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RESEARCH **Open Access**

The Effectiveness of Pineapple Extract (*Ananas Comosus*) and Kesum Leaves (*Polygonus Minus*) on the Quality of Coconut Oil (*Coconus Nucifera*)

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Abstract
The processed oil from the coconut plant is generally understood as coconut oil. A method is required to produce a product with a higher oil extraction rate and is able to reduce the water content and free fatty acids in the coconut oil production. It is also necessary to add substances that can delay or prevent fat oxidation reactions by generating substances in the form of antioxidants. The method that can be implemented is the enzymatic method employing the bromelain enzyme in a pineapple with the addition of an antioxidants substance from the kesum leaf. The objective of this research is to describe the quality of coconut oil after the addition of pineapple (*ananas comosus*) and kesum leaves (*polygonus minus*) extracts. The parameters for describing the quality of the oil are the organoleptic test, the degree of acidity, the oil extract rate, the peroxide number, the saponification number, and the acid number. This research is a quasi-experiment. The samples in this research were coconut oil without the addition of pineapple fruit extract, coconut oil with the addition of pineapple fruit extract without the addition of kesum leaves, and coconut oil with the addition of pineapple fruit extract and kesum leaves as much as 20gr, 30gr and 40gr. Based on the statistical results of the linear regression test, it was discovered that p-value = 0.000 <0.05, so it was concluded that there was an effect of the addition of pineapple fruit and leaves of kesum on acid number content with an effect of 76.4% on the acid number, 71.4% on the peroxide number, and 81.5% to the saponification number. It is recommended to test the water content, free fatty acids, and iodine number.

Keywords: Oil Quality, Coconut Oil, Pineapple, Kesum Leaves.

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1. INTRODUCTION

Cooking oil can be produced by employing plants as a source of manufacture, for instance from coconut plants (Lempang, et al., 2016). The processed oil from the coconut plant is generally understood as coconut oil. Coconut oil is a processed oil which is obtained from copra or from the coconut milk juice. Coconut oil is essential for the body's metabolism because it contains fat-soluble vitamins (Effendi, et al., 2012).

Coconut oil production in the traditional way produces products with quality standards and oil extraction rate which are not yet optimal. One of the parameters for the quality of coconut oil products which can be implemented is to examine the water and free fatty acid content. The presence of excess water and free fatty acid can accelerate the process of rancidity of coconut oil. A method is required which produces products with more oil extraction rate and reduces the water content and free fatty acids in coconut oil production (Palilingan & Pungus, 2018). In coconut oil production, it is also necessary to add substances that can delay or prevent fat oxidation reactions, by adding substances in the form of antioxidants (Mahmud, et al., 2021).

The method which can be conducted to obtain more oil extraction rate is by performing enzymatic production. The enzyme frequently employed in the manufacture of coconut oil is the enzyme bromelain (Prihanani, et al., 2013).The bromelain enzyme added to the coconut milk will hydrolyzes protein and make the oil separated from the water in the coconut emulsion maximally (Palilingan & Pungus, 2018). Bromelain enzyme is a proteolytic enzyme which is able to accelerate the process of making coconut oil and the process of destroying the coconut milk emulsion system which is hydrolyzed into amino acids through peptide bonds (Effendi, et al., 2012).

The content of bromelain enzyme in pineapple plants with the highest specific activity is 62.5 U/mg. Research performed by Effendi, et al. (2012) employed pineapple core producing 97 mL of oil with a volume ratio of coconut milk and pineapple core extract, 800:600. The results of the analysis revealed that the volume ratio of coconut milk and pineapple core extract fulfilled the criteria for water content, acid number and saponification number in coconut oil but did not meet the criteria on the iodine number.

The iodine number in coconut oil displays the unsaturated bonds discovered in coconut oil. If coconut oil has less unsaturated bonds than a normal, the oil will be easily damaged because its nutritional value is less than the standard. Hence, when it is utilized for cooking it cannot maintain the nutritional value of what it is cooking, whereas if coconut oil possesses many saturated bonds, the melting point will increase so that it results in rancidity to oil because it is easily oxidized (Novitriani & Sapitri, 2014).

