

Chemical and Physical Characteristics of Cooking Oil After Tempeh Frying

Sri Hartati, Afriyanti*, Catur Budi Handayani, Novian Wely Asmoro, Cindhe Putri Larasati

Agricultural Product Technology, Universitas Veteran Bangun Nusantara Sukoharjo, Indonesia

afriyantimsc@gmail.com

Abstract: This study aims to determine the effect of seasoning and type of oil on chemical and physical characteristics of cooking oil after being used for tempeh frying. This factor needs to be learned to understand how to handle it. The experimental design used in this study was a factorial completely randomized design with two treatments, namely, (A) Seasoning consisting of (A1) No Seasoning and (A2) Seasoning. The second treatment is the type of oil (B) consisting of: (B1) bulk oil, (B2) GM oil, (B3) Sunco oil. The experiment was repeated 3 times so that 18 experimental units were obtained. The parameters measured were free fatty acid levels, oil color and water content. The results showed that seasoning and type of oil affect the levels of free fatty acids, oil color and water content. The highest free fatty acid levels were obtained from seasoned tempeh frying using bulk oil of 1.53%. The yellowest oil color and the highest water content obtained from seasoning tempeh frying using bulk oil of 32.07 and 0,06%.

Keywords: color, free fatty acid, oil, seasoning, tempeh

1. Introduction

Tempeh is a type of food that almost everyone in Indonesia knows and even likes, especially in Java. Almost everyday the Javanese people consume Tempeh as side dishes and snacks. The average consumption of Tempeh per capita for a week in Indonesia reaches 0.147 kg, 18.5% higher than chicken meat consumption [1].

Tempeh is made from fermented soybeans with the fungus *Rhizopus* sp. Various processed Tempeh are well known, but most people are familiar with fried Tempeh. Fried Tempeh is processed from the frying process of raw soybean Tempeh in cooking oil. Tempeh frying process will leave used cooking oil.

Research related to used cooking oil has been done a lot but mostly to find out the quality of oil after frying. The bulk cooking oil peroxide number and the organoleptic properties of Tempeh on frying repetition was examined [2]. The study of the quality of used cooking oil on the use of repeated

cooking oil was also researched and published. The quality of used cooking oil in terms of peroxide numbers, acid numbers and water content [3] [4]. There is an examined the levels of free fatty acids and peroxide numbers in used cooking oil in Samarinda [5].

Used cooking oil as a result of raw Tempeh frying is usually found in a cloudy color which gradually leaves impurities in the bottom of the frying pan. It has become a habit in the community, that Tempeh frying oil is considered to use again, in contrast to used oil after frying fish or eggs. Tempeh used frying oil is usually used repeatedly. It is not yet known exactly what impurities is contained in Tempeh frying oil. Therefore this research will be carried out to find out the effects of seasoning and type of oil on chemical and physical characteristics of cooking oil after tempe frying.

2. Methods

The experimental design used in this study was a factorial completely randomized design with two treatments, namely, (A) Seasoning consisting of (A1) No Seasoning and (A2) Seasoned. The second treatment is the type of oil (B) consisting of: (B1) bulk oil, (B2) GM oil, (B3) Sunco oil. The experiment was repeated 3 times so that 18 experimental units were obtained. The parameters measured were free fatty acid levels, oil color and water content

2.1. Determination of Free Fatty Acid Levels (FFA) [7]

Oil of 5 grams is weighed in erlenmeyer and added with 50 mL 96% ethanol. Then it is boiled for 10 minutes and shaken vigorously to dissolve free fatty acids. After it cools, it is titrated with 0.1 N standard KOH solution by adding phenolphthalein indicator to form a pink color that lasts no less than 10 seconds. Acid numbers are expressed as the number of milligrams of KOH needed to neutralize free fatty acids present in 1 gram of oil. Determination of free fatty acid levels or Free Fatty Acids (FFA) in oil is calculated using the following equation:

2.2. Color test [8]

The measurement of the color of cooking oil after Tempeh frying is done by using a chromameter. The color test is carried out with the Hunter L* white color system, a* (red color), b* (yellow color). Chromameter is calibrated first with the white standard contained in the tool. The results of the analysis of the resulting white degrees in the form of values L*, a*, b*. Measurement of the total degree of color is used as a white base color.

