Journal of Health Sciences and Medical Development
Vol. 1, No. 02, p. 58-67
journal.iistr.org/index.php/HESMED
DOI: 10.56741/hesmed.v1i02.156

Formulation and Evaluation of Sappan Wood Extract Transparent Solid Soap with Variations in the Concentration of Glycerin as a Humectant

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ARTICLE INFO

Article history
Received 19 September 2022
Revised 30 September 2022
Accepted 17 October 2022

ABSTRACT

Soap is a product that can be used to clean hands from bacteria and dirt. One of the natural ingredients that can be formulated into soap is sappan wood. Sappan wood contains 5 compounds belonging to flavonoids, including brazilin, brazilein, 3'-O-methyl brazilin, sappanin, chalcone, and sappanchalcone which have antioxidant and antibacterial properties. This study aims to formulate sappan wood extract into a transparent solid soap preparation with an olive oil base using variations in glycerin concentration, namely F1 (10%), F2 (15%), and F3 (20%) transparent soap preparations. The type of research conducted is experimental research. Evaluation of transparent soap preparations consisted of organoleptic testing, pH, moisture content, foam stability, wetting power, and hardness of the preparation. The results of the study showed that the transparent soap met the requirements for the organoleptic test, pH test, water content test, wetting power test, and hardness test. In the results of the stability test, F3 foam has a longer foam stability compared to F1 and F2.

Keywords
Sappan wood
Glycerin
Transparent soap
Olive oil

Introduction

Hand hygiene is very important in maintaining health because the hands are the entrance for germs to enter the body. Hand washing can prevent infection as well as inhibit or kill microorganisms on the skin [1]. Soap is a product that is used to clean hands from bacteria or microbes and dirt on the hands. Transparent soap is one type of soap that produces a softer lather, is used in skin care because it contains humectants, and looks shinier than other types of soap [2]. Along with the development of science and technology in the cosmetic field that leads to natural products with a back-to-nature trend [3]. One of the natural materials that can be used is sappan wood. There are 5 active compounds in sappan wood that are classified as flavonoids, including brazilin, brazilein, 3'-O-methyl brazilin, sappanin, chalcone, and sappanchalcone which are efficacious as primary and secondary antioxidants [4]. In a study conducted by Ref. [5], it was shown that sappan wood extract could inhibit Staphylococcus aureus, Escherichia coli, and Shigella sonnei bacteria.

In soap making, there is a saponification reaction involving oil and alkali. Olive oil can be used as a base in soap making. Olive oil with oleic acid content has benefits for the skin. Soap with olive oil as the main ingredient can help remove dead skin cells, moisturize and tighten the skin and fade scars [6]. In the manufacture of transparent solid soap is added a substance that acts as a humectant. According to Soeratri, humectants are hygroscopic materials that can bind water from the air and also retain water in the preparation. Glycerin is added in the manufacture of transparent soap because it has uses as a humectant [7].

One example of a humectant used in transparent soap is glycerin. According to Ref. [8], besides acting as a humectant, glycerin can increase the transparency of soap. Based on this background, it is necessary to research the formulation of transparent solid soap preparations of sappan wood extract (Caesalpinia sappan L.) with olive oil base with varying concentrations of glycerin as a humectant.

Methods

A. Context

The tools used in this study include a digital scale, measuring cup, beaker glass, hot plate, stirrer head, stirring rod, watch glass, evaporating cup, silicon soap mold, universal pH indicator, oven, and hardness tester. The materials used in this study include Sappan wood extract (Lansida), olive oil (Lansida), stearic acid (Quadrant), 30% NaOH (Quadrant), NaCl (Quadrant), 96% ethanol (Quadrant), glycerin (Quadrant), sucrose (Quadrant), cocamide DEA (Quadrant), citric acid (Quadrant), lavender oleum (Lansida), and water.

B. Research Design

The type of research conducted is experimental research. In this study, several stages were carried out including collecting raw materials for sappan wood extract, making transparent solid soap with sappan wood extract, and evaluating soap preparations which included organoleptic testing, testing pH, water content, foam stability, wetting power, and hardness. The physical evaluation was carried out during 28 days of storage, namely days 0, 1, 7, 14, 21, and 28 days at room temperature. See Table 1 for the result.

