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THE EFFECTIVENESS OF ADDING ANTIOXIDANT COMPOUNDS FROM PEDADA LEAVES EXTRACT (*Sonneratia caseolaris*) IN ANTISEPTIC SOAP PRODUCTION

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ABSTRACT

Pedada leaves (*Sonneratia caseolaris*) are plants from tropical areas with relatively high antioxidant content. This research aims to make antiseptic soap with the addition of pedada leaves and see the quality of the antiseptic soap by SNI 03-3532-1994. This research includes the pre-treatment process, namely taking pedada leaf extract by maceration using ethanol and acetone solvents using a variety of evaporation tools in the form of a water bath and soxhlet, then making soap with coconut oil with variations used in the form of evaporation methods and the amount of extract used. This research analyzed water content, free alkali, and free fatty acids. The observations showed that using a water bath would produce a more significant amount of extract. The results of the soap-free alkali analysis produced ranged from 0.061% to 0.088%, which shows that the free alkali content is still below the limit determined by SNI. The lowest water content analysis results obtained were 11.30%.

Keywords: pedada leaves, maceration, antiseptic soap, antibacterial.

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INTRODUCTION

Soap does not just remove dirt from the skin but must contain antioxidant compounds that can protect the skin and not damage the skin due to the effects of free radicals. Antioxidants in soap are needed to fight free radicals, which can cause wrinkled skin, premature aging, black spots, dull skin, dry skin, and even skin cancer [1-3].

Soap results from a reaction between sodium or potassium and fatty acids. Soap is formed based on the composition of several ingredients, one of which is coconut oil. Using coconut oil as a raw material for making soap is based on the desired quality, with appropriate treatment for each ingredient. Apart from that, several additional ingredients are needed to obtain the desired soap quality, such as thickeners, antioxidants, fillers, dyes, and fragrances [4-6].

Indonesia has the most significant coconut production in the world, with a capacity of 18.3 million tons per year; this value gives Indonesia a market share of 30.24% of coconut sales worldwide. Coconut consumption has a high selling value; one form of utilization is coconut oil [7, 8]. The use of antiseptic soap in the era of globalization is considered a primary need. However, the antiseptic soap on the market mainly uses synthetic active substances, which can cause bacterial resistance to antibiotics, so natural antiseptic soap is expected to reduce bacterial resistance [9-11].

A study by Rochester *et al*. (2017) stated that triclocarban is one of the synthetic antimicrobial agents. Triclocarban (N-(4-chlorophenyl-N-(3,4-dichlorophenyl)) urea), or (N-(3,4-dichlorophenyl-N-(4-chlorophenyl) urea), or (1-(3' ,4'Dichlorophenyl)-3-(4-chlorophenyl)) urea), is an antimicrobial agent primarily used in bar soap, plastics, cleaning lotions, and tissues. According to Ley *et al*. (2018), triclocarban is a broad-spectrum microbicide active against bacteria, fungi and viruses. To date, triclocarban is found in various consumer products, including bars, liquid soap, and toothpaste. Triclocarban is rapidly becoming a nearly ubiquitous human exposure agent. In 2011-2013, nearly 72% of human urine samples in the United States contained triclocarban. Long-term triclocarban use causes bacterial antibiotic resistance because its structure is similar to antibiotics. Therefore, it is necessary to use natural antibacterial compounds as a substitute for triclocarban. Secondary metabolite ingredients are the best antibacterials because they are bacteriostatic and bacteriocidal. The phenol, steroid and flavonoid compounds in pedada leaves can be used as natural antioxidants that can inhibit free radicals in the human body [12-14].

One of the natural antioxidants comes from pedada mangrove leaves (*Sonneratia caseolaris*). Fresh pedada leaves have an antioxidant activity content of 78.5%, higher than dried pedada leaves. Ethanol and water extracts of pedada leaves (*Sonneratia caseolaris*) have activity in reducing free radicals. The IC50 value of the isolate was 45.85 ppm, and the IC50 value of vitamin C was 3.4024 ppm. A compound is said to be a potent free radical reducer or antioxidant if the IC50 value is less than 50 ppm, strong (50 ppm-100 ppm), medium (100 ppm-150 ppm), and weak (150 ppm-200 ppm) [15-18].

From the description above, the use of pedada leaf extract as an additive in making antioxidant soap based on coconut oil can be done because pedada leaf extract has a high antioxidant content, so it can inhibit free radicals and be antibacterial, which can ward off bacterial growth. The choice of pedada leaves as a sample was due to the availability of pedada leaves in large quantities, but they had yet to be explored for research needs.

MATERIALS AND METHODS

Materials

The materials used in this research were pedada leaves, coconut oil, ethanol, acetone, distilled water, NaOH, glycerin, Cocomide-DEA, fragrance, and stearic acid.

Experimental Design

The pedada leaf extract is made by sorting the pedada leaves, drying them, and reducing the sample size. Next, the pedada leaf simplicia is dissolved in several solvents such as acetone, methanol and ethanol. The method used is maceration, with the extraction process using a soxhlet extractor and evaporation using a water bath at a temperature of 40℃, which helps concentrate the maceration results. Antiseptic soap from coconut oil is done through a saponification process, with a reaction temperature of 50℃. Meanwhile, the independent variable is the volume of extract used. The experimental design and test results of antiseptic soap are given in Table-1.

Experimental Procedure

The extraction procedure for pedada leaves (Sonneratia caseolaris) by maceration was carried out with modifications in previous research as follows [19-21]. Pedada leaves are taken according to the criteria of not dark green colour, smooth surface, shiny green top, pale bottom, not stiff texture, and thick. Pedada leaves are washed clean and cut into small pieces. Dry under the sun. The dried leaves are crushed. One hundred grams of pedada leaf powder was taken and soaked in a solvent with a ratio (gr/mL) 1:6 for three days. The resulting macerate was filtered using Whatman No.1 filter paper. Next, evaporate until you get a thick extract.