To prevent free radical oxidation reactions in lipid oxidation in the rancidity process, it is necessary to add substances in the form of antioxidants (Tomagola, et al., 2016). Phenolic compounds as antioxidants possess the ability to reduce free radicals (Ahmad, et al., 2018). High antioxidant activity with a large enough phenol content, which are coumaric acid and gallic acid, can be obtained in Kesum plants (Dewi, et al., 2019).

Research conducted by Ratnawati & Indrawati, (2021) revealed that there is a relationship between the addition of 20 gr and 40 g of kesum leaves to the free fatty acid content in applying cooking oil, with an average of free fatty acid content before the addition of kesum leaves which is 7.12% to 6.93% and 5.36%.

The objective of this research is to identify the quality of coconut oil after the addition of pineapple (*ananas comosus*) and kesum leaves (*polygonus minus*) extracts.

2. RESEARCH METHOD

This research employed a quasi-experimental research design. This research was conducted at the Health Analyst Department Laboratory of the Pontianak Health Polytechnic. The samples in this research were coconut oil without the addition of pineapple fruit extract, coconut oil with the addition of pineapple fruit extract but without the addition of kesum leaves, and coconut oil with the addition of pineapple fruit extracts and kesum leaves as much as 20 gr, 30 gr, and 40 replication was administered 5 times in order to obtain a total sample size of 25.

The bromelain enzyme was formulated by taking 600 grams of pineapple for each treatment in a blender, then squeezed and filtered to obtain pineapple juice. The juice obtained was utilized for the process of making coconut oil. The traditional process of making coconut oil was grated the coconut flesh, then squeezed, and coconut milk was obtained. The coconut milk obtained remained to stand for 3 hours so that it was separated into three layers, a layer of cream, skim, and sediment. The cream layer was then heated over low heat for 30 minutes and stirred continuously, then the oil from presscake was separated. The process of making coconut oil enzymatically was obtained by grated coconut flesh, squeezed then coconut milk was obtained. Coconut milk was then added with the bromelain enzyme for the fermentation process by incubating it at room temperature (27^0C) for 24 hours. The fermented coconut milk was separated into two layers, the top layer is coconut oil and press cake, the bottom layer is water. The coconut milk that has been formed into two layers was filtered by implementing filter paper. The cream layers were then heated over low heat for 30 minutes and stirred continuously, then the oil from the press cake was separated. The obtained oil was then added with blended kesum leaves according to predetermined concentration variations. Each treatment on coconut oil was examined organoleptically (color, taste, and smell). The degree of acidity measured employing a pH meter, oil extraction rate of oil per unit weight of wet coconut pulp, peroxide number, saponification number, and acid number.

Peroxide numbers were performed by adding the sample with Glacial-Chloroform Acetic Acid and saturated Potassium Iodide solution (covered with black plastic). Then, it was added with the distilled water and titrate with Sodium Thiosulfate solution 0.05 N until the yellow color disappears. It was also then added with starch indicator and titrate again with Sodium Thiosulfate solution 0.05 N. Next, it was shaken vigorously to release all iodine from the solvent layer so that the blue color disappears. The peroxide number is expressed as milliequivalents of O_2/kg of fat obtained from dividing between {1000 x N x (V0-V1) x 8} and W (Badan Standarisasi Nasional, 2013).

The analysis of the saponification number of coconut oil producing enzymatically was performed by dissolving the oil sample with alcoholic KOH, closed with a back-cooling and boiled it carefully (with a water bath) for 30 minutes. After being cooled and added with the pp indicator, the excess KOH 0.5 N was titrated with a standard solution of 0.5 N HCl (Effendi, et al., 2012).

