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ANTIOXIDANT ACTIVITY OF HERBAL SOAP FORMULATIONS EXTRACT GAHARU LEAVES (*GYRINOPS VERSTEEGII*)

I. Made Oka Adi Parwata*, Sang Ayu Made Risma Maharani, Wiwik Susanah Rita, A. A. Istri Agung Mayun Laksmiwati, I. Gusti Agung Gede Bawa and I. Wayan Suirta

Chemistry Study Program, Faculty of Mathematics and Natural Sciences, Udayana University Indonesia.

***Corresponding Author: I. Made Oka Adi Parwata**
Chemistry Study Program, Faculty of Mathematics and Natural Sciences, Udayana University Indonesia.

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ABSTRACT
Antioxidant soap can protect the skin from free radicals, one of the plants that has benefits as a natural antioxidant is agarwood leaves *(Gyrinops versteegii).* This research aims to find the best formulation that has the strongest antioxidant activity but still meets the requirements of SNI quality standards with four variations of concentration. Solid and liquid soaps ware made through saponification reaction between oil and alkali using *semi-boiled process* method. The activity phase includes the preparation of extracts, solid soap and liquid soap formulations, antioxidant tests of extracts, solid soap and liquid soap, then continued with soap quality tests including pH test, specific gravity test, water content test, total fat test, ethanol insoluble material test, alkali/free fatty acid test, unsaponified fat test, and chloride content test. The results of soap quality testing show that all formulas have met the quality standard requirements set by SNI 3532-2016 for solid soap and SNI 4085-2017 for liquid soap which has the best antioxidant activity, namely formula IV of 476.1456 ppm for solid soap and 414.5924 ppm for liquid soap.

KEYWORDS: *Antioxidants, Agarwood leaves (Gyrinops versteegii), Solid Soap and Liquid soap*.

INTRODUCTION

The rapid development of science and technology in the industrial sector is also accompanied by drastic climate change from year to year, which certainly has a negative impact on human life, especially in terms of health, especially skin health caused by environmental pollution which can trigger the formation of free radicals (Parker, 2021).

Radicals can come from radiation exposure to electronic goods, namely televisions, cellphones, computers/ laptops, exposure to air pollution and cigarette smoke, or as a result of depletion of the ozone layer or global warming which can cause ultra-violet radiation which can directly interfere with skin health (Prasetya *et al.*, 2020). Free radicals can be exposed to the skin surface (Isfardiyana and Safitri, 2014), and can enter the body directly through the respiratory tract and can enter through food and drink. When the production of free radicals exceeds the body's antioxidant defenses, it can result in oxidative stress (Sinaga, 2016).

Free radicals on the skin surface can cause health problems on the skin, including redness, pigmentation, dry skin, dull skin, premature aging, and even in the long run cause cancer risk and decreased immune response ability (Isfardiyana and Safitri, 2014). Free radical reactions that cause skin infections can be prevented by the presence of antioxidants that can protect the skin, both endogenous and exogenous antioxidants. One of them is by using soap that has antioxidant activity. Antioxidant activity in soap can be obtained by adding natural ingredients that contain natural antioxidant compounds.

One plant that has a high antioxidant content is agarwood. Agarwood leaf extract has been studied to have high antioxidant activity (Yanti *et al.*, 2013). The research was also supported by Prihantini and Rizqiani (2019) who stated that agarwood leaves have better antioxidant activity than stem bark and fruit skin. The agarwood leaves contain a class of secondary metabolite compounds such as phenols, terpenoids, and flavonoids (Parwata *et al.*, 2022). The content of secondary metabolites in soap can play a natural antioxidant role. It is suspected that active compounds from agarwood leaf extract added to soap can react with free radical compounds. Antioxidants work by donating one electron to compounds that are oxidants so that the activity of these oxidant compounds can be inhibited (Winarti,

2010).

Soap is generally divided into two types: liquid and solid. The main difference between these two forms of soap is the alkali used in the soap making reaction. Liquid soap uses potassium hydroxide (KOH) while solid soap uses sodium hydroxide (NaOH). Both of these soaps have their respective advantages. The advantages of solid soap are more economical and have a good glycerin content for problem skin (Husnah *et al.*, 2019). While the advantages of liquid soap are more practical, easy to travel with, and more hygienic than the use of solid soap (Adiwibowo, 2020).