The procedure for making antiseptic soap with the addition of pedada leaf extract (Sonneratia caseolaris) was carried out with modifications to previous research as follows [22-24]. Coconut oil is heated to 50℃. Add 50 mL of 31% NaOH a little while stirring gently. Add 15 grams of stearic acid while keeping it at 50℃. The mixture is heated to 70℃. After the temperature of 70℃ is reached, add 50 mL of 96% ethanol. Next, the glycerin solution and Cocomide DEA are mixed into the soap preparation. Fragrance and pedada leaf extract are added when the temperature is 50℃. The soap preparation is poured into the mould and left for 2 x 24 hours.

Table-1. Experimental design and test results for antiseptic soap.

No.	Equipment	Solvent	Solvent Amount (mL)	Water Content (%)	Alkaline Content (%)	Free Fatty Acid (%)
1	Water Bath	Ethanol	0	20.24	0.061	1.281
2			5	11.30	0.065	1.365
3			10	14.81	0.072	1.512
4			15	13.28	0.088	1.848
5	Water Bath	Acetone	0	20.24	0.061	1.281
6			5	12.60	0.064	1.344
7			10	15.35	0.064	1.344
8			15	14.80	0.080	1.680
9	Soxhlet	Ethanol	0	20.24	0.061	1.281
10			5	16.31	0.088	1.848
11			10	15.14	0.064	1.344
12			15	14.28	0.072	1.512
13	Soxhlet	Acetone	0	20.24	0.061	1.281
14			5	17.03	0.065	1.365
15			10	14.21	0.061	1.281
16			15	15.70	0.084	1.764

Testing Results

The tests carried out on pedada leaf extract and antiseptic soap with pedada leaf extract added is as follows:

Water Content Analysis

Water content is a material that evaporates at a specific temperature and time. The maximum water content in soap is 15%; this is because the soap produced is hard enough to make it more efficient to use and does not dissolve easily in water. The water content will affect the hardness of the soap. The principle of testing the water content of soap is measuring the lack of weight after drying at 105°C. The water content of the soap greatly influences its hardness level. The higher the water content, the softer the soap [25]. The water content calculation procedure is carried out by SNI 06-3532-1994.

Free Alkaline and Free Fatty Acid Analysis

In soap stock formation, an alkali that does not completely react with fatty acids is considered free. This free alkali is a harsh alkali that can cause skin irritation. This is due to NaOH, which quickly absorbs skin moisture. In determining it, the free alkali content must not exceed 0.1%. The amount of fatty acids is the total amount of all fatty acids in soap that have or have not reacted with alkali. Good quality soap has a total fatty acid content of at least 70% [26]. The procedure for determining free alkali and free fatty acid levels is carried out by SNI 06-3532-1994.

RESULTS AND DISCUSSIONS

Stoichiometry of Saponification

Stoichiometry is the science of quantitative comparative measurements or comparison measurements between one chemical element and another. Stoichiometry is a field in chemistry that concerns the quantitative relationships between substances involved in chemical reactions, both as reactants and as reaction products. This concept can efficiently help the numerical solution of chemical reactions [26, 27].

One of the reactions studied in this research is the saponification reaction of coconut oil and caustic soda to produce solid soap [28]. The supporting data needed is the molecular weight of the coconut oil used, namely the Barco brand, which has a molecular weight of 642.24 g/mol. Stoichiometric calculations show that the saponification requires 11.21 grams of caustic soda for 60 grams of coconut oil.

The following reaction was studied using a foaming agent in the form of stearic acid, which also underwent a neutralization saponification reaction, which is a process of reacting fatty acids with an alkaline solution that produces soap. The types of alkali commonly used in the saponification process are NaOH, KOH and ethanolamines. NaOH, commonly known as caustic soda in the soap industry, is the alkali most widely used in making hard soap. Overall, saponification requires 14.02 grams of caustic soda.

Extraction Product

Extraction is a method of extracting chemical content from simplicia using a suitable method and solvent so that the chemical content can be dissolved and separated from materials that cannot be dissolved with liquid solvents. The solvent used in extraction must be selected based on its ability to dissolve the maximum amount of active substances and the minimum possible amount of undesirable elements.

Flavonoid compounds are polar, so a polar solvent is needed. The effectiveness of extraction of a compound by a solvent depends on the compound's solubility. Polar solvents include ethanol, methanol, acetone and water [17].

When extracting lemon peel, the highest antioxidant activity was obtained using 70% ethanol solvent compared to 80% methanol [26]. Flavonoid extraction in Spirogyra sp. using acetone solvent provided the highest total flavonoids [25]. So, it is necessary to vary the use of solvents to obtain the correct type of solvent for the highest antioxidant activity in this study.

Maceration is extracting simplicia using a solvent with several shaking or stirring at room temperature. The basis of maceration is the dissolution of simplicia ingredients from damaged cells, which are formed during the refinement extraction of ingredients from cells that are still intact. After the maceration time is complete, meaning that the balance between the material extracted from the inside of the cell and entering the liquid has been reached, the diffusion process immediately ends [23].

The results of pedada leaf extract (*Sonneratia caseolaris*) using the ethanol and acetone solvent maceration method were carried out using various soxhlet and water bath evaporation tools. The extraction results showed that the extract yield with the ethanol solvent was more significant than the acetone solvent, and the evaporation yield from the water bath was more significant than with the soxhlet evaporation tool. Extracts obtained using ethanol solvent successively for the maceration method using a water bath and soxhlet evaporation tool were 7.12% and 4.21%, respectively. Meanwhile, using the same evaporation method and equipment, the acetone solvent produced extract yields of 5.39% and 2.09%. Based on these results, the evaporation tool with the most extract is the Water bath, which has a relatively longer evaporation time than a soxhlet.

Analysis of Water Content in Antiseptic Soap

Figure-1 shows the effect of the mass of extract given on the water content of the soap. The value of soap water content without adding extract (blue colour) is 20.24%. Then, variations in the addition of antioxidant extracts were taken, 5, 10, and 15 mL, with different solvents, acetone and ethanol. Extract extraction is carried out using two tools, namely a soxhlet and a water bath.

