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Original Research Article

The quality of indonesian brands of consumable cooking oils is reviewed by peroxide numbers and free fatty acid value

Mirwa Adiprahara Anggarani - *https://orcid.org/0000-0002-9966-7467*
Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, Surabaya 60213, Indonesia

Prima Retno Wikandari - *https://orcid.org/0009-0004-7288-3225*
Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, Surabaya 60213, Indonesia

Rudiana Agustini - *https://orcid.org/0000-0001-5437-1219*
Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, Surabaya 60213, Indonesia

Rusyariyanto Waskito - *https://orcid.org/0009-0005-3639-9396*
Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, Surabaya 60213, Indonesia

Yuni Fransiska - *https://orcid.org/*
Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, Surabaya 60213, Indonesia

Corresponding authors: Mirwa Adiprahara Anggarani (e-Mail: mirwaanggarani@unesa.ac.id)

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ABSTRACT

This study evaluated laboratory skills among the students during biochemistry practicum activities and built laboratory information for the internal and external community of Universitas Negeri Surabaya in 2024. The habit of reusing cooking oil for the main reason of saving costs can cause health problems. Parameters used to determine quality cooking oils include content-free fatty acids and number peroxide. The research purposes for this experiment are to know the rate of free fatty acids and the number of peroxides in Branded and out-of-stock cooking oil used for now. Determination of free fatty acids was done with the method of alkalimetry and the determination number of peroxide was done with the technique of iodometry. Result of the study This shows average rate of sour fat-free oil frying before frying is 0.22% And after frying becomes 0.40% or enhancement amounting to 185.98 %. The average level of number peroxide oil fried before frying is as big as 1.11 meq O2 /kg and after frying to 3.52 meq O2 /kg or enhancement as big as 317.25%. Average rate sour fat-free oil fry before frying No exceed standard SNI 7702: 2012, namely maximum 0.3%. However, the average level of free fatty acids in cooking oil after frying exceeds the SNI 7702:2012 standard, namely above 0.3%. Whereas the average rate number peroxide oil fry before and after frying does not exceed standard SNI 7709: 2012 which is a maximum of 10 meq O2 /kg.

Introduction

This study was conducted to evaluate laboratory skills among the students during biochemistry practicum activities and to build laboratory information for the internal and external community of Universitas Negeri Surabaya (Unesa) in 2024. Cooking oil is one of the materials included in fat, both derived from plant fats and animal fat (Priskila and Darmawan, 2022). Oils and fats are a source of energy for humans (9 cal/g), and a vehicle for fat-soluble vitamins such as vitamins A, D, E, and K, increasing the taste and deliciousness of food and slows down hunger (Chalid et al., 2008). Using cooking oil works as a delivery medium that adds a savory taste, as well adds marks nutrition and calories in food (Damarani et al., 2019). Composed cooking oil from several compounds like fatty acids and triglycerides (Ketaren, 1986).

Cooking oil on the market is usually made of coconut palm (Hutapea et al., 2021) and must fulfill condition quality determined by the government according to SNI 7702:2012 concerning quality palm cooking oil (National Standards Agency, 2012). Condition quality such as content-free fatty acids and numbers peroxide in cooking oil. The maximum level for number peroxide is 10 meq O2 /kg and the level of maximum free fatty acids is 0.3%. Number peroxide shows the amount of compound peroxide formed in the declared oil as milliequivalent oxygen existing active in 1 kg of oil (Rustiana and Rahayu, 2021). Compound peroxide formed Because exists reaction oxidation of fats, especially fats containing fatty acids does not saturation (Alkaff and Nurlela, 2020). Free fatty acids are the numbers that show the amount of free fatty acids contained in the usual fat/oil connected by the hydrolysis process oil (Wiadnya et al., 2019). Hydrolysis oil by water with catalyst enzymes and heat in triglyceride ester bonds will produce free fatty acids (Neilsen, 2003).

Society has a habit use returning ready-made cooking oil used called oil waste cooking (Inayati and Dhanti, 2021). Physical, new cooking oil used once or twice is still seen clearly so that tends to be used return. The most important reason is savings cost. Oil waste cooking prices are cheaper so the cost becomes smaller compared to using packaged cooking oil. However, there is a problem to use oil used use the that is security oil for health. Several studies have been done to study the connection used cooking oil use with health, that is security for creature life. In oil waste cooking there is no material useful that compound peroxide causes an increasing risk of several diseases, including carcinoma (Ihwan et al., 2019). Giving oil coconut palm oil that has been heated dozens of times in mice will give rise to damage heart and awaken the response to inflammation liver.