Based on the above background, the researcher wants to further examine the antioxidant activity of solid and liquid soaps with the addition of natural antioxidants in the form of agarwood leaf extract. This research is expected to produce soap preparations or products that have the strongest antioxidant activity that can be produced based on the formulation of several concentrations of agarwood leaf extract and quality according to SNI. Formulation plays an important role in determining the amount of extract and other mixtures used and will be related to the effectiveness of antioxidants in the extracts used and the quality of soap quality.

MATERIALS AND METHODS

Research Materials and Equipment

The material used in this research was agarwood leaves (*Gyrinops versteegii*) which had been inoculated and obtained from Klaci Village, Marga District, Tabanan Regency. Plant determination was carried out at E - Science Services, National Research and Innovation Agency (BRIN) Bedugul, Bali.

The chemicals used are DPPH, DMSO 10%, NaCl, stearic acid, NaOH, glycerin, distilled water, HCl, distilled water, $AgNO_3$, K_2CrO_4, propylene glycol, methanol, ethanol, KOH, cocamid-DEA, methyl orange, phenolphthalein, n-hexane, coconut oil, and olive oil.

The equipment used in this study includes a set of glassware, scissors, analytical balance, pycnometer, blender, coarse filter paper, maceration container, stirring rod, vortex device, thermometer, water bath, Vacuum Rotary Evaporator, 200 mesh sieve, soap mold, oven, desiccator, filter paper, napkin, a set of distillation apparatus, separatory funnel, petri dish, vacuum pump, filler, micro pipette and tip, test tube, a set of titration apparatus, a set of Ultraviolet-visible (UV-Vis) spectrophotometer, pH meter, brown bottle, and reflux.

METHOD

Preparation and extraction of agarwood leaves (*Gyrinops versteegii*)

Agarwood (Gyrinops versteegii) leaf samples were sorted and then washed thoroughly with running water to remove dirt. The clean agarwood leaves were cut into small pieces and then dried. The dried leaves were blended into powder. The powder is sieved using a 200 mesh sieve to separate the grains that are not yet smooth, agarwood leaf powder is weighed as much as 0.5 kg and then macerated using hot distilled water (± 800C) for 2 x 24 hours in a maceration container. The results of maceration are filtered with coarse filter paper to separate the filtrate and the residue of agarwood leaf powder, so that the liquid extract of agarwood leaves is obtained. The liquid extract was then evaporated using a Vacuum Rotary Evaporator at a temperature of 55°C at vacuum pressure, so that the thick water extract was taken to be mixed with the soap formulation. The extract yield was determined using the following formula % Yield = $\frac{b_2}{b_1} \times 100\%$ Information b_1= initial simplicia weight (g) b_2= final extract weight (g).

Solid soap making

The process of making solid soap begins with mixing coconut oil and olive oil first into a container (the mass of each according to the formulation). The oil mixture is then mixed with stearic acid which has been melted by heating (70°C) until it melts. After the stearic acid and oil were homogenized, 30% NaOH solution was added at 35°C. At the time of this NaOH addition, the dough will become hard and sticky, indicating the formation of soap stock. Stirring is carried out until the situation is homogeneous then glycerin is added to facilitate the stirring process. After the solution becomes homogeneous, cocamid - DEA, NaCl, distilled water, and agarwood leaf extract are added. Soap was poured into the mold and allowed to stand for ± 24 hours at room temperature. Soap was removed from the mold and then stored. The aging process is carried out for 4 weeks before the soap can be used and analyzed.

The soap formula was designed in four different concentrations to find out the best formulation. The formulation will be used as the main ingredient of antioxidant soap. Four soap formula designs were made with different concentrations of agarwood leaf extract used. The mass amount of agarwood leaf extract used for formulas I, II, II, and IV were 0 g; 0.6087 g; 3.0435 g; and 6.0870 g, respectively. The soap formulas are presented in Table 1.

Liquid soap making

The manufacture of liquid soap begins with coconut oil mixed with olive oil and then heated at 75°C, then 30% potassium hydroxide (KOH) is added little by little while stirring and still heated at 75°C until soap paste is obtained. Soap paste is added with glycerin, then distilled water is added, as well as propylene glycol, the mixture remains heated at 75°C, stirring until homogeneous. The mixture was added cocamid - DEA (as a foamer) and the mixture was heated at 40°C and stirred until homogeneous. Agarwood leaf extract was added to the mixture and stirred until homogeneous.