Water content dramatically influences the texture and quality of the soap produced; the higher the percentage of water content, the softer the resulting soap will dissolve easily in water, so the soap will be uncomfortable to use and will not last long. According to SNI 3532 of 2016 concerning solid bath soap, the maximum water content recommended for solid bath soap is 15% [4]. In this research, the percentage value of water content in antioxidant soap was obtained for each variation, including variations in the addition of extracts, the solvent used, and the tools used, namely the soxhlet and water bath. Based on SNI 2016, it can be concluded that only a few soaps produced have a water content value according to SNI, namely a maximum of 15%. Some of the soaps produced have a water content value above 15%.

The increased water content can be caused by adding raw materials, such as cocomide-DEA, glycerin, and water as a NaOH solvent [9]. The research does this because water is added to dissolve sugar and NaOH in amounts that exceed the oil used. The source of water that also causes high water content is when a reaction occurs between added stearic acid and caustic soda, which causes the formation of stearic salt and water. The formation of water from the neutralization process of fatty acids is caused because water can be one of the products of the neutralization reaction of triglycerides with NaOH [19].

Analysis of Free Alkali Content in Antiseptic Soap

Figure-2 shows the effect of the mass of extract given on the free alkali content obtained from soap products. The soap-free alkali value, without adding extracts for all variations of solvent types, is 0.061%.

Free alkali is the alkali content in soap that is not bound as a compound. Excessive levels of free alkali in soap making can cause skin irritation. The Indonesian National Standard (SNI) states that soap's maximum free alkali content is 0.1%. The results of the antiseptic soap that has been made show a free alkali value range of 0.061% to 0.088%, indicating that the free alkali content is still below the limit determined by SNI when ready for production. This shows that the soap obtained is by standards.

This study also showed that adding pedada fruit extract after one week did not show free alkaline activity, namely a colour change in the phenolphthalein indicator to pink. This is because the NaOH has completely reacted with the oil, and there is no remaining alkali. The pedada fruit extract added to soap has a pH value of 3-3.2, so it can help neutralize alkali in soap because the acid content in the fruit is acidic, so it can help neutralize alkali residue [22].

Analysis of Free Fatty Acid Levels in Antiseptic Soap

Figure-3 shows the effect of the mass of the extract given on soap's free fatty acid content after going through the storage process. The fatty acid value of soap without adding extract is 1.281%, while the maceration water bath (MW) and maceration soxhlet (MS) variations have the same free fatty acid content, 1.281%. Free fatty acids are acids that are not bound to sodium or triglycerides. Fatty acid levels that are too high can cause rancidity, reduce the shelf life of soap, and reduce its ability to bind to dirt [28]. The high levels of free fatty acids in soap are caused by incomplete saponification reactions and excess raw materials, which means that the alkali cannot bind all the oil [24].

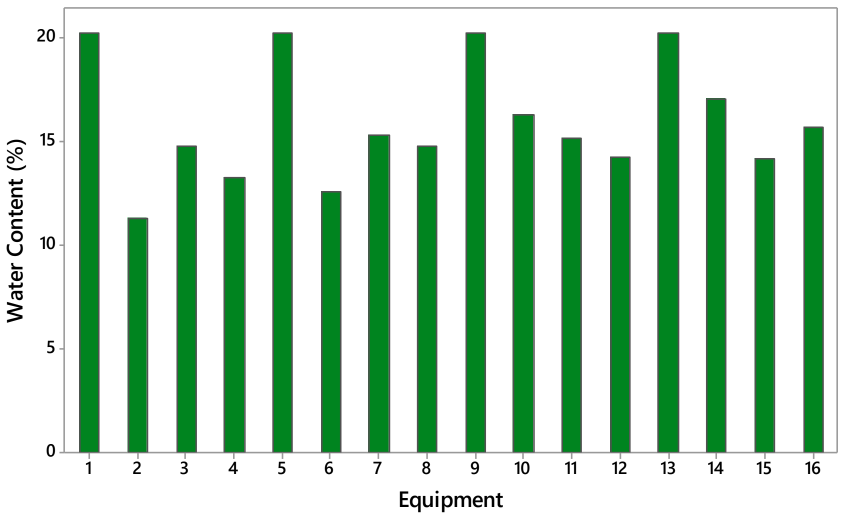

Figure-1. Effect of the mass of extract given on the water content of the soap.

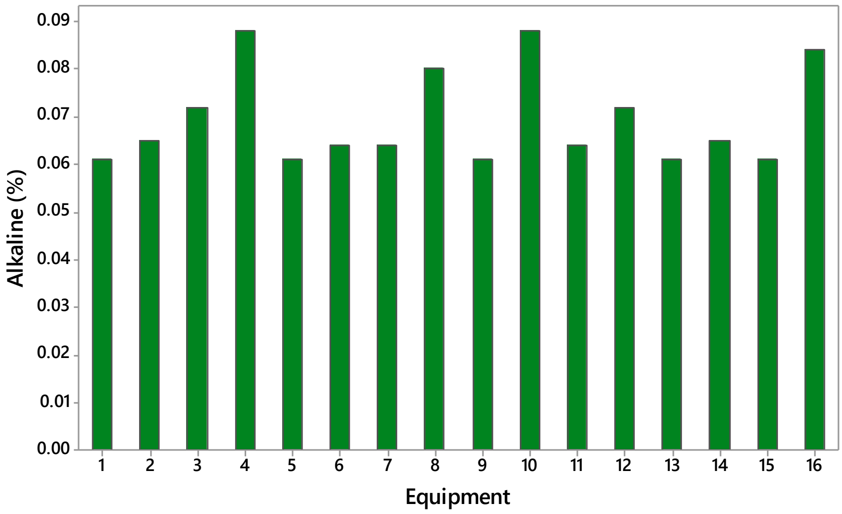

Figure-2. Effect of the mass of extract given on the free alkali content.