Table 1. Transparent Solid Soap Preparation Formula Sappan Wood Extract

Ingredients	Concentration (% weight percent)			Function
	F1	F2	F3	
Sappan Wood Extract	1	1	1	Active ingredients
Olive oil	20	20	20	Base
NaOH 30%	20	20	20	Saponification reagent
Glycerin	10	15	20	Humectants
Ethanol 96%	16	16	16	Solvent
Sucrose	5	5	5	Transparent agent
NaCl	0.2	0.2	0.2	Soap cleanser
Cocamide DEA	5	5	5	Surfactants and foam stabilizers
Citric Acid	3	3	3	chelating agent
Stearic Acid	6.5	6.5	6.5	Soap hardener and foam stabilizer
Oleum Lavender	0.5	0.5	0.5	Deodorizer
Aqua dest ad	100	100	100	Solvent

C. Detailed Procedure

In this study, 3 formulas of transparent solid soap were made with the glycerin concentration, namely 10% (F1); 15% (F2); and 20% (F3). This variation was carried out to determine whether differences in glycerin concentration affected the results of the evaluation of the preparations which included organoleptic tests, pH tests, moisture content, foam stability, wetting, and hardness tests.

The first process of making transparent solid soap with sappan wood extract is stearic acid melted in olive oil at a temperature of 70-90°C while stirring using a head stirrer at a speed of 350 rpm. The 30% NaOH solution was added little by little into the olive oil and stearic acid mixture, stirring for 5 minutes until a soap stock was formed. After the soap stock is formed, add glycerin, citric acid, NaCl, sucrose (which has been dissolved in aqua dest), and cocamide DEA at a temperature of 75°C, stirring until homogeneous. The temperature was lowered to 60°C by adjusting the heat strength on the hot plate, then added 96% ethanol, sappan wood extract, and lavender oleum were stirred until a transparent and homogeneous mass was formed, then poured into molds and allowed to stand for approximately 24 hours at room temperature.

D. Evaluation of Soap Preparation

1. Organoleptic Test

The organoleptic test aims to see the physical preparation of a preparation which includes observations of shape, color, and odor [9].

2. pH test

The pH value by following the requirements based on SNI 3532-2016 is in the range of 8-11 [10]. Testing pH using a pH indicator, by weighing as much as 1 gram then dissolving in 10 ml of aqua dest then measuring the pH [11].

3. Test Moisture Content

Testing the water content in soap needs to be done because the water in the preparation can affect the quality and shelf life of the soap preparation. The water content test was carried out by weighing 2 grams of the soap preparation, then heating it in the oven for 2 hours at a temperature of 105°C. After 2 hours, re-weigh the heated soap. According to SNI 3532-2016, the good water content in soap is less than 15% [12].

4. Foam Stability Test

The foam stability test aims to determine the amount of foam and the stability of the foam produced by soap preparations. The stability of the foam is done by weighing 1 gram of soap and dissolving it with 9 ml of water, then shaking it for 30 seconds and letting it sit for 1 hour, then seeing the changes before and after being allowed to stand70 % [12].

5. Wetting Power Test

A total of 1 gram of soap is dissolved in 500 ml of distilled water. Take a woolen thread weighing 2 grams that have been cut into pieces with a length of 9 cm, the ends of the thread are tied with a weight of 2 grams. The stopwatch is turned on when the wool thread touches the solution and when the load touches the bottom of the glass beaker the stopwatch is turned off [9].

6. Hardness Test

The hardness tester is used to test the hardness of soap. Soap is shaped like a cube with a size of 1x1x1 cm, stored in a vertical position on the tool. Turn the hardness tester until it penetrates the soap part [13].

E. Statistic Analysis

Statistical data analysis was determined by testing the normality of the data using the Kolmogorov Smirnov test. If the value of $p > 0.05$ then the data is normally distributed and if $p < 0.05$ then the data is not normally distributed. Data that are normally distributed are continued with the Repeated one-way Anova Test. Data that are not normally distributed are continued using the Kruskal Wallis Test.

Results

Table 2 shows the result of organoleptic evaluation of F1, F2, and F3 for 0, 1, 7, 14, 21, and 28 days. It explains that in all days the characteriscs one were constant (Transparent, Pink, and Smells Typical of Lavender).

Table 2. Organoleptic Evaluation Results

Day	F1	F2	F3
0	Transparent Pink Smells Typical of Lavender	Transparent Pink Smells Typical of Lavender	Transparent Pink Smells Typical of Lavender
1	Transparent Pink Smells Typical of Lavender	Transparent Pink Smells Typical of Lavender	Transparent Pink Smells Typical of Lavender
7	Transparent Pink Smells Typical of Lavender	Transparent Pink Smells Typical of Lavender	Transparent Pink Smells Typical of Lavender
14	Transparent Pink Smells Typical of Lavender	Transparent Pink Smells Typical of Lavender	Transparent Pink Smells Typical of Lavender
21	Transparent Pink Smells Typical of Lavender	Transparent Pink Smells Typical of Lavender	Transparent Pink Smells Typical of Lavender
28	Transparent Pink Smells Typical of Lavender	Transparent Pink Smells Typical of Lavender	Transparent Pink Smells Typical of Lavender

Fig. 1 to Fig. 5 shows the product characteristics.