The soap formula was designed in four different concentrations to find out the best formulation. The best formulation will be used as the main ingredient of antioxidant soap. Four soap formula designs were made with different concentrations of agarwood leaf extract used. The percentage of agarwood leaf extract for formulas I, II, II, and IV are 0 g; 1.98 g; 9.9 g; and 19.8 g, respectively. The soap formulas are presented in Table 2.

Table 1: Solid soap formulation from agarwood leaf extract (*Gyrinops versteegii*).

Material	Unit	Formulas			
		I	II	III	IV
Agarwood leaf extract (*Gyrinops versteegii*)	g	0	0,6087	3,0435	6,087
Coconut oil	g	20	20	20	20
Olive oil	g	6	6	6	6
NaOH 30%	g	4,49	4,49	4,49	4,49
Stearic acid	g	5,33	5,33	5,33	5,33
Aquades	g	14,96	14,96	14,96	14,96
Cocamid-DEA	g	3,33	3,33	3,33	3,33
Glycerin	g	6,66	6,66	6,66	6,66
NaCl	g	0,1	0,1	0,1	0,1

Source: Widyasanti and Hasna, 2016 (with modifications)
Information:
Formula I: Solid soap preparation with 0 g agarwood leaf extract
Formula II : Solid soap preparation with 0,6087 g agarwood leaf extract
Formula III : Solid soap preparation with 3,0435 g agarwood leaf extract
Formula IV: Solid soap preparation with 6,0870 g agarwood leaf extract

Table 2: Liquid soap formulation from agarwood leaf extract (*Gyrinops versteegii*).

Material	Unit	Formulas			
		I	II	III	IV
Agarwood leaf extract (*Gyrinops versteegii*)	g	0	1,98	9,9	19,8
Coconut oil	g	30	30	30	30
Olive oil	g	14	14	14	14
KOH 30%	g	22	22	22	22
Aquades	g	75	75	75	75
Cocamid-DEA	g	22	22	22	22
Glycerin	g	15	15	15	15
propylene glycol	g	20	20	20	20

Source: Widyasanti *et al.*, 2017 (with modifications)

Information
Formula I: Solid soap preparation with 0 g agarwood leaf extract
Formula II: Solid soap preparation with 1,98 g agarwood leaf extract
Formula III: Solid soap preparation with 9,9 g agarwood leaf extract
Formula IV: Solid soap preparation with 19,8 g agarwood leaf extract

Soap Quality Test
The tests carried out in this study on solid soap are pH test, water content test, total fat test, ethanol insoluble material test, free alkali or free fatty acid test, unsaponifiable fat test, and chloride content test. While testing on liquid soap is the pH test, specific gravity test, total fat test, and free alkali or free fatty acid test. Wavelength.

Antioxidant activity test of solid soap and liquid soap of agarwood leaf extract
A total of 20 mg of solid and liquid soap without extract and with agarwood leaf extract was weighed and then put into a glass beaker and then dissolved with 4 mL of 10% MSO, so that the concentration of the mother solution was 5000 ppm. Solutions with **Preparation of 40 ppm DPPH solution and** concentrations of 125, 250, 375 and 500 ppm were **Measurement of the maximum absorption** made by diluting successively 50; 100; 150 and 200 wavelength of DPPH.

DPPH was weighed as much as 4.06 mg and then dissolved with methanol in a 100 mL volumetric flask as a 40 ppm DPPH mother solution. The absorbance of the solution was measured by UV- Vis spectrophotometry at a wavelength of 400 - 800 nm.

Antioxidant activity test of thick agarwood leaf extract
A total of 5 mg of thick agarwood leaf extract was

weighed then put into a 5 mL volumetric flask and dissolved with 10% DMSO until the limit line so that the concentration of the mother liquor became 1000 ppm. The 100 ppm mother solution was made by diluting 1 mL of 1000 ppm mother solution with distilled water into a 10 mL volumetric flask until the limit mark. Solutions with concentrations of 20, 40, 60, 80 and 100 ppm were made by diluting 400; 800; 1200; 1600; and 2000 µL respectively, the volume of the solution was sufficient to 2 mL with methanol. Each concentration series was added 2 mL of 40 ppm DPPH solution. The sample was homogenized, left for 30 minutes in a dark place. The absorbance was measured by UV – Vis spectrophotometer at the wavelength of µL, sufficient solution volume up to 2 mL with methanol. Each concentration series was added with 2 mL of 40 ppm DPPH solution. Samples were homogenized, left for 30 minutes in a dark place. The absorbance was measured by UV – Vis spectrophotometer at the wavelength of maximum absorption based on the maximum wavelength of Maximum absorption based on the maximum.