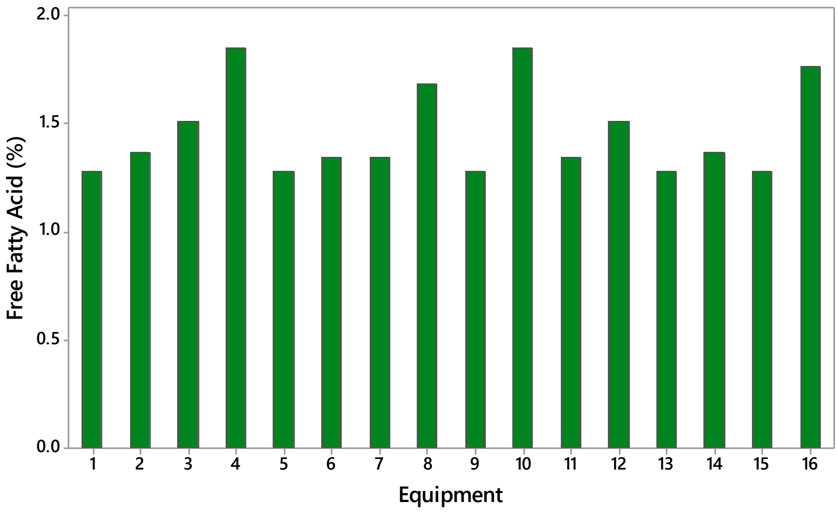

Figure-3. Effect of the mass of extract given on free fatty acid levels.

Table-2. Interpretation of data output for water content analysis.

Equipment	Mean	Variance	Minimum	Maximum	Skewness	Kurtosis
1 (Water Bath)	15.330	10.95	11.300	20.240	0.75	0.61
2 (Soxhlet)	16.644	5.827	14.210	20.240	0.83	0.79
Solvent	Mean	Variance	Minimum	Maximum	Skewness	Kurtosis
Aseton	16.271	7.592	12.600	20.240	0.57	-0.73
Ethanol	15.700	9.990	11.300	20.240	0.51	-0.56
Solvent Amount (mL)	Mean	Variance	Minimum	Maximum	Skewness	Kurtosis
0	20.240	0.000	20.240	20.240	*	*
5	14.310	7.790	11.300	17.030	-0.13	-4.65
10	14.878	0.247	14.210	15.350	-0.94	0.28
15	14.515	1.022	13.280	15.700	-0.14	0.25

Based on SNI quality requirements, it is shown that the content limit set by SNI is 2.5%. In the experiments, where the free fatty acid levels were measured after one week of storage, it showed that all the free alkali had been used up, and free fatty acids were left in all variations of the experiments. All variations show that the concentration of free fatty acids is still below the limits set by SNI.

Descriptive Statistics Water Content Analysis

The next stage, descriptive analysis, is carried out to describe or describe the data summary. Interpretation of the data output for water content analysis is shown in Table-2. Table-2 shows that soap using water bath maceration (MW) has an average water content of 15.33 with a distribution of water content from the average of 10.95. Compared with soap from water bath equipment, the average soap water content where pedada leaves were macerated using soxhlet (MS) equipment was higher, namely 16.644, with a variance of 5.827. So, the data distribution based on equipment type is more varied for soap from water bath (MW) than soap from soxhlet (MS). This is also shown by the lowest water content of bath soap (MW) at 11.30.

Meanwhile, for soap from soxhlet (MS), it is 14.210. Judging from the shape of the distribution, soap from the water bath (MW) has a skewness of 0.75, which appears to be a positive value, so the tailed distribution shape is skewed to the right. Kurtosis 0.61 is also positive. Meanwhile, the distribution form for soap from the soxhlet (MS) also has tails skewed to the right (skewness 0.83) with a kurtosis value of 0.79.

Soap formulated using acetone solvent has an average water content of 16.271 with a water content distribution of 7.592. Compared to soap using acetone, the average water content of soap using ethanol is lower, namely 16.644, with a variance of 9.99. So, the data distribution based on solvent type is more varied for soap using ethanol than soap using acetone. The lowest water content also shows this for acetone soap, which is 12.600, while for soap using ethanol, it is 11.30. Judging from the shape of the distribution, soap using acetone has a skewness of 0.57, which appears to be a positive value, so the tailed distribution shape is skewed to the right. As for kurtosis -0.73, it is negative. Meanwhile, the distribution form for soap using ethanol also has a tail skewed to the right (skewness 0.51) with a kurtosis value of -0.56.

In Table-2, it is also shown that soap with a solvent amount of 0 mL has an average water content of 20.240 with a distribution of water content from the average of 0.000. Compared to soap with a solvent amount of 0 mL, the average water content with a solvent amount of 5 mL is lower, namely 14.31 with a variance of 7.79. So, the data distribution based on the amount of solvent is more varied for soap with a solvent amount of 5 mL than soap with a solvent amount of 0 mL. This is also shown by the lowest water content for soap with 0 mL of solvent, which is also 20.240, while for soap with 5 mL of solvent, it is 11.30.

For soap with a solvent amount of 10 mL, the average water content is 14.878, with a distribution of average water content of 0.247. Compared to soap with a solvent amount of 10 mL, the average water content with a solvent amount of 15 mL is lower, namely 14.515 with a variance of 1,022. So, the data distribution based on the amount of solvent is more varied for soap with a solvent amount of 15 mL than soap with a solvent amount of 10 mL. This is also shown by the lowest water content for soap with 10 mL of solvent, which is also 14.210, while for soap with 15 mL of solvent, it is 13.280.

Judging from the shape of the distribution, soap with a solvent amount of 5 mL has a skewness of -0.13, which appears to be a negative value so that the shape of the distribution is tailed and deviates to the left. Kurtosis -4.65 is also harmful. Meanwhile, the distribution form for soap with a solvent amount of 10 mL also has a tail that deviates to the left (skewness -0.94) with a kurtosis value of 0.28. For soap with a solvent amount of 15 mL, the tail deviates to the left (skewness -0.14) with a kurtosis value of 0.25.