The test of the acid number was conducted by adding the sample with 95% alcohol then heated for 10 minutes in a boiling flask while stirring with a magnetic stirrer and closed with a back coat to dissolve the free fatty acids. After cooled, the oil solution was titrated with 0.1 N KOH solution by applying the pp standard indicator (phenolphthalein). The end point of the titration was achieved when a pink color was

generated which did not disappear for half of minute (Effendi, et al., 2012). This research has received an approval from the Health Research Commission of the Health Polytechnic of the Ministry of Health Pontianak with No. 061/KEPK-PK.PKP/II/2020.

3. RESULTS AND DISCUSSION

The objective of making coconut oil process with the addition of pineapple juice is to increase the results of oil and accelerate the processing. The bromelain enzyme in pineapple juice was able to break down the emulsion of fat or oil (Wahyusi, et al., 2020). The bromelain enzyme was also able to break the peptide bonds so that the protein could be denatured into simpler parts, which were amino acids and other components, hence, the bound oil came out and coagulated into one. The function of leaving the coconut milk for 3 hours is to separate the cream which is rich of oil from the skim part at the bottom. After that, kesum leaves were added according to the concentration. The sample processing employed the heating method, the temperature was maintained at a temperature of 60-70^{0}C, hence, the substances contained in the oil were not damaged. The oil quality test was administered by organoleptic test, degree of acidity, oil extraction rate, acid number test, peroxide number test, and saponification number test.

Table 1. Recapitulation of Results of Determination of Organoleptic Test Characteristics, Degree of Acidity and Oil Extraction Rate.

Characterization		**Observation result**				
		P1	**P2**	**P3**	**P4**	**P5**
Organoleptic	Aroma	Typical coconut oil	Typical coconut oil and pineapple aroma	Typical coconut oil and pineapple aroma	Typical coconut oil and pineapple aroma	Typical coconut oil and pineapple aroma
	Taste	Normal	Normal	Normal	Normal	Normal
	Color	Clear	Pale yellow	Greenish yellow	Green	Deep green
Acidity		5	4	5	5	5
Oil Extraction Rate (OER)		24,3 %	26,3 %	26,5 %	26,8 %	26,9 %

Information:
P1: Coconut oil without the addition of pineapple and kesum leaves
P2: Coconut oil with the addition of pineapple fruit, without kesum leaves
P3: Coconut oil with the addition of pineapple fruit and 20 grams of kesum leaves
P4: Coconut oil with the addition of pineapple fruit and 30 grams of kesum leaves
P5: Coconut oil with the addition of pineapple fruit and 40 grams of kesum leaves

The highest Oil Extraction Rate (OER) of coconut cooking oil was in the volume of 40gr pineapple extract and kesum leaves. At low substrate concentrations (coconut cream), the reaction speed depends on the substrate concentration. It happens because the more substrates are connected to the active part of the enzyme, the more the reaction speed and the number of reaction products increase (Male, et al., 2014).

Table 2. Acid Numbers Levels in Coconut Oil (Cocos Nucifera) With the Addition of Pineapple Fruit and Kesum Leaves.

	Acid Numbers				
	P1	**P2**	**P3**	**P4**	**P5**
Average	0,3732	0,3088	0,2584	0,2533	0,2547
Reduction	0,00	0,0644	0,1148	0,1199	0,1185
Percentage of Reduction (%)	0,00	17,26	30,76	32,13	31,75