The color of the flour is analyzed in chroma (C) value, hue ($^{\circ}h$), a*, b* and brightness (L*) with using chromameter. a* positive values indicate hue red-purple; a* negative indicates blue-green; b* value positive indicates yellow; b* negative shows blue; L* values range from 0 (black) to 100 (white); C value shows the intensity of color from low (faded) to high (concentrated)

2.3. Water content [4]

Clean porcelain cup heated in the oven with temperature 105 ° C for 30 minutes, then cooled in the excicator, then weighed until a constant weight is obtained. Oil sample fried weighed as much as 2 g deep the cup is then heated in an oven at 105 ° C for 4 hours. The sample is cooled in an excitator for about 15 minutes and reconsidered. Drying is done until a constant weight (difference) is obtained consecutive weighing is less than (0.2 mg). Weight reduction is the amount of water in oil. Determination the water content was carried out in three replications time.

3. Results

3.1. Free Fatty Acid Level

The amount of free fatty acids contained in oil can indicate the quality of oil, i.e. the higher the value of free fatty acids, the lower the quality of the oil. The level of free fatty acids in cooking

oil after frying Tempeh was affected ($P < 0.05$) by Tempeh seasoned and the type of oil (Figure 1).

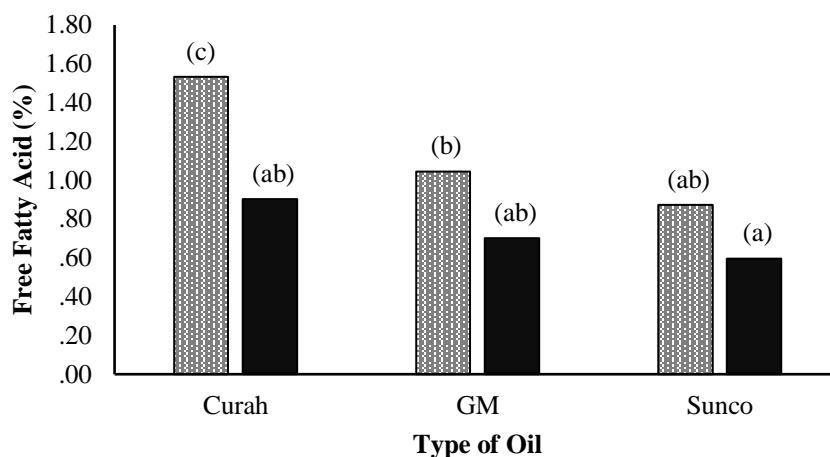


Figure 1. The effect of seasoning and types of oil on free fatty acid level after tempeh frying
Note:



 : No seasoning
 : Seasoning

Figure 1 showed that free fatty acids contained in Tempeh frying oil ranged from 0.60 to 1.53%. These conditions indicate that the free fatty acids contained have exceeded the SNI 01-3741-1995 which requires a maximum free fatty acid content of 0.30%. This happens because free fatty acids are produced by the process of hydrolysis and oxidation, usually joining neutral fat. The results of the hydrolysis reaction of palm oil are glycerol and free fatty acids. This reaction will be accelerated in the presence of heat, water, acidity, and catalyst (enzyme) factors. The longer this reaction lasts, the more free fatty acid levels are formed [9], [10].

The amount of free fatty acids contained in oil can indicate the quality of oil, where the higher the value of free fatty acids, the more the quality decreases. Thus, Tempeh that is not seasoned / seasoned which is fried in different types of oil results in increased levels of free fatty acids. This indicates a decrease in the quality of cooking oil after Tempeh frying. The highest levels of free fatty acids in cooking oil after Tempeh frying are found in bulk cooking oil with no seasoned Tempeh, while the lowest free fatty acid levels are in sunco oil with seasoned Tempeh

The price of free fatty acids has increased quite high, which indicates that the used oil has been damaged. Although the increase in acid number has not exceeded the quality limit set by SII 0062-1975, the increase in the amount of free fatty acids is already high enough and can poison the body [11].

3.2. Color Test

According to the Indonesian National Standard (SNI) 01-3741-2002, the color of cooking oil is required to be white-yellow or pale-yellow. The color of post-frying Tempeh cooking oil, which is varied with the treatment of different seasoned and non-seasoned Tempeh and types of oil, is presented in Table 1.