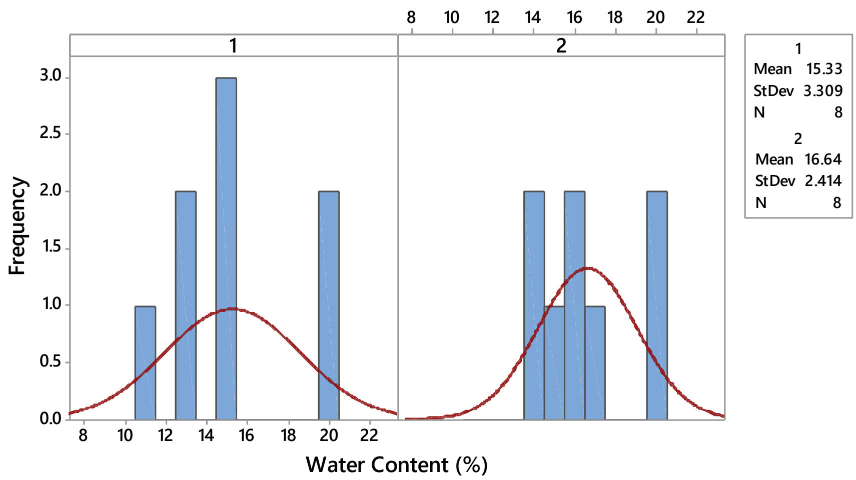

Figure-4. Histogram with normal distribution, water content based on equipment type.

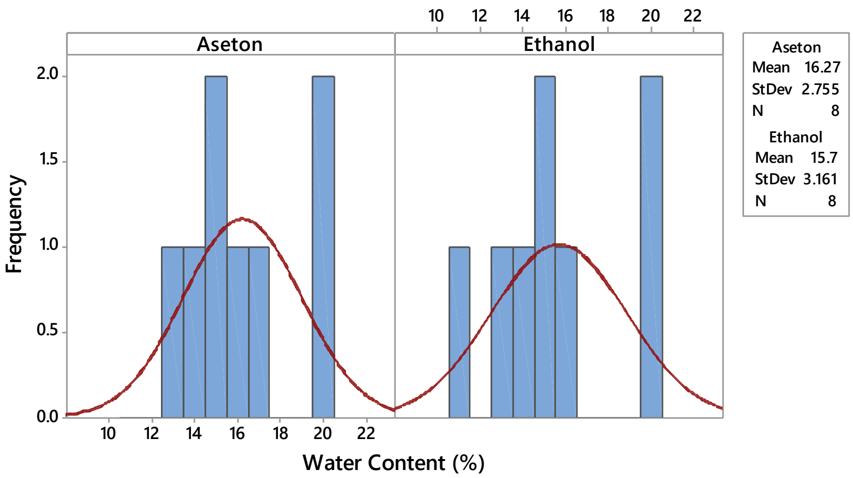

Figure-5. Histogram with normal distribution, water content based on solvent type.

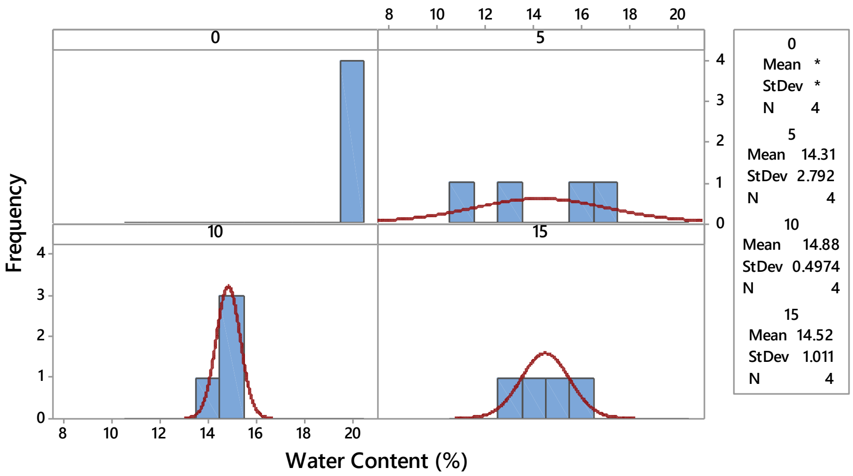

Figure-6. Histogram with normal distribution, water content based on the amount of solvent.

Figure-4 is a histogram form accompanied by a normal distribution of water content based on the type of water bath and soxhlet equipment. From the histogram above, observations of soap in the water bath (total data 8) are the same as observations of soap from soxhlet (total data 8). The water bath has an average water content of 15.33 with a standard deviation of 3.309, while the soxhlet has an average water content of 16.64 with a standard deviation of 2.414. From the size of the variance, it appears that in terms of the distribution of water content values from the average value, the soxhlet is slightly larger than the water bath.

Figure-5 is a histogram form accompanied by a normal distribution of water content based on the type of solvent, namely acetone and ethanol. Acetone has an average water content of 16.27 with a standard deviation of 2,755, while ethanol has an average water content of 15.7 with a standard deviation of 3,161. From the size of the variance, it appears that the spread of water content values from the average value of acetone tends to be greater than ethanol.

Figure-6 is a histogram form accompanied by a normal distribution of water content based on the amount of solvent, namely 0, 5, 10, and 15 mL. For a solvent amount of 5 mL, the average water content is 14.31 with a standard deviation of 2.792, while for a solvent amount of 10 mL; the average water content is 14.88 with a standard deviation of 0.4974. For the most significant amount of solvent, namely 15 mL, the average water content is 14.52, with a standard deviation of 1.011.

From the size of the variance, it appears that for the distribution of water content values from the average value, the amount of 10 mL solvent is greater than the amount of 5 mL and 15 mL solvent.

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Table-3. Interpretation of output data for alkaline content analysis.

