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Utilization of Red Onion Skin Extract as a Natural Antioxidant to Reduce Free Fatty Acid Levels in Used Cooking Oil

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Abstract— *The quality of cooking oil, both bulk and packaged, can decrease over time and oil utilization and one of the factors that influence this is the oxidation reaction and hydrolysis reaction. Long storage time can cause an increase in free fatty acid levels because during storage oil undergoes physico-chemical changes due to hydrolysis and oxidation processes. This research aims to utilize shallot skin extract to reduce the levels of free fatty acids found in used cooking oil. Thus, shallot skin is extracted using the maceration method. The independent variables are 5 samples of used cooking oil and cooking oil storage time of 0.3 and 6 days. A fixed variable was determined in the form of the extract content used at 1.6% because it was considered the most effective. The method used to collect data on free fatty acid levels is the alkalimetric titration method. The highest reduction in free fatty acid levels from used cooking oil samples was obtained with a reduction of 30.10% on the 6th day.*

Keywords— *Antioxidants, cooking oil, free fatty acids, onion skin.*

I. INTRODUCTION

The medium for frying food that is consumed by many people is oil. The average consumption of cooking oil was 0.222 per capita a week in 2020 and 0.242 per capita a week in 2021 in the city of Samarinda (Central Statistics Agency, 2021). There are 2 types of cooking oil on the market, namely bulk cooking oil and packaged cooking oil. The difference between the two is in the filtering process. Bulk cooking oil is cooking oil that only undergoes one filtering process so that it has a quality that is no better than packaged cooking oil (Mukaromah, 2019).

The quality of cooking oil, both bulk and packaged, can decrease over time and oil utilization and one of the factors that influences this is oxidation. Long storage time can cause an increase in free fatty acid levels because during storage oil undergoes physico-chemical changes due to hydrolysis and oxidation processes (Fauziah et al., 2013). The oxidation process that damages the quality of this oil can be inhibited or prevented by chemical compounds that have anti-oxidant activity (Ketaren, 1986).

Shallots are a natural ingredient that has antioxidant activity. Apart from shallots, shallot skin extract is also known to contain antioxidant substances such as flavonoids (Mardiah et al., 2017). Because of this, shallot skin has the potential to be used as an oxidation inhibitor in cooking oil, thereby reducing the increase in peroxide levels and reducing the amount of free fatty acids.

Asriyanti (2017) researched the effect of adding noni fruit extract to bulk cooking oil on the oxidation process using variations in heating temperature and the level of extract added to the cooking oil. The temperature variations used were 110oC, 130oC, 150oC, and 170oC, while the variations in noni fruit extract levels used were 0.4; 0.8; 1.2, and 1.6% of the mass of bulk cooking oil. In this study, it was stated that the greatest decrease in peroxide value occurred when 1.6% noni fruit extract was added at a heating temperature of 110oC (Asriyanti, 2017). However, in this study, free fatty acid levels, which are one of the factors decreasing the quality of cooking oil, have not been tested.

Research regarding the effect of adding shallot powder as a natural antioxidant on the quality of cooking oil conducted by Fardani et al. (2021) used variations in oil storage time and added mass of onion powder. The variations in storage time used were 0, 4, and 8 days, while the variations in the mass of shallot powder were 5 g and 10 g. In this study, it was stated that on days 0 to 8 without the addition of antioxidants the acid number did not meet the Indonesian National Standards, whereas with the addition of antioxidants the acid number of bulk cooking oil still met the standards (Fardani et al., 2021). However, in this study, the antioxidants used had not been purified.

Based on the weaknesses of these studies, further research was carried out regarding the levels of free fatty acids in cooking oil and the natural antioxidant ingredient used was shallot skin extract because it is easy to find and has the potential to work effectively as an antioxidant. Thus, the improvements made were natural antioxidant ingredients in the form of onion skin extract and independent variables in the form of 5 samples of used cooking oil and cooking oil storage times of 0, 3, and 6 days. A fixed variable was obtained from Asriyanti's research (2017) in the form of an extract content used of 1.6% because it was considered the most effective.

This research aims to use shallot skin extract to reduce the levels of free fatty acids found in used cooking oil.

This research can be useful for reducing the risk of environmental pollution caused by shallot skin waste and can improve the quality of used cooking oil.

II. RESEARCH METHODS

Place and Time of Implementation

Mustafa1, Kusyanto, Syarifuddin Oko3 Sirajuddin, Siti Zainab, "Utilization of Red Onion Skin Extract as a Natural Antioxidant to Reduce Free Fatty Acid Levels in Used Cooking Oil," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 6, Issue 6, pp. 264-267, 2023.

The place and time for the implementation were at the Basic Laboratory, Chemical Engineering Department, Samarinda State Polytechnic. Used cooking oil and shallot skins as research raw materials. Implementation time is in the even semester.