Quality cooking oil specifies from component its constituent fatty acids, namely group saturated fatty acids or No saturation (Setyawati et al., 2022). Fatty acids do not feed up and contain bond duplicates (Zulkifli and Estiasih, 2014). On the other hand, saturated fatty acids Do have bond duplicates. Fatty acids that have more bonds double will the more reactive to oxygen so they tend to be easily oxidized. Temporary that is, the chain of fatty acids dominant contains bond single tend easier hydrolyzed. Each damaged process the can lower quality of the oil. Reaction Another important thing is hydrogenation, i.e. saturation bond doubled by hydrogen. Another quality of oil is its ability not to decompose at high temperatures. Coconut and palm oils have the most saturated bonds compared to other oils. This oil is more stable against the effects of heating and oxidation because it has many double bonds. Omega 9 or oleic acid is part of a liquid oil called olein. Omega 9 has double bonds and has a positive influence on health, but it will become useless if heated. Therefore, if you want to get.

As a solution to the problem, this is necessary to do business more to analyze the quality of cooking oil sold in the community. This study aims to know the content number peroxide and free fatty acids in some sample branded cooking oils of new and finished use, as well as compare the content with the standard quality that has been set.

Methods

Materials and Sample

For analysis of content free fatty acids and numbers of peroxide cooking oil, sample cooking oil was obtained from supermarkets (Surabaya, Indonesia), 0.1 N NaOH solution was obtained from Chemindo (Surabaya, Indonesia), 96% alcohol was obtained from Chemindo (Surabaya, Indonesia), 1% phenolphthalein (PP) indicator was obtained from Chemindo (Surabaya, Indonesia), distilled water was obtained from Chemindo (Surabaya, Indonesia), H_2SO_4 4N solution was obtained from Chemindo (Surabaya, Indonesia), $KMnO_4$ 0.1 N solution was obtained from Chemindo (Surabaya, Indonesia).

Instrumentation

Beaker (Pyrex), burette (Pyrex), Erlenmeyer (Pyrex), volume pipette (Pyrex), pro pipette (Pyrex), glass measuring (Pyrex), dropper pipette (Pyrex), balance analytical (e.g., Ohaus PioneerTM), stative and clamping.

Determination of Peroxide Value in Sample

cooking oil sample is pipetted 5 mL and later entered into Erlenmeyer. Furthermore, added distilled water as much as 45 mL and H_2SO_4 4 N as much as 15 mL. After that, titrated with $KMnO_4$ 0.1 N solution up to change color to become red guava or the color stable. Titration process the is repeated 3 times (triple). Then The titration volume obtained is recorded and calculated number of peroxide in the sample.

Determination of Free Fatty Acids (FFA)

Testing sample blank done with weighing 6 grams of distilled water Then entered to in Erlenmeyer. Furthermore, 10 mL of 96% alcohol was added and 5 drops of PP indicator were added. Then titrated with 0.1 N NaOH solution that has been standardized until the color red guava is achieved or not is lost for 30 seconds. Titration volume blank obtained noted.

Data Analysis

Testing sample cooking oil for free fatty acids is done by weighing as many as 6 grams of sample oil new and used Then entering it in Erlenmeyer. Furthermore, 10 mL of 96% alcohol was added and 5 drops of PP indicator were added. Then titrated with 0.1 N NaOH solution that has been standardized until the color red guava is achieved or not is lost for 30 seconds. The titration process was done 3 times (triple). Then The titration volume obtained is recorded and calculated rate of free fatty acids in the sample. Free fatty acids are stated as %FFA or as number sour. Following formula calculation rate free fatty acids:

$$\text{FFA levels (\%)} = \frac{(V_{titration} - V_{blank}) \times N_{NaOH} \times BM_{Fatty\ Acids}}{Sample\ Weight\ (gram) \times 1000} \times 100\%$$

Results and Discussion

Free Fatty Acids

Free fatty acids are fatty acids that exist as free fatty acids not bound as triglycerides. Free fatty acids produced by hydrolysis and oxidation processes usually combine with neutral fats. The results of the palm oil hydrolysis reaction are glycerol and free fatty acids. This reaction will be accelerated by the presence of heat factors, and water. acidity and catalysts (enzymes). The longer this reaction takes, the more levels of free fatty acids are formed. Research results for the free fatty acid test

carried out on eleven sample branded cooking oils new and used Using it twice shows the results shown in Table 1 on a variety of sample cooking oil.