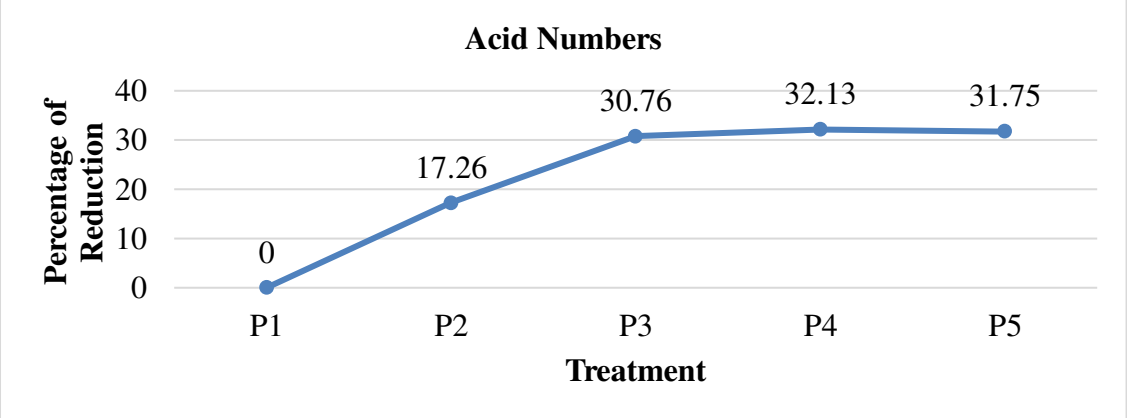

Figure 1. Analysis of Acid Number Levels

The acid number was determined by the titration method. The addition of alcohol and heating was performed so that the oil is more easily dissolved in alcohol and it is easy to titrate (Hernawati & Jirana, 2018). In figure 1, it can be identified that the percentage reduction in acid number levels in the addition of pineapple fruit and 30 grams of kesum provides the largest percentage with a reduction in acid number levels by 32.13%. The presence of antioxidant compounds which are more active in donating hydrogen atoms causes fatty acids with unstable double bonds to react with free fatty acids generated from hydrolysis (Ariono, et al., 2017). The hydrolysis process released short chain fatty acids causing odors. In the presence of water, fat was hydrolyzed to a form of glycerol and free fatty acids (Ngatemin, et al., 2013).

Table 3. Peroxide Numbers Levels in Coconut Oil (Coconus Nucifera) with the Addition of Pineapple Fruit and Kesum Leaves

	Level of Peroxide Numbers				
	P1	**P2**	**P3**	**P4**	**P5**
Average	17,4959	9,9889	6,8697	6,6595	6,6551
Reduction	0,00	7,5070	10,6262	10,8364	10,8408
Percentage of Reduction (%)	0,00	42,91	60,74	61,94	61,96

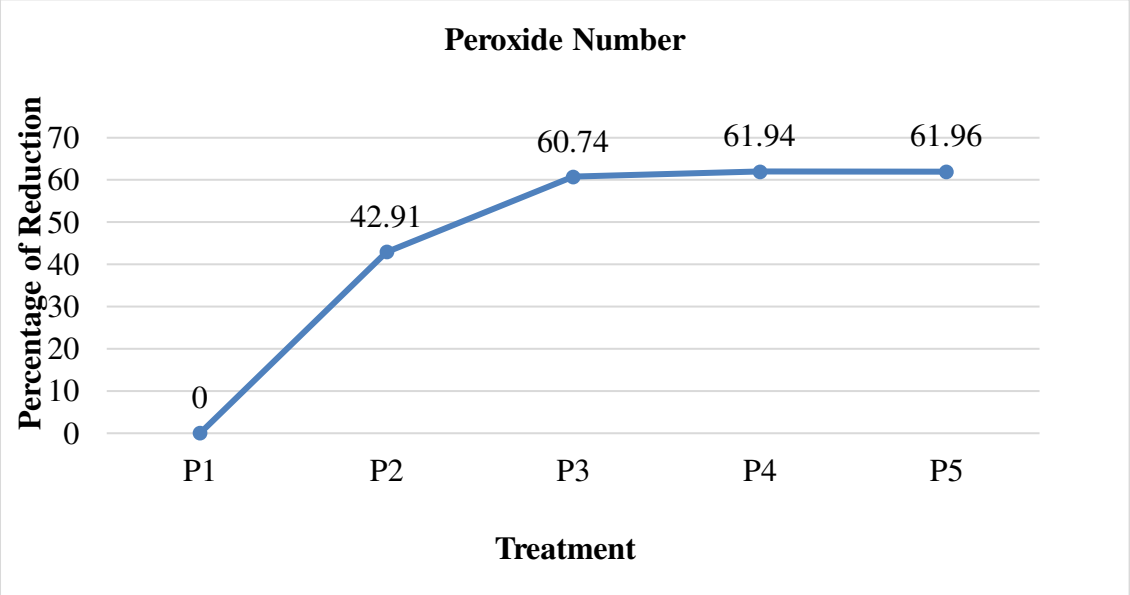

Figure 2. Analysis of Peroxide Number Level.