Tools and materials

The tools used in this research are aluminum foil, 80 mesh sieve, bulb, 50 mL burette, Erlenmeyer, beaker, digital balance, oven, drop pipette, 50 mL volume pipette, rotary evaporator, static and clamps, measuring cup, thermometer, Watch glass and spatula. Meanwhile, the materials used in this research were distilled water, shallots, 95% neutral ethanol, PP indicator, used cooking oil, 0.1 N NaOH standard, and methanol.

Work procedures

A. Preparation of Shallot Skin

Prepare the shallot skin. Then wash the shallot skin with running water. Dry the clean shallot skin in the oven at a temperature of 40-45oC. Sorting shallot skins to separate shallot skins that are damaged (too dry) due to drying. Smooth the sorted shallot skin and sift it with an 80-mesh sieve.

B. Red Onion Skin Extraction

Weigh out 200 g of crushed red onion skin. Add 1.6 L of methanol solution. Cover and let sit for 3 days and every 24 hours stir for a few minutes. Filter the extraction results with filter paper. Concentrate the filtrate obtained using a vacuum rotary evaporator at a temperature of 50OC. Macerate the residue obtained from the filtering results by adding 0.8 L of methanol solution every day for 5 days.

C. Main Process

Weigh 50 g of bulk cooking oil in an Erlenmeyer flask. Add red onion skin extract as much as 1.6% of the mass of cooking oil. Store the samples at room temperature for 0, 3, and 6 days then analyze the free fatty acid levels.

D. NaOH standardization

Pipette a 10 mL oxalic acid solution into a 250 mL Erlenmeyer. Add 3 drops of PP indicator. Titrate with 0.1 N NaOH solution. Observe the color change and record the volume of NaOH used for titration. Do it in duplicate.

E. Analysis of Free Fatty Acid Levels

Weigh 2 g - 5 g of sample into an Erlenmeyer. Add 50 mL of neutral 95% ethanol. Add 3 drops – 5 drops of PP indicator and minute with standard 0.1 N NaOH solution until the pink color remains (does not change for 15 seconds). Carry out a duplicate determination. Calculate the free fatty acid content in the sample: ALB content (%) = (M × V × T)/(10 × m)
Information :

V = Volume of NaOH required in the titer (mL)
T = Normality of NaOH used
m = Sample mass (g)
M = Molecular weight of fatty acid

F. Determination of raw material density

Wash the pycnometer thoroughly and dry it. Weigh the empty pycnometer. Put 10 mL of red onion skin extract into the pycnometer until it is full. Close the pycnometer until it overflows and there are no air bubbles and weigh it. Repeat steps 1-5 for samples A to E.

III. Result And Discussion

TABLE 1. Results of Analysis of Free Fatty Acid Levels

Sample	Extract Content (%)	Free Fatty Acid Content (%)		
		0 days	3 days	6 days
Sample A	0	0.63	1.01	1.07
	1.6	0.51	0.76	0.81
Sample B	0	0.76	0.95	1.14
	1.6	0.70	0.88	0.95
Sample C	0	4.99	5.43	5.67
	1.6	4.05	4.39	4.87
Sample D	0	1.58	1.90	2.06
	1.6	1.20	1.38	1.44
Sample E	0	1.07	1.14	1.39
	1.6	0.95	1.00	1.14

TABLE 2. Raw Material Observation Results

Sample	Parameter	
	Density (g/mL)	pH
Sample A	0.9069	6
Sample B	0.9049	6
Sample l C	0.8989	6
Sample D	0.9051	6
Sample E	0.8969	6
Red Onion Skin Extract	0.7948	4

This research aims to use shallot skin extract to reduce the levels of free fatty acids found in used cooking oil.

In the research carried out, the shallot skin went through a washing stage which aims to remove the dirt on the shallot skin. After the washing process, the drying process is carried out using 27.

oven with a temperature of 45oC to reduce the water content thereby prolonging the storage process. Surface expansion of the sample is carried out after drying to maximize contact between the sample and the solvent.

The extraction method used is the maceration extraction method which has advantages in terms of isolating material compounds. Extraction is carried out to obtain flavonoid compounds from shallot skin. The maceration extraction process is carried out to avoid damage to some flavonoid compounds which are not heat resistant and flavonoid compounds are easily oxidized at high temperatures. Extraction is carried out repeatedly to ensure that all the active substances contained in the shallot skin have been extracted.

In this maceration extraction process, methanol solvent is used. The choice of methanol solvent was made because methanol has a small molecular structure so it is considered capable of penetrating all shallot skin tissue to draw the active compounds out (Rahayu et al., 2015). The filtrate produced from the maceration process is 4L. The resulting filtrate was then concentrated using a vacuum rotary evaporator and in this process, 2.9L of concentrated extract was produced.

In the research, an analysis of the free fatty acid levels of used cooking oil and bulk cooking oil was carried out as a comparison. A comparison of the levels of free fatty acids in the oil after and before the addition of shallot skin extract was carried out to determine the antioxidant capacity contained in shallot skin extract in inhibiting the process of increasing free

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fatty acids. Free fatty acid content testing was carried out using the titration method.