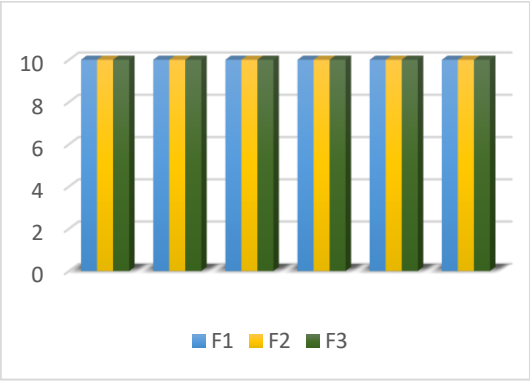

Fig. 1. pH Measurement

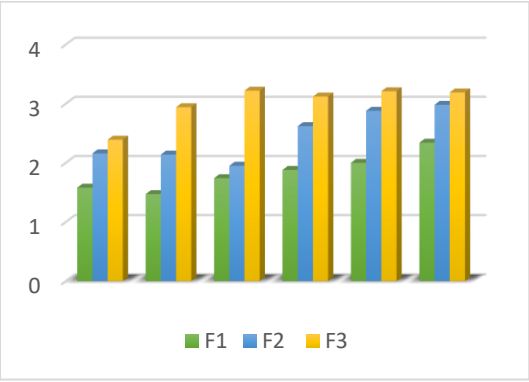

Fig. 2. Water Content Evaluation

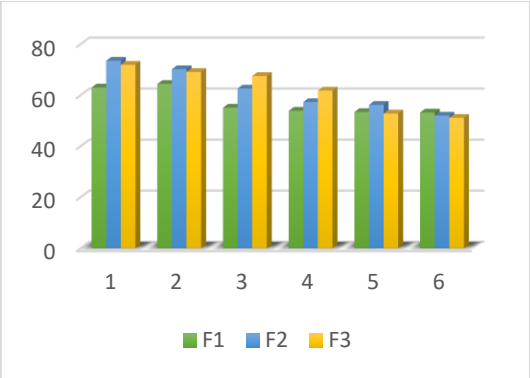

Fig. 3. Foam Stability

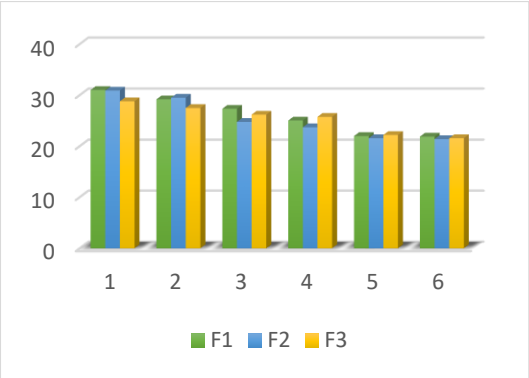

Fig. 4. Wetting Power

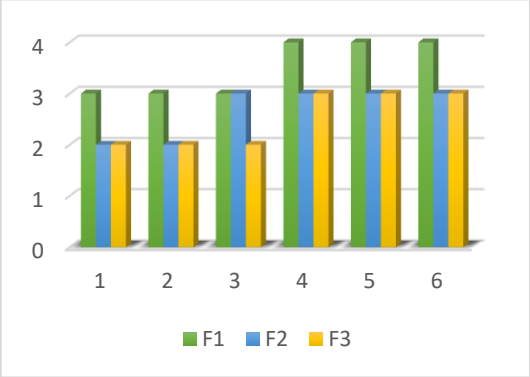

Fig. 5. Hardness

Discussion

In this study, researchers compared the evaluation of preparations with variations in the concentration of glycerin for each formula, namely 10% (F1), 15% (F2), and 20% (F3). The preparation of transparent solid soap with sappan wood extract was evaluated including organoleptic tests, pH, moisture content, foam stability, wetting power, and hardness which were stored for 28 days at room temperature.

The organoleptic test of soap includes observing the shape, color, and smell of soap. This organoleptic test aims to determine the effect of variations in the concentration of glycerin in each formula on the evaluation results of soap. The results of the organoleptic evaluation for 28 days (Table 2), the three formulas had the same shape, color, and odor and there was no change in color and odor during storage.

