstuffs.

2. RESEARCH METHOD

The research design used was experiments laboratory conducted at the Research Laboratory, Faculty of Mathematics and Natural Sciences, Yogyakarta State University. The oil sample is obtained from the frying of foodstuffs such as chicken, catfish, and flour with each repeat of frying that is from frying of 0, 1st, 2nd, 3rd, 4th and 5th. First of the fryer of 0 is new oil that has not used, then first frying, boiling oil time is 3 minutes, after boiling oil and then put fried food stuffed chicken, frying process lasted for 7 minutes counted until the food is cooked. After that, the fried oil is taken 20 mL for analysis using acid-base titration. The frying oil is allowed to stand for 10 minutes before proceeding to the next fryer. The same treatment is performed on the 1st, 2nd, 3rd, 4th and 5th fryers and on catfish and flour foods.

Acid base titration measurements with 5 grams of cooking oil sample were weighed at each stage and incorporated into a 250 mL Erlenmeyer which had been known to be empty weight. Added 50 mL of 96% ethanol and heated at 4000C. After oil was already cold, 2 mL of phenopthalin indicator was added. It is titrated with a standard solution of 0.1 M NaOH to form a pink solution and is not lost for 30 seconds. Note the volume of NaOH used. Conducted calculation of the rate by the formula:

$$\%\text{FFA} = \frac{V_{NaOH} \times N_{NaOH} \times \text{Bm Fatty Acid}}{\text{M} \times 1000}$$

Information :

% FFA	= Fat Free Acid content / free fatty acids (%)
V_{NaOH}	= Volume of 0.1 N NaOH titration (mL)
N_{NaOH}	= Normality of NaOH (N)
Bm Fatty Acid	= Molecular weight fatty acid (gram)
M	= Mass of oil sample

3. RESULTS AND ANALYSIS

Forty-five samples with fiveteen type of cooking oil from frying of various foodstuffs were analyzed free fatty acid content using titration method. The foodstuffs that use in this experiment is chicken, cat fish, and flour. The free fatty acid contents in the cooking oil is one indicator of oil quality.

Cooking Oil will be damaged if used continuously and in relatively long time. The color of cooking oil can used for seeing the oil degradation contents. Frying is heating food process in the cooking oil as heat conductor. When heating, the cooking oil changes color from red-yellow to darker. This is due to the degradation reaction that can degrade oil quality. The degradation product of cooking oil can also reduce the quality of fried food.

Frying is heating food process in the cooking oil as heat conductor. In the food frying process occurs heat and mass transfer simultaneously. During frying, cooking oil is in high temperature and direct contact with air and water from foodstuff. When frying process, the water inthe food will evaporate, and the vapor of water will contact with cooking oil. it will cause the oil

into food to replace the precence of water. The longer the frying time and the greater the amount of fried food make the water contact of cooking oil is greater.
The event will cause an oil hydrolysis reaction.

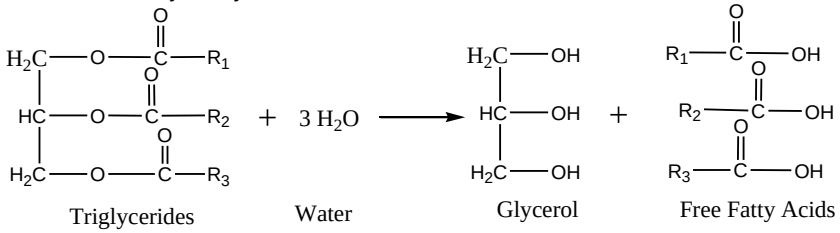

Figure 1. Hidrolysis reaction of fatty acids

The hydrolysis reaction of the oil will produce free fatty acids This reaction usually occurs on heating with high temperature ie at 160-200°C. It will increase the free fatty acid contents in cooking oil. According to the recommendation of SNI 7709: 2012, the maximum free fatty acid contents in the cooking oil is 0,3 %.

The free fatty acid analysis method that used in this experiment is acid-base titration or alkalimetric. The cooking oil samples reacted with base solution, sodium hydroxide or NaOH 0,1 N, so produced soap and water. The soap product is base, so can detected by solution color changing from colorless to pink with adding phenoplthalein indicator. The changing color of sample solutions can used to free fatty acid qualitative analysis.

RCOOH	+ NaOH	→	RCOONa	+ H_2O
Free Fatty Acid	Base		Soap	Water

Figure 2. Netralisation Reaction

When titratation, all samples color is changed from colorless to pink. So, all cooking oil samples contains free fatty acid. Before the samples are titrated, the sample reacted with ethanol 96% and the solution is heated. This step is done for diluted the free fatty acid.

The result of free fatty acid analysis in the cooking oil are presented in Table 1.

Table 1. The Free Fatty Acid Contents

The Numbers of Continuously fryers	FFA (%)		
	Flour	Chicken	Cat-Fish
0	0,24	0,24	0,24
1	0,49	0,49	0,49
2	0,61	0,51	0,54
3	0,63	0,56	0,61
4	0,72	0,60	0,67
5	0,72	0,73	0,68

The result of free fatty acids content in the cooking oil that has been used in continuously fryers of various of foodstuffs can be presented in the chart.