The results of determining free fatty acid levels from the effect of storage days 0, 3, and 6 can be seen in Table 2. High free fatty acid levels are free fatty acid levels that exceed 0.3%. The free fatty acid levels before adding the extract on days 0, 3, and 6 of samples A to sample E did not meet the standard, while on day 0 sample F, namely bulk cooking oil after adding shallot skin extract, was assessed as meeting the standard.

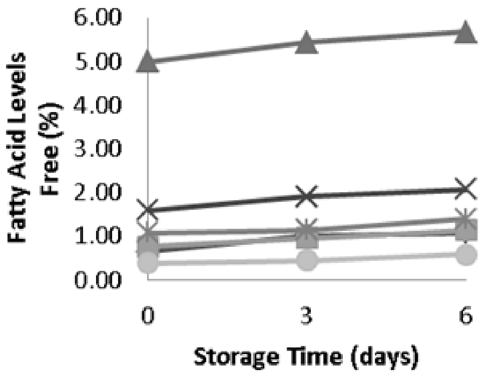

Figure 1. Relationship between storage time and increasing levels of free fatty acids in cooking oil

In Figure 1, it can be seen that the longer the storage time, the higher the free fatty acid levels in the sample. An increase in free fatty acid levels in the sample can occur due to hydrolysis and oxidation reactions. Sample F, which is bulk oil, can influence the increase in free fatty acid levels because it only goes through one filtering process.

Samples A to E have relatively high free fatty acid levels that do not meet the standards. This can be caused by using cooking oil repeatedly, resulting in oxidation and hydrolysis processes which are usually caused by the frying process at high temperatures and producing water vapor. The presence of microbes in cooking oil can also hydrolyze triglycerides into free fatty acids.

Therefore, red onion skin extract which contains flavonoids as a natural antioxidant can minimize free fatty acid levels and can kill existing microbes so that the microbes cannot hydrolyze triglycerides into free fatty acids. Antioxidants can be defined as compounds that can delay, slow down, and prevent the oxidation process of lipids. So, it can delay the process of further formation of free fatty acids.

The largest decrease in free fatty acid levels occurred on day 6 of sample D, amounting to 30.10%. In sample F, the largest decrease in free fatty acid levels was obtained on day 6, amounting to 33.48%. This could be caused by sample F having never been used for frying so the increase in free fatty acid levels before adding shallot peel extract was not significant, whereas adding shallot peel extract could minimize the free fatty acid levels in sample F.

FTIR testing aims to determine the functional groups contained in cooking oil. FTIR absorbance spectra were measured on cooking oil samples in the wave number region of 400-4000 cm-1. The wave number around 3400 cm-1 is known as the O-H vibration of alcohol. The 3000 cm-1 and 720 cm-1 areas are cis C=C vibrations. Wave numbers around the 1400, 2800, and 2900 cm-1 areas represent the vibration of the aliphatic C-H group. C-O vibrations in esters are found in the wave number area of 2300 cm-1. The C-O vibration of carboxylic acids is found at a wave number of 1100 cm-1. The C=O ester vibration is in the 1700 wavenumber region, while the trans-C=C vibration is in the 960 cm-1 wave number region.

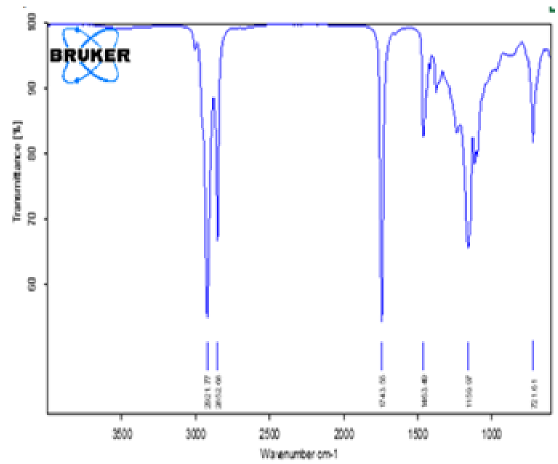

Figure 2. Identification of Cooking Oil Samples Using FTIR Analysis

Regional wave numbers of 1100 and 1700 cm-1 in samples A to F indicate the presence of C-O bond interactions found in ester bonds. This shows that there is glycerol that is still bound to glycerol. This type of bond is often found in monoglycerides, diglycerides, and triglycerides. Triglycerides are the most abundant component in palm oil, while monoglycerides and diglycerides are less abundant.

Samples A to F show the presence of C-H bonds which are shown at wave numbers 2900, 2800, and 1400 cm-1. This bond is a bond that is often found in hydrocarbon groups. The number 720 indicates the presence of an alkene double bond (C=C). Alkenes are groups commonly found in vegetable oils that contain unsaturated fatty acids. Palm oil itself contains quite a large amount of unsaturated fatty acids.

IV. CONCLUSION

Based on the research that has been carried out, it can be concluded that red onion skin extract can be used to reduce free fatty acid levels in used cooking oil. A decrease in free fatty acid levels was found in samples of used cooking oil from fresh chicken on Jl. Hero with a drop of 30.10% on the day.

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