RESULTS AND DISCUSSION

Preparation and extraction of agarwood leaves (*Gyrinops versteegii*)

Agarwood leaf samples that have been inoculated as much as 5 kg are sorted and washed with running water aimed at separating contaminants attached to the leaves so that good quality leaves are obtained and clean from dirt. The clean agarwood leaves are then cut into small pieces and dried to reduce the water content in the sample so that the sample is not easily damaged. Dry agarwood leaves are made into 500 grams of simplisia powder to reduce particle size, the smaller the particle size means the greater and wider the contact surface between solids and solvents, so as to maximize the extraction process of agarwood leaf simplisia.

Maceration of agarwood leaf simplisia powder is carried out using distilled water solvent to extract secondary metabolites present in agarwood leaf samplisia. According to Parwata *et al.*, (2016) maceration of agarwood leaf water extract has antiocicdan activity of 3.03 ppm greater than ethanol and methanol extracts of agarwood leaves which have the same antiocicdan activity of 24.04 ppm. In addition, the total phenolic content in the water extract of 14,980 mg GAE/100 g is higher than the ethanol extract of 1,508 mg GAE/100 g and methanol extract of 6,070 mg GAE/100 g. The filtrate from maceration was then evaporated using a vacuum rotary evaporator to evaporate the distilled water solvent so that the thick extract of agarwood leaves was obtained as much as 49.2549 grams with a yield of 9.85%. The thick extract of agarwood leaves obtained has the characteristics of a blackish brown color with a distinctive odor.

Solid and liquid soap making

The solid and liquid soaps obtained from the results of this study have different colors according to the formula that has been made. One soap formulation recipe produces 2 molds for each formula. One formulation recipe produces a total soap mass of 198 g in each formulation. The results of solid and liquid soap formulations in this study are presented in Table 3 as follows.

Table 3: Results of solid soap formulation.

Types of soap	Formulas	Weight of soap (g)	Color of soap
Solid soap	F I	28,49	White
	F II	28,29	Light brown
	F III	28,75	Deep brown
	F IV	28,46	Deep brown
Liquid soap	F I	198	White
	F II	198	Light brown
	F III	198	Deep brown
	F IV	198	Deep brown

Table 3 shows that the soap obtained produces different colors. This color difference is caused by the mass of agarwood leaf extract added to the soap formula, where the more extract added, the darker the brown color of the soap.

Soap quality test results

Quality testing of solid bath soap preparations is carried out to determine whether the soap is made in accordance with SNI or permitted soap standards. The tests carried out in this research were pH test, water content test, total fat test, ethanol insoluble material test, free alkali or free fatty acid test, unsaponifiable fat test, and chloride content test. While testing on liquid soap is the pH test, specific gravity test, total fat test, and free alkali or free fatty acid test.

Acidity test results (pH)

The results of the acidity (pH) test for solid soap in this study are presented in table 4 as follows.

Table 4: Acidity (pH) test results for solid soap.

Types of soap	Formulas	Degree of acidity (pH)
Solid soap	F I	10,25
	F II	10,44
	F III	10,48
	F IV	10,44
Liquid soap	F I	10,55
	F II	10,58
	F III	10,50
	F IV	10,56

Table 4 shows The results of measurements of the pH of solid soap and liquid soap show that the pH of solid soap and liquid soap in this study meets SNI standards, which are in the range of 8-11. This alkaline pH value is due to the basic ingredients that make up the soap, namely NaOH / KOH which is a strong base and oil or fat which is a weak acid so that it forms a salt that is alkaline (Widyasanti, 2017). NaOH / KOH and the fat or oil used will produce a saponification reaction which has a pH value above neutral pH, thus affecting the pH of the soap preparation which becomes alkaline (Irmayanti *et al.*, 2014).