Equipment	Mean	Variance	Minimum	Maximum	Skewness	Kurtosis
1 (Water Bath)	0.06938	0.00010	0.06100	0.08800	1.21	0.31
2 (Soxhlet)	0.06950	0.00012	0.06100	0.08800	1.08	-0.51
Solvent	Mean	Variance	Minimum	Maximum	Skewness	Kurtosis
Aseton	0.06750	0.00080	0.06100	0.08400	1.37	0.20
Ethanol	0.07138	0.00012	0.06100	0.08800	0.87	-0.84
Solvent Amount (mL)	Mean	Variance	Minimum	Maximum	Skewness	Kurtosis
0	0.06100	0.00000	0.06100	0.06100	*	*
5	0.07050	0.00014	0.06400	0.08800	1.99	3.97
10	0.06525	0.00002	0.06100	0.07200	1.44	2.71
15	0.08100	0.00005	0.07200	0.08800	-0.75	0.34

Descriptive Statistics Analysis of Alkaline Levels

Descriptive statistics of alkaline content are shown in Table-3. The average alkaline content for soap using water bath equipment is 0.06938, with a distribution of alkaline content from the average of 0.00010. Compared with water bath soap, it can be seen that the average alkaline content of soxhlet soap is slightly higher, namely 0.06950 with a variance of 0.00012. Thus, it was concluded that the data distribution based on equipment type was more varied for soxhlet soap than water soap. It was also shown that the lowest alkaline content in water bath soap was 0.061. This value is the same as that of soxhlet soap, namely 0.061. Judging from the shape of the distribution, water bath soap has a skewness of 1.21; it appears to be a positive value, so the shape of the distribution has a tail skewed to the right. Kurtosis 0.61 is also positive. Like water bath soap, soxhlet soap also has a tail that deviates to the right (skewness 1.08) with a kurtosis value of -0.51.

For soap, an acetone solvent has an average alkaline content of 0.06750 with a distribution of an average alkaline content of 0.00008. Compared to acetone soap, the average alkaline content of ethanol soap is higher, namely 0.07138, with a variance of 0.00012. So, the data distribution based on solvent type shows that ethanol soap is more varied than acetone soap. From Table-3, it is also shown that the lowest alkaline content for acetone soap is 0.061, which is the same as the minimum alkaline content for ethanol soap, which is 0.061. Judging from the shape of the distribution, acetone soap has a skewness of 1.37; it appears to be a positive value, so the shape of the distribution has a tail skewed to the right. As for kurtosis 0.20, it is also positive. Meanwhile, the distribution form for ethanol soap also has a tail skewed to the right (skewness 0.87) with a kurtosis value of -0.84.

The average alkaline content for soap with a solvent amount of 0 mL is 0.061, with a distribution of alkaline levels from the average of 0.000. Compared to soap with 0 mL of solvent, the average alkaline content with 5 mL of solvent is higher, namely 0.0705 with a variance of 0.00014. So, the data distribution based on the amount of solvent is more varied for soap with a solvent amount of 5 mL than soap with a solvent amount of 0 mL. This is also shown by the lowest alkaline content for soap with 0 mL of solvent, which is also 0.061, while for soap with 5 mL of solvent, it is 0.064.

For soap with a solvent amount of 10 mL, the average alkaline content is 0.0625, with a distribution of alkaline levels from the average of 0.00002. Compared to soap with a solvent amount of 10 mL, the average alkaline content with a solvent amount of 15 mL is lower, namely 0.081 with a variance of 0.00005. So, the data distribution based on the amount of solvent is more varied for soap with a solvent amount of 15 mL than soap with a solvent amount of 10 mL. This is also shown by the lowest alkaline content for soap with 10 mL of solvent, which is also 0.062, while for soap with 15 mL of solvent, it is 0.071.

Judging from the shape of the distribution, soap with a solvent amount of 5 mL has a skewness of 1.99, which appears to be a positive value so that the shape of the distribution is tailed and deviates to the right. As for kurtosis 3.97, it is also positive. Meanwhile, the distribution form for soap with a solvent amount of 10 mL also has a tail skewed to the right (skewness 1.44) with a kurtosis value of 2.71. For soap with a solvent amount of 15 mL, the tail deviates to the left (skewness -0.75) with a kurtosis value of 0.34.

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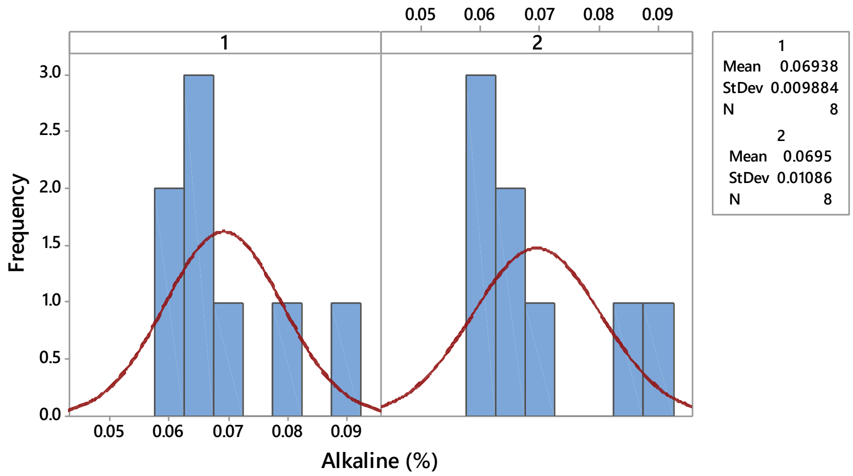

Figure-7. Histogram with normal distribution, alkaline levels based on equipment type.