Table 1. Free fatty acid levels

Samples	Free Fatty Acid Content (%)	
	New (%)	Used (%) (Used 2 times)
Brand 1	0.12	0.35
Brand 2	0.1276	0.3556
Brand 3	0.1281	0.1709
Brand 4	0.0852	0.2702
Brand 5	0.44	0.61
Brand 6	0.584	0.625
Brand 7	0.19	0.33
Brand 8	0.084	0.085
Brand 9	0.24	0.58
Brand 10	0.3269	0.851
Brand 11	0.085	0.256

The presence of free fatty acids in the sample cooking oil is possible Because the hydrolysis process occurs in cooking oil. Analysis results free fatty acids in the sample branded cooking oil the Then compared to with SNI 7702:2012, the results of which are shown in Fig-1.

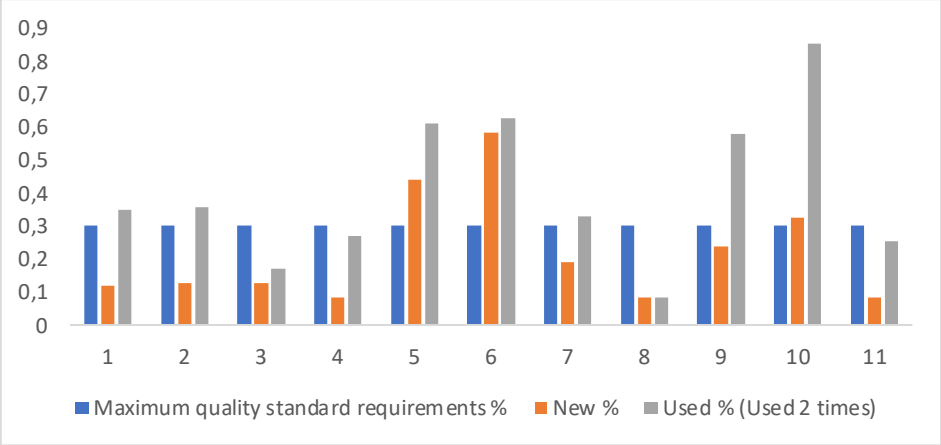

Fig-1. Comparison of free fatty acids new and used cooking oil

Free fatty acid levels from eleven samples of branded cooking oil new and used usage, some samples have fulfilled requirements set out in SNI 7702:2012 which requires content-free fatty acids as palmitate in palm cooking oil maximum of 0.3%. However, in some samples still cooking oil too some have not fulfilled the requirements set out in SNI 7702:2012, namely exceeding the content maximum free fatty acids of 0.3%. It happened to an increased rate of free fatty acids caused by the use of cooking oil.

Free fatty acids are fatty acids is at as sour fat-free No bound as triglycerides (Nurhasnawati, 2015). Free fatty acids generated by the process of hydrolysis and oxidation usually join with fat neutral (Ati et al., 2020). Results reaction hydrolysis oil coconut palm is glycerol and sour fat-free (Maimun et al., 2017). Reaction This will accelerate with existing factors of heat, water, acidity, and catalyst (enzyme). The longer the reaction is ongoing, the more Lots rate sour fat-free ones formed (Fauzi, 2006). Sour fat-free oil is not desired Because increased free fatty acids produce flavor and smell Which is not preferred (Prastiwi et al., 2023). The amount of free fatty acids present in the oil can show quality oil, where the taller mark fatty acid-free so the more down quality (Winarno, 2004).

The results determination rate shows exists enhancement rate of free fatty acids on oil fry after frying pan. Usually, the percentage of sour fat increases with time and frequency of frying pan, p This is used as an indicator quality of oil (Aminah et al., 2010). Enhancement percentage This caused exists exchange of water components in the material the food fried with oil Which made a media frying pan. Abdullah's Research (2007) shows the rate of sour fat-free on oil fry which is used for fry has own increase in the rate of sour fat-free which is more tall compared to sour fat-free on oil fry for fry tempeh and banana (Abdullah, 2007). This matters due to its high internal water content. This matters to Ketaren (1986), that damage that occurs on oil fry used repeated times in the process of frying causes complex reactions that occur the moment the material food is fried and the best cooking oil to use is sample 8.

Peroxide Number

Number measurements peroxide on the basis is to measure the levels of peroxide and hydroperoxide formed in the early stages of the fat oxidation reaction. A high peroxide number indicates the fat or oil has undergone oxidation. Research results for the determination number of peroxide done on eleven samples of branded cooking oil new and used usage twice are shown in Table 2. Analysis results number peroxide on the sample new and used cooking oil used twice, then compared to with SNI 7702:2012, the results of which are shown in Fig-2.