The peroxide value presents the degree of damage to the oil due to the oxidation process (Khoirunnisa, et al., 2019). The peroxides constructed can be calculated as iodometry. The principle of measurement is to react the sample with a potassium iodide solution at normal temperatures. Iodine liberated by peroxide was titrated with a standard solution of sodium thiosulfate. The reduction percentage in the level of peroxide number in the addition of pineapple fruit and 40 grams of kesum provided the largest percentage with the reduction percentage in the level of peroxide number by 61.96%. The addition of pineapple and kesum leaves reduced the level of oxidation in coconut cooking oil. The mechanism of antioxidants in delaying or preventing fat oxidation was administered through several mechanisms, encompassing reacting with radical compounds and forming more stable compounds as a chelating agent against metal ions. Hence, the formation of reactive compounds or peroxide decomposition, muffled singlet O2 triggering the peroxides formation, and damaging hydroperoxides or regenerating antioxidants cutting off radical reactions could be prevented (Purwaningsih, et al., 2019).

Table 4. Saponification Numbers Levels in Coconut Oil (Coconus Nucifera) with the Addition of Pineapple Fruit and Kesum Leaves.

	Level of Saponification Number				
	P1	**P2**	**P3**	**P4**	**P5**
Average	224,3738	209,9211	202,6926	199,5017	198,1058
Reduction	0,00	14,4527	21,6813	24,8721	26,2681
Percentage of Reduction(%)	0,00	6,44	9,66	11,09	11,71

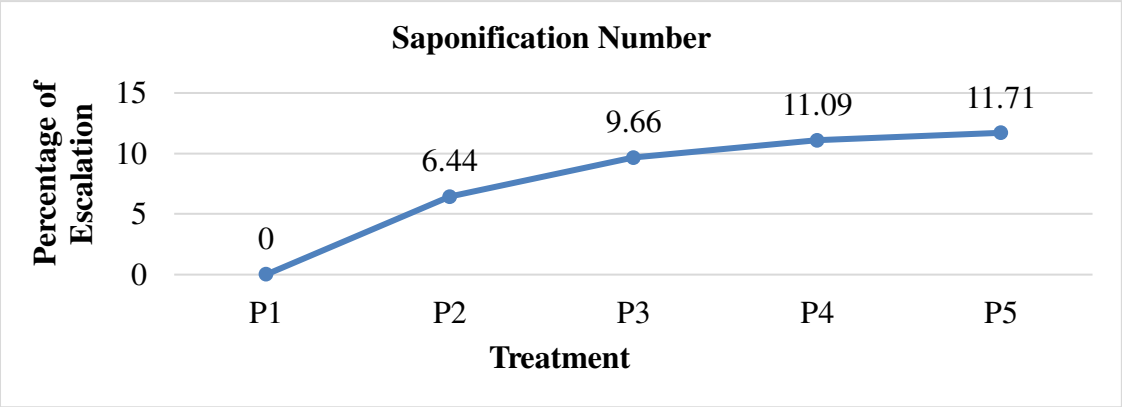

Figure 3. Saponification Number Analysis

The saponification number demonstrates the molecular weight of fat, oil which has a large molecular weight, hence, the saponification number is relatively small, whereas the oil composed of short carbon chain fatty acids possessing a relatively small molecular weight to own a large saponification number (Kurnianingsih, et al., 2020).