Specific gravity test results

The results of the liquid soap specific gravity test in this study are presented in Table 5.

Table 5: Results of specific gravity tests on liquid soap.

Formulas	Specific gravity (g/mL) Average SD
F I	1,03654 ± 0,000118
F II	1,03777 ± 0,002096
F III	1,04186 ± 0,000040
F IV	1,05052 ± 0,000215

Table 3 shows that the specific gravity value of liquid soap foam for agarwood leaf extract from formula I- IV is 1,03654; 1,03777; 1,04186; and 1,05052 g/mL.

From the results of the specific gravity test on agarwood leaf extract liquid soap has met the SNI (2017) standard for liquid bath soap. If the specific gravity value is too high, it will affect the absorption process on the skin because the soap obtained is too thick. The specific gravity value is influenced by the type and concentration of the constituent ingredients in the solution. Each ingredient added to the soap formulation determines the specific gravity of the resulting product. The higher the weight of the constituent ingredients added, the higher the specific gravity of the resulting soap (Widyasanti *et al.*, 2017).

Water content test results

The results of the solid soap water content test in this Table 7 shows the test results for the total solid soap fat of agarwood leaf extract respectively from formula I-IV, namely 66,7827; 69,2507; 81,0887; and 86,7640%. While table 8 shows the total fat test results of agarwood leaf extract liquid soap from formula I-IV, namely 24,9313; 33,0233; 36,8920; and 42,9393%. The total fat test results from solid and liquid soap from agarwood leaf extract formula I-IV show that the solid soap produced is in accordance with the total fat quality study are presented in Table 6.

Table 6: Water content test results in solid soap.

Formulas	Water content (%) Average ± SD
F I	13,4305 ± 1,2915
F II	12,3617 ± 0,4991
F III	13,0341 ± 1,6980
F IV	11,7585 ± 1,3295

Table 6 shows the test results for the water content of agarwood leaf extract solid soap respectively from formula I-IV, namely 13,4305; 12,3617; 13,0341%; and 11,7585%. %. From the data, it can be seen that formulas 1 - IV have non-linear results. This is likely due to the factor of absorption of water vapor in the air by the soap resulting in an increase in the water content of the soap. The test results show that after going through the aging process on solid soap for 30 days, the water content of agarwood leaf extract solid soap formulas I - IV has met SNI (2016) solid bath soap. Measurement of moisture content in an ingredient needs to be done because water can affect the quality and shelf life of the soap made. According to Widyasanti *et al.*, (2017) the amount of water added to soap products affects the solubility of soap in water when used, the high water content in soap can also result in easier soap shrinkage and cause discomfort when used (Rita *et al.*, 2018).

Total fat test results

The total fat test result of solid and liquid soaps s in this study are presented in Table 7.

Table 7: Total fat test results in solid soap.

Formulas	Total fat (%) Average SD
F I	66,7827 ± 1,2868
F II	69,2507 ± 1,5194
F III	81,0887 ± 1,9519
F IV	86,7640 ± 1,7636

Table 8: Total fat test results in liquid soap.

Formulas	Free fatty acids (%) Average ± SD
F I	0,000068 ± ,000024
F II	0,000178 ± ,000024
F III	0,000437 ± ,000024
F IV	0,000506 ± ,000024

Standard according to SNI (2016), namely a minimum of 65% and according to SNI (2017), namely a minimum of 15%. Total fat is the determination of the total amount of

fat bound with sodium and free fatty acids plus neutral fat (triglycerides). The data shows that the total fat content in solid soap and liquid soap of agarwood leaf extract increases along with the addition of agarwood leaf extract mass, presumably because agarwood leaf extract contains fatty acid compounds. According to research conducted by Isromarina and Sriwijaya (2017) the methanol extract of agarwood leaves (Gyrinops versteegii) contains oleic acid, stearic acid, oleic acid methyl ester, myristic acid, and palmitic acid.

The material is insoluble in ethanol test results

The test results for materials insoluble in ethanol in this study are presented in Table 9.

Table 9: Test results for substances insoluble in ethanol in solid soap.