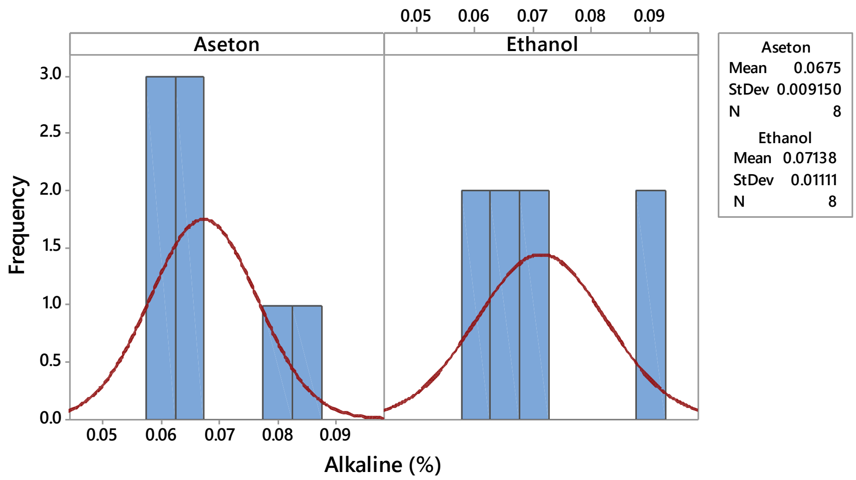

Figure-8. Histogram with normal distribution, alkaline levels based on solvent type.

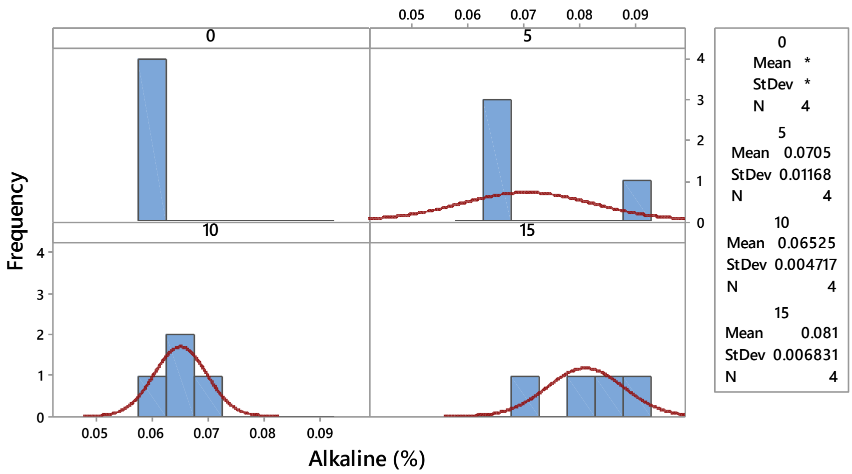

Figure-9. Histogram with normal distribution, alkaline levels based on the amount of solvent.

Figure-7 is a histogram with a normal distribution of alkaline levels based on the water bath type and soxhlet equipment from the histogram above because the observation of soap by the water bath (total data 8) is the same as the observation of soap soxhlet (total data 8). The water bath has an average alkaline content of 0.06938 with a standard deviation of 0.00988, while the booklet has an average alkaline content of 0.0695 with a standard deviation of 0.01086. From the size of the variance, it appears that for the distribution of alkaline content values from the mean value, the water bath is slightly larger than the soxhlet.

Figure-8 is a histogram with a normal distribution of alkaline levels based on the type of solvent, namely acetone and ethanol. Acetone has an average alkaline content of 0.0675 with a standard deviation of 0.00915, while ethanol has an average alkaline content of 0.07138 with a standard deviation of 0.01111. From the size of the variance, it appears that the spread of alkaline content values from the mean value of acetone tends to be greater than ethanol.

Figure-9 is a histogram with a normal distribution of alkaline levels based on the amount of solvent, namely 0, 5, 10, and 15 mL. For a solvent amount of 5 mL, the average alkaline content is 0.0705 with a standard deviation of 0.01168, while for a solvent amount of 10 mL; the average alkaline content is 0.06525 with a standard deviation of 0.004717. For the most significant amount of solvent, 15 mL, the average alkaline content is 0.006831 with a standard deviation of 0.006831.

From the size of the variance, it appears that for the distribution of alkaline content values from the mean value, the amount of 10 mL solvent is more significant than the amount of 5 mL and 15 mL solvents.

CONCLUSIONS

Antiseptic solid soap products can be produced using pure coconut oil as a source of fatty acids. The best antiseptic soap is obtained by adding ethanol maceration extract using a water bath evaporation device (MW) and 5 mL of pedada leaves. This variety has the highest antioxidant value, namely 58.2486 ppm. Increasing the concentration of pedada leaf extract can reduce the free alkali content obtained from soap. A decrease in free alkali levels is also shown after the soap has been left to rest during the curing process and the free alkali has completely reacted with the raw materials used. The water content in the soap products produced is different from the standards permitted by SNI 3531:2016 because many sources of water are added to the product, which affects the water content produced, namely in the range of 11.30% -20.24%.

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REFERENCES

[1] Aras N. R. M., Santi, Nur R. A., Isma and Yusriadi. 2023. Antiseptic liquid soap from corn oil (Zea mays L) and aloe vera extract with the variation of SLS (sodium lauryl sulfate). Indonesia Chimica Acta. 16: 23-31.

[2] Upula S. A., Bassey E. E. and Ije U. E. 2021. Antiseptic soaps and body cleansing agents and its effects on the normal flora of the human skin. World Journal of Pharmaceutical and Medical Research. 7(4): 28-34.

[3] Lawan R. and Idris A. 2021. Effects of some locally made antiseptic soaps on some skin microbes. International Journal of Scientific Research in Science, Engineering and Technology. 8(3): 339-341.

[4] Oktari S. A. S. E., Wrasiati L. P. and Wartini N. M. 2017. Pengaruh jenis minyak dan konsentrasi larutan alginat terhadap karakteristik sabun cair cuci tangan. Jurnal Rekayasa dan Manajemen AgroIndustri. 5(2): 47–57.

[5] Dwiyanti S., Sulandjari S., Winanti T., Asto I. G. P. and Anifah L. 2021. Cyprus rotundus L: formulation and evaluation antiseptic soap. International Joint Conference on Science and Engineering. 209: 46-50.