The reduction percentage in the level of saponification numbers of pineapple fruit addition and 40 grams of kesum leaves produced the largest percentage with an increase in the level of saponification numbers of 11.71%. The saponification number revealed the molecular weight of fat, in which the oil composed of short carbon chain fatty acids possessing a relatively small molecular weight owns large saponification numbers levels, and vice versa, if the oil possesses a large molecular weight, the level of saponification numbers is relatively small (Azman, et al., 2018).

From the results of the examination, the data were examined by implementing the SPSS program. The univariate test was employed to determine the normality test of the data with the Kolmogorov-Smirnov test so that a significance value> 0.05 could be obtained for each treatment. Bivariate tests with Pearson correlation test and linear regression were also administered. The Pearson correlation test obtained a significance value of 0.000 less than 0.05. It is implied that there is a relationship between the addition of pineapple extract and kesum leaves with the acid number, peroxide number, and saponification number. The r-value for the acid number is -0.874, the peroxide number is -0.845 and the saponification number is -0.903. The r-value presents the direction of the negative relationship, which means that the more pineapple and kesum leaves are added, the lower the acid number, peroxide number, and saponification number are.

Table 5. Model Summary of Simple Regression Analysis Results of Pineapple and Kesum Leaf Addition to Coconut Oil.

	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
Acid Numbers	1	,874[a]	,764	,754	,02395
Peroxide Numbers	1	,845[a]	,714	,702	2,33248
Saponification Numbers	1	,903[a]	,815	,807	4,41978

The addition of pineapple and kesum leaves had an effect of 76.4% on the acid number, 71.4% on the peroxide number, and 81.5% on the saponification number.

Table 6. ANOVA Results of Simple Regression Analysis of the Pineapple and Kesum Leaves Addition to Coconut Oil.

		Model	df	Mean Square	F	Sig.
Acid Numbers	1	Regression	1	,043	74,579	,000[b]
		Residual	23	,001		
		Total	24			
Peroxide Numbers	1	Regression	1	312,777	57,491	,000[b]
		Residual	23	5,440		
		Total	24			
Saponification Numbers	1	Regression	1	1981,701	101,446	,000[b]
		Residual	23	19,534		
		Total	24			

ANOVA test revealed the significance of the independent variables on the dependent variable. From this output, it can be identified that the significance level is 0.000<0.005. Thus, a simple linear regression model can be employed to foresee the levels of acid numbers, peroxide numbers, and saponification numbers in coconut cooking oil added with pineapple and kesum leaves.

Table 7. Coefficient Simple Regression Analysis Result of Pineapple and Kesum Leaves Addition to Coconut Oil.

		Model	Unstandardized Coefficient		Standardized Coefficients	t	Sig.
			B	Std. Error	Beta		
Acid Numbers	1	(Constant)	.377	,011		33,597	,000
		Treatment	-,029	,003	-,874	-8,636	,000
Peroxide Numbers	1	(Constant)	17,037	1,094		15,573	,000
		Treatment	-2,501	,330	-,845	-7,582	,000
Saponification Numbers	1	(Constant)	225,806	2,073		108,924	,000
		Treatment	-6,296	,625	-,903	-7,589	,000

Based on the Coefficients table, it is discovered that the regression equation model for estimating the addition of pineapple and kesum leaves affecting the acid number levels, peroxide number, and saponification number is:

y = a + bx

y = 0.377 - 0.029x) for the acid numbers

y = 17,037 - 2,501x) for the peroxide numbers

y = 225.806 - 6.296x) for the saponification numbers

Where "y" is the percentage of escalation in acid number, peroxide number, or saponification number, while "x" is the number of added kesum leaves. From the results of simple regression analysis, the t count= 2.687 with a significance value of 0.000<0.05. It means that there is an effect of pineapple and kesum leaves application

on the level of acid numbers, peroxide numbers, and saponification numbers in coconut oil.

4. CONCLUSION

From the result of the study, it can be concluded that the addition of pineapple fruit and *kesum* leaves on acid number content possessed an effect of 76.4% on the acid number, 71.4% on the peroxide number, and 81.5% on the saponification number. However, it is recommended to continue this research to examine the water content, free fatty acids, and iodine number.

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