Table 2. Peroxide values

Samples	Peroxide Value (meq O_2/10kg)	
	New (meq O_2/10kg)	Used (meq O_2/10kg) (Used 2 times)
Brand 1	1.51	2.67
Brand 2	1.018	7.640
Brand 3	1.528	2.801
Brand 4	1.273	4.075
Brand 5	0.152	0.865
Brand 6	0.381	2.617
Brand 7	0.537	3.560
Brand 8	0.573	0.955
Brand 9	1.273	6.494
Brand 10	2.674	4.966
Brand 11	1.273	2.037

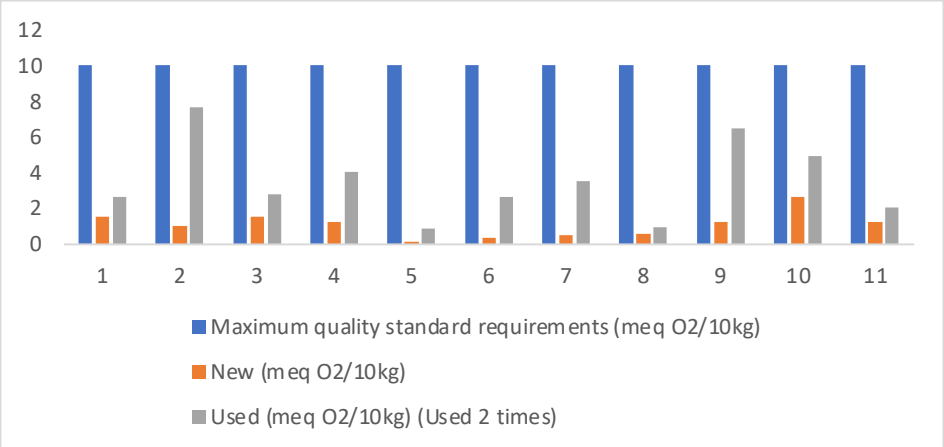

Fig-2. Comparison number peroxide new and used cooking oil

These results after compared to with SNI 7702:2012 which requires a rate number peroxide in palm cooking oil maximum of 10 meq O2 /kg then rate number peroxide from eleven samples branded and used cooking oil usage, everything has fulfilled requirements set by SNI 7702:2012. The measurement number peroxide is measure rate of peroxide and hydroperoxide Which formed on stage beginning reaction fat oxidation. The number of the peroxide tall indicates fat or oil has Already experienced oxidation (Raharjo, 2006).

Oxidation of fat by oxygen happens in a way If material fatty left in contact with air, whereas the speed process the oxidation depends on the type of fat and condition of storage (Maulinda et al., 2017). Oil bulk is distributed without packaging, and exposure to oxygen and light on bulk cooking oil is bigger than oil packaging (Lempang, 2016). Exposure to oxygen, light, and temperature during frying triggers oxidation oil (Khoirunnisa et al., 2019). According to deMan (1999), with every enhancement temperature 10°C rate speed oxidation increases two-time fold (deMan, 1999). Speed oxidation fat will increase with increased temperature and decrease with temperature low (Tuasamu, 2018). Composition material food Also influences the rate number peroxide, A study by Abdullah (2007) shows enhancement of the rate of peroxide on oil fry used fry know taller than the rate number peroxide on oil fry used fry tempeh and banana. This matter possibly happens because of the height rate of the water and the best cooking oil with the least amount of number of peroxides is sample 5.

Conclusion

Based on the results study determination rate of free fatty acids and numbers of peroxide on oil branded and used fritters usage which were used twice, then conclusions were obtained as follows. The average rate of sour fat-free oil frying before frying is 0.22% And after frying it becomes 0.40% or enhancement amounting to 185.98 %. The average level of number peroxide oil fried before frying is 1.11 meq O2 /kg and after frying to 3.52 meq O2 /kg or enhancement as big as 317.25 %. Average rate sour fat-free oil fry before frying No exceed standard SNI 7702: 2012, namely maximum 0.3%. However, the average level of free fatty acids in cooking oil after frying exceeds the SNI 7702:2012 standard, namely above 0.3%. Whereas the average rate number peroxide oil fried before and after frying does not exceed standard SNI 7709: 2012 which is a maximum of 10 meq O2 /kg.

Conflict of Interests

The author(s) declares that there is no conflict of interest in this research and manuscript.

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