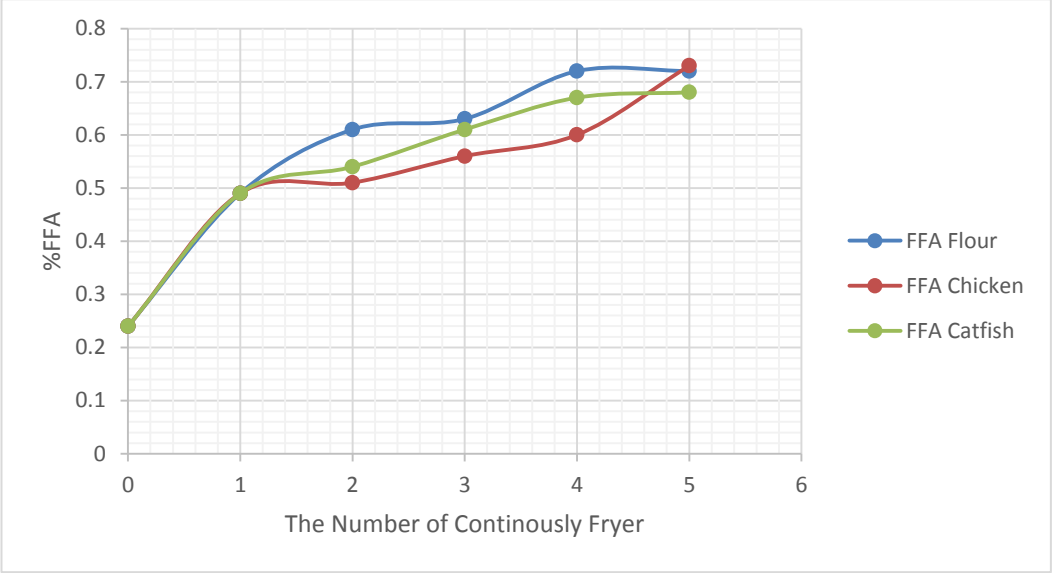

Figure 3. The Inceasing of Free Fatty Acid in Continously Fryer 0 to 5th various foodstuffs

From this chart, we can see that more the amount of reuse of cooking oil (the numbers of continuously fryers), the free fatty acid contents will increase. In the free fatty acid content calculations, we use assumption that the all free fatty acids in the cooking oil is palmitic acid (BM: 256). The used this assumption based on SNI free fatty acids calculation. In addition, the fatty acids that dominate the cooking oil is palmitic acid which is about 40-46%. Free fatty acid content in the cooking oil yet is 0,239 %. After frying process with various foodstuffs (ie. Chicken, Cat Fish, and Flour), the free fatty acid content in the cooking oils is increase became 0.494 %. This free fatty acid content has exceeded the safe standard of free fatty acid content of cooking oil consumption (SNI 7709: 2012). Excessive consumption of free fatty acids will cause negative effect for body healt. So, the use of cooking oil for frying food is ideally done in one used (disposable).

In five times the re-use of cooking oil in fying pan, the highest increase in free fatty acids content occurs in flour frying ie the higher free fatty acid content is 0.766 %, then following by chicken frying (0.731%) and cat-fish (0.682). The type of foodstuff gives the difference in the degree affect of the increase of free fatty acid content on the cooking oil. It is caused by the difference of water content contained in each foodstuff. The water content contained in various foodstuff is presented in Table 2.

Table 2. Water Content in Various Foodstuff

Foodstuff type	Water content (/100 grams)
Chicken	55,9 grams
Cat fish	76 grams
Flour	12 grams (+80grams for make the dough)

The water presence from foodstuff will caused hydrolysis reaction in the cooking oil that produced free fatty acids. From various foodstuff that used in this experiment, the highest water content is in the flour. So, this is can explain why the highest increasing free fatty acid content in the cooking oil occur in the flour frying.

The color of cooking oil can be one of the cooking oil damage indicators. But the color of cooking oil is not absolute can be used as a marker high or low free fatty acid content in this oil. In this experiment, the highest increase free fatty acid content occurs in the flour frying. But the color of cooking oil from flour frying is lightest. The color changing of cooking oil can caused by various

factors. One of which is the natural dyestuff degradation reaction found in cooking oil that is toccoferol. The color changing of cooking oil became darker can also cause the product of Millard reaction.

4. CONCLUSION

In the free fatty acids content analysis using acid-base titration, on fifth reuse of cooking oil the highest increase free fatty acid occurs in the flour frying (0.766%), then followed by chicken frying (0.731%) and cat-fish frying (0.682%). The continuously frying of cooking oil increasing its free fatty acid content. More the amount of reuse of cooking, the free fatty acid contents will increase. Each foodstuffs gives the difference in the degree affect of the increase of free fatty acid content on the cooking oil. The increasing free fatty acid content foodstuff effect depended by water content in this foodstuff.

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