Table 1. The color of oil after Tempeh frying

Color	Bulk Oil		GM Oil		Sunco Oil	
	Seasoning	No Seasoning	Seasoning	No Seasoning	Seasoning	No Seasoning
L*	61,20 (bc)	59,80 (b)	57,41 (a)	60,01 (bc)	64,29 (d)	62,29 (c)
a*	-2,64 (a)	-1,77 (b)	-1,55(bc)	-1,32 (c)	-2,43 (a)	-1,57(bc)
b*	30,57 (c)	32,07 (c)	23,96 (b)	26,33 (b)	16,17 (a)	16,74 (a)

Table 1 showed that the cooking oil after frying Tempeh which is treated with no seasoning and used Sunco oil has the highest lightness (brightness) compared to other oils. All post-frying Tempeh oils have a pale color as indicated by the value of a*. The b* value shown in the table indicates the color of the post-frying Tempeh cooking oil which tends to turn yellow. The oil color that tends to be dark is shown in the low a* value and high b* value., this is the oil which is with seasoned Tempeh and a type of bulk oil.

The color of the oil was caused by the presence of pigments, from coconut / palm itself and pigments from cooking spices, fried foods. The dark color of used cooking oil is caused by oxidative damage. Oxidation reactions occur between oxygen and the double bonds of triglycerides / oils. Dark colors in oil can also occur during the processing, storage and use of oil. Overheating and repetitive heating causes polymeration and Maillard reactions which cause the oil to thicken and become dark in color [4]

3.3. Water Content

The water content of post-frying tempeh due to the influence of seasoning and the type of oil showed significant differences statistically ($P < 0.05$). The real difference occurs in the post-frying cooking oil with seasoning tempeh and bulk cooking oil. This is shown in Figure 2.

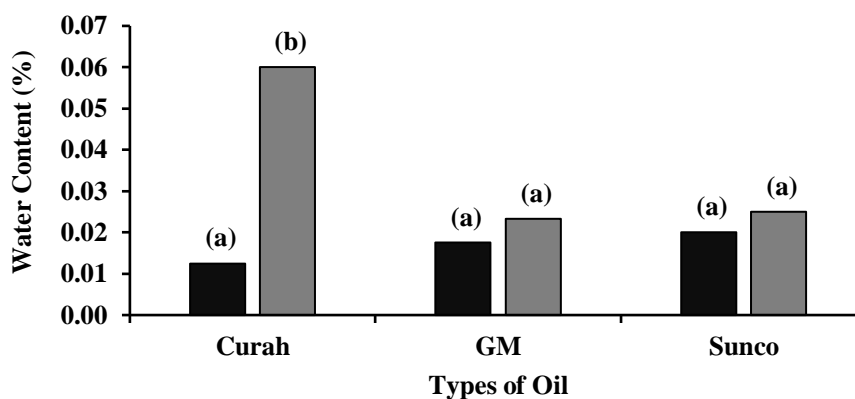


Figure 2. The effect of seasoning and types of oil on water content after tempeh frying

Note:

- : No seasoning
- : Seasoning

Figure 2 showed that the water content of oil after frying tempeh ranges from 0.01 to 0.06%. The water content is known to still meet the water content requirements of cooking oil based on the Indonesian National Standard (SNI) 01-3741-2002 which requires 0.01-0.30%.

The highest water content was significantly found in the post frying oil sample from seasoning tempeh with bulk cooking oil. It happened because bulk cooking oil already contained higher water content than other types of oil. Besides the seasoning factor which in the process is added water to dissolve the seasoning is also a factor why the water content of cooking oil after frying is higher than without seasoning. Seasoning factor and type of oil have a very significant effect on the water content of cooking oil after tempeh frying.

High levels of water content in oil can be obtained from ingredients fried food, the current frying process, or humidity when storage. During the frying process, water in food will come out and filled by cooking oil so it raise the water content in oil [4]

4. Conclusion

The conclusion of this experiment is seasoning and type of oil affect the levels of free fatty acids, oil color and water content. The highest free fatty acid levels were obtained from seasoned tempeh frying using bulk oil of 1.53%. The yellowest oil color and the highest water content obtained from seasoning tempeh frying using bulk oil of 32.07 and 0,06%.

5. Acknowledgment

Thanks to the Veteran Bangun Nusantara University for funding this research.

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