[6] Masyithah Z., Amelia A. R. and Hafsyah. 2023. Synthesis and characterization of n-acyl alkanolamide surfactant from fatty acids and alcohol amines using sodium methoxide catalyst. ARPN Journal of Engineering and Applied Sciences. 18(2): 55-63.

[7] Velázquez-Hernández M., Schabes-Retchkiman P., Martínez-Gallegos S. and Albiter V. 2020. Titanium nanoparticles phytosynthesized from eichhornia crassipes leaf extract and their antimicrobial activity. MRS Adv. 5(62): 3293-3299.

[8] Masyithah Z., Simanjuntak L. and Yudhika S. R. 2019. Simultaneously trans-esterification and amidification of coconut oil into cocamide-DEA using heterogeneous catalyst. ARPN Journal of Engineering and Applied Sciences. 14(11): 2111-2117.

[9] Sanharis A. and Wahyuningtyas D. 2018. Modifikasi sabun antiseptik alami dari virgin coconut oil (VCO) - minyak sereh dengan penambahan minyak zaitun sebagai antioksidan. Jurnal Inovasi Proses. 3(2): 46-52.

[10] Santos-Junior C. J., Lins F. C. C. O., Santor P. O., Silva V. B., Barros Y. V. R., Araujo M. A. S., Rocha T. J. M. and Souza A. K. P. 2024. Evaluation of antibacterial and antifungal activity of antimicrobial soaps. Brazilian Journal of Biology. 84: 1-7. DOI: 10.1590/1519-6984.263364.

[11] Ameh A. O., Muhammad J. A. and Audu H. G. 2013. Synthesis and characterization of antiseptic soap from neem oil and shea butter oil. African Journal of Biology. 12(29): 4656-4662.

[12] Rochester J., Bolden A., Pelch K. E. and Kwiatkowski C.F. 2017. Potential developmental and reproductive impacts of triclocarban: a scoping review. Journal of Toxicology. DOI: 10.1155/2017/9679738.

[13] Ley. C., Sundaram V., Sanchez M., Desai M. and Parsonnet J. 2018. Triclosan and triclocarban exposure, infectious disease symptoms and antibiotic prescription in infants community-based randomized intervention. Plos One. DOI: 10.1371/journal.pone.0199298.

[14] Masyithah Z., Purba S. O. and Rajagukguk D. 2019. A two-step catalytic production of coco fatty acid amide from coconut oil using a metal catalyst. ARPN Journal of Engineering and Applied Sciences. 14(11): 2100-2105.

[15] Wetwitayaklung P., Limmatvapirat C. and Phaechamud T. 2013. Antioxidant and anticholinesterase activities in various parts of Sonneratia caseolaris (L.). Indian Journal of Pharmaceutical Sciences. 75(6): 649-656.

[16] Sari M. 2018. The utilization of VCO (virgin coconut oil) in manufacturing of solid soap with red betel leaf extract addition. IOP Conference Series: Materials Science and Engineering. 335(1).

[17] Putra A. Y. T., Susiloningsih E. K. B. and Susanti M. A. 2020. Physicochemical and sensory properties of pedada fruit (Sonneratia caseolaris) bar. Journal of Physics: Conference Series, 1569(3). DOI: 10.1088/17426596/1569/3/032013.

[18] Latief M. and Muhaimin. 2019. The characterization of active compound of pedada magrove plants (Sonneratia caseolaris). Journal of Chemical Natural Resources. 1(1): 1-11.

[19] Hasibuan N. and Sumartini. 2021. Potensi antibakteri ekstrak daun pedada (Sonneratia Caseolaris) sebagai pengawet alami ikan kembung (Rastrelliger Sp) segar. Jurnal Agritechno. 14(02): 81-87.

[20] Pratiwi D. 2021. Antimicrobial potential of Sonneratia alba and Sonneratia caseolaris against shrimp pathogens. Asian Journal of Fisheries and Aquatic Research. 12(4): 7-14.

[21] Sumartini and Sari R. 2021. Ekstrak daun mangrove (Sonneratia caseolaris) sebagai pengawet alami ikan tongkol (Euthynnus affinis) selama penyimpanan. Jurnal Airaha. 10(1): 109-122.

[22] Sahambangung M., Datu O., Tiwow G. and Potolangi N. 2019. Formulasi sediaan sabun antiseptik ekstrak daun pepaya. Jurnal Biofarmasetrikal. 2(1): 43-51.

[23] Aznury M., Hajar I. and Serlina A. 2021. Optimasi formula pembuatan sabun padat antiseptik alami dengan penambahan ekstrak daun sirih hijau. Jurnal Kinetika. 12(1): 51-59.

[24] Pangestika W., Abrian S. and Adauwiyah R. 2021. Pembuatan sabun padat dengan penambahan ekstrak daun Avi cennia marina. Jurnal Teknologi Agro-Industri. 8(2): 135-153.

[25] Champa P., Whangchai N., Jaturonglumlert S., Nakao N. and Whangchai K. 2016. Determination of phytochemical compound from Spirogyra sp. using ultrasonic assisted extraction. International Journal of Geomate. 11(24): 2391-2396.

[26] El-Ghfar M. H. A. A., Ibrahim H. M., Hassan I. M., Fattah A. A. A. and Mahmoud M. H. 2016. Peels of lemon and orange as value-added ingredients: chemical and antioxidant properties. International Journal of Current Microbiology and Applied Sciences. 5(12): 777-794.

[27] Nobossé P., Fombang E. N. and Mbofung C. M. F. 2018. Effects of age and extraction solvent on phytochemical content and antioxidant activity of fresh Moringa oleifera L. leaves. Food Science and Nutrition. 6(8): 2188-2198.

[28] Vidal N. P., Adigun O. A., Pham T. A., Mumtaz A., Manful C., Ca;;ahan G., Stewart P. Keough D. and Thomas R. H. 2018. The effects of cold saponification on the unsaponified fatty acid composition and sensory perception of commercial natural herbal soaps. Molecules. 23(9): 1-20.