Formulas	Substances insoluble in ethanol Average ± SD
F I	0,5267 ± 0,0110
F II	0,7880 ± 0,0393
F III	2,7187 ± 0,1513
F IV	3,6667 ± 0,0264

Table 9 shows the test results for ethanol insoluble substances in solid soap of agarwood leaf extract increases along with the addition of agarwood leaf extract mass. The test results for ethanol insoluble substances in solid soap of agarwood leaf extract respectively in formulas I - IV are 0.5267; 0.7880; 2.7187; and 3.6667%. From the test results, the levels of insoluble ingredients in ethanol in the solid soap of agarwood leaf extract have met the SNI (2016) standard for solid bath soap.

Test results for the amount of free alkali or free fatty acids

The test results for the amount of free alkali from solid and liquid soap from agarwood leaf extract formula I – IV showed that the solid soap produced did not contain free alkali, where when the phenolphthalein indicator was added the solution did not change color to pink, meaning that there was no free alkali but there were free fatty acids present on soap. The free fatty acid test results are presented in Table 10.

Table 10: Free fatty acid test results in solid soap.

Formulas	Free fatty acids (%) Average ± SD
F I	0,000191 ± 0,000024
F II	0,000273 ± 0,000024
F III	0,000383 ± 0,000063
F IV	0,000513 ± 0,000021

Table 11: Free fatty acid test results in liquid soap.

Formulas	Free fatty acids (%) Average ± SD
F I	0,000068 ± ,000024
F II	0,000178 ± ,000024
F III	0,000437 ± ,000024
F IV	0,000506 ± ,000024

Table 10 shows the results of the free fatty acid test on agarwood leaf extract solid soap respectively from formula I – IV, namely 0,000191; 0,000273; 0,000383; and 0,000513%.

While table 11 shows the results of the free fatty acid test on agarwood leaf extract liquid soap respectively from formula I – IV, namely 0,000068 ; 0,000178; 0,000437; and 0,000506%.

The data shows that the free fatty acid content in agarwood leaf extract solid soap increases along with the addition of agarwood leaf extract mass. Based on these data, solid soap and liquid soap have met the quality standards of SNI (2016) solid soap quality standards, namely a maximum of 2.5% and SNI (2017) solid soap quality standards, namely a maximum of 4%, this means that the solid soap and liquid soap produced from agarwood leaf extract have a low amount of free fatty acids so that the soap has good cleaning power and also has a good ability to clean oil from oily materials.

Unsaponifiable fat test results

The results of the solid soap unsaponifiable fat test in this study are presented in Table 12.

Table 12: Test results for unsaponifiable fat in solid soap.

Formulas	Unsaponifiable fat (%) Average ± SD
F I	0,0085 ± 0,0002
F II	0,0104 ± 0,0006
F III	0,0146 ± 0,0005
F IV	0,0166 ± 0,0002

Table 12 shows the results of the unsaponifiable fat test in agarwood leaf extract solid soap respectively from formula I-IV, namely 0.0085; 0.0104; 0.0146; and 0.0166%. This shows that almost all the fat in the I-V soap formulation has been saponified by alkali and is in accordance with the quality standards according to SNI (2016), namely a maximum of 0.5%.

High levels of unsaponifiable fat in solid soap can cause the soap to produce little foam, so that the cleaning ability of the soap decreases in the detergency of the soap is inhibited (Dini *et al.*, 2019).

Chloride level test results

The results of solid soap chloride level test in this study are presented in Table 13.

Table 13: Test results for chloride levels in solid soap.

Formulas	Chloride content (%) Average±SD
F I	0,3039 ± 0,1013
F II	0,2680 ± 0,1013
F III	0,3652 ± 0,1013
F IV	0,3510 ± 0,2026

Table 13 shows the results of the chloride content test in agarwood leaf extract solid soap respectively from formula I – IV, namely 0.3039; 0.2680; 0.3652; and 0.3501%. The results of the chloride content test from solid soap from agarwood leaf extract formula I-V show that the solid soap produced is in accordance with the quality standards according to SNI (2016), namely a maximum of 1%. The presence of chloride in this study was caused by the addition of NaCl which was used when making soap, however the chloride levels obtained were not high because if the chloride levels in the soap were high it could be dangerous for skin health because it is corrosive and causes skin irritation (Ningrum *et al.*, 2021).

Antioxidant activity test results

Determination of the maximum wavelength of 40 ppm DPPH solution produced maximum absorption at a wavelength of 515,50 nm with absorbance of 1,0217. Antioxidant activity testing was carried out on agarwood leaf extract. The results of the antioxidant activity test of agarwood leaf extract extract obtained an IC_{50} value of 44,247 ppm which is categorized into strong antioxidants (Putri and Hidajati, 2015). Solid soap and liquid soap of agarwood leaf extract were tested at four variations of mass concentration of agarwood leaf extract. The results of the antioxidant activity test of solid soap and liquid soap of agarwood leaf extract are presented in Table 14.

Table 14. Results of antioxidant activity tests on solid and liquid soap.

Formula	IC_{50} ppm value	
	Solid Sooap	Liquid Soap
F I	1089,1010	997,5704
F II	741,1456	810,5068
F III	526,9710	493,4561
F IV	476,1456	414,5924

liquid soap during the saponification process makes natural antioxidant compounds unstable. In addition, natural antioxidant compounds contained in soap preparations obtained from the addition of extracts have been mixed by various non-polar compounds at the time of manufacture, especially VCO. The presence of other groups in the extract content can also cause natural antioxidant compounds to be Table 14 shows that the antioxidant activity in solid soap and liquid soap of agarwood leaf extract for formulas 1 – IV is said to be included in the very weak category (Putri and Hidajati, 2015). The weak antioxidant activity is likely due to the addition of extracts for each formula is too little compared to the net weight of the soap preparation. According to Purwanto (2019), flavonoids, terpenoids, and phenol compounds that act as natural antioxidant compounds have hydroxyl groups that can release protons in the form of hydrogen ions. Hydrogen radicals have only one proton and no electrons, so in radical electrons contained in nitrogen atoms in DPPH compounds bind to hydrogen radicals and produce reduced DPPH. However, excessive heat exposure to extracts added to solid soap and eliminated as a result of some non-polar compounds that do not work synergistically with natural antioxidant compounds from agarwood leaf extract.

Selection of the best agarwood leaf extract solid and liquid soap

The results of the research we conducted showed that the quality test of formula I – IV agarwood leaf extract solid and liquid soap met SNI 2016 and 2017 in all parameters, so the selection of the best formula was carried out by comparing the results of the antioxidant activity tests for each soap formulation. Solid soap and liquid soap of agarwood leaf extract formula IV has the smallest IC_{50} value. So formula IV is the best formula of solid soap and liquid soap of agarwood leaf extract.

Table 15: Recapitulation of results of analysis of agarwood leaf extract solid soap.

Parameter	F I	F II	F III	F IV	SNI
Acidity (pH)	10,25	10,44	10,48	10,44	Range8-11
Water content (%)	13,4305	12,3617	13,0341	11,7585	Max 15.0
Total fat (%)	66,7827	69,2507	81,0887	86,7640	Min 65.0
Substances insoluble in ethanol (%)	0,5267	0,7880	2,7187	3,6667	Max 5.0
Free alkali (%)	-	-	-	-	Max 0.1
Free fatty acids (%)	0,000191	0,000273	0,000383	0,000513	Max 2.5
Unsaponifiable fat (%)	0.0085	0.0104	0.0146	0.0166	Max 0.5
Chloride content (%)	0,3039	0,2680	0,3652	0,3510	Max 1.0
Antioxidan activity	1089,1010	741,1456	526,9710	476,1456	-

Table 15: Recapitulation of results of analysis of agarwood leaf extract liquid soap.

Parameter	F I	F II	F III	F IV	SNI
Acidity (pH)	10,55	10,58	10,50	10,56	Range 8-11
Specific gravity (g/mL)	1,03654	1,03777	1,04186	1,05052	Range 1,01 – 1,10
Total fat (%)	24,9313	33,0233	36,8920	42,9393	Min 15
Free alkali (%)	-	-	-	-	Max 0.1
Free fatty acids (%)	0, 000068	0,000178	0,000437	0,000506	Max 4
Antioxidan activity	997,5704	810,5068	493,4561	414,5924	-

CONCLUSION

The Solid and liquid herbal soap products with agarwood leaf extract that have the best antioxidant activity are in formula IV, with an IC_{50} of 476.1456 ppm in solid soap and 414.5924 ppm in liquid soap. The solid and liquid herbal soap products of agarwood leaf extract produced in this study have met the requirements of SNI quality standards.

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