The purpose of testing the pH of this soap preparation is to determine whether the soap that has been made meets the pH requirements according to SNI 3532-2016, which is between 8-11. Preparations with a pH value that does not meet the requirements will cause problems for the skin. Soap with a pH value of more than 11 will make the skin dry, if the soap with a pH

value of less than 8 will irritate the skin [14]. The pH test was carried out using a pH indicator. The pH values obtained for soap preparations F1, F2, and F3 during storage for 28 days each had the same pH of 10, and variations in the concentration of glycerin did not affect the stability of the pH.

The water content indicates the amount of water contained in the preparation and can affect the quality of the preparation. The value of water content that meets the requirements according to SNI 3532-2016 is 15%. It can be seen in Figure 2. that the highest water content value is in F3 while the lowest water content is in F1. These results indicate that the higher the glycerin content, the higher the water content value of preparation. The water content in soap preparations will increase due to the presence of water and hygroscopic materials such as sucrose, glycerin, NaCl, and citric acid in the formulation of soap preparations. Soap with a high water content will produce a soft soap and it is easier to lose weight [15].

One of the main components in determining the quality of soap is foam. Foam is formed because the surfactant stabilizes a gas dispersion in a liquid. In its use, foam plays a role in cleansing the skin. The purpose of the foam stability test is to determine the amount of foam and the foam stability of the soap preparation. After making transparent solid soap preparations, Sappan wood extract with various concentrations of glycerin 10%, 15%, and 20% had the same tendency, namely, the longer it was stored, the lower the foam stability but the level of decline was different. The foam becomes unstable due to the presence of hygroscopic substances, causing the foam to break faster, this is due to evaporation of the foam layer and gravity by pulling water from the top to the bottom [16]. The stability of the soap foam can be affected by the use of an anti-foaming agent in the preparation process, namely ethanol. According to Setyoningrum, excessive use of antifoaming agents during soap making can reduce the foam formed [17]. The test method is one of the factors that can affect the stability value of the foam preparation, where the foam stability results obtained from the test depend on the strength of the shaking and are also inaccurate in reading the foam height due to the use of a non-uniform measuring cup [18].

The wetting test involves the time required for a woolen thread to reach the bottom of a glass beaker filled with a soap solution. After making transparent soap preparations of sappan wood extract with various concentrations of glycerin with F1 10%, F2 15%, and F3 20% it can be seen that all formulations meet the requirements for wetting power, which is not less than 0.2 seconds. The contact angle between the wetting liquid and the surface will reduce its surface tension by the surfactant solution and the air phase on the surface will be moved and replaced by the liquid phase. A thread will be easily wetted by a soap solution because of the decrease in surface tension between the thread and the soap solution [18]. Thus the air contained in the pores of the yarn will be replaced quickly by a soap solution [9].

The hardness of the soap increases the efficiency of the soap when it is used. The soap hardness test was carried out using a hardness tester, with a soap size of 1x1x1. Soap hardness value requirements are not yet available so no requirement that indicates hardness in soap. The level of hardness of soap is related to the water content and the amount of saturated fatty acids in the soap, the greater the water content and the amount of saturated fatty acids in the soap, the lower the hardness value of the soap [6]. The higher the number obtained, the harder the soap preparation. During storage for 4 weeks (28 days) each formula increased in the hardness value of the preparation, on the 28th day F1 hardened to 4 Kg, and F2 and F3 hardened to 3 Kg. The preparation of transparent soap with sappan wood extract with various concentrations of glycerin 10%, 15%, and 20% showed different hardness values, this was because the water content in each soap formula was different and the amount of saturated fatty acids in the preparation was high. This study uses olive oil which contains oleic acid so that the soap produced has a soft texture. According to Elisabeth, the preparation will harden during the storage period because it is influenced by the reaction that has occurred perfectly or the occurrence of an aging mass [13].

The statistical results of Reappeted One-way Anova show that the formulation of transparent soap preparations with sappan wood extract has a value of Sig. 0.00 where 0.00 < 0.05 then there is a difference in the average water content in F1, F2 and F3. Likewise with the Sig value of foam stability, Sig value of 0.05 = 0.05 then there is a difference in the average value of foam stability in each formula (F1, F2, F3). In the hardness variable which has a Sig value of 0.003 which means it is less than 0.05, there is a difference in the average hardness value in each formula. Unlike the case with the Sig value on wetting power which has a Sig value > 0.05 (p> 0.05), then there is no difference in the average for each formulation.

Conclusion

Based on the results of the study it can be concluded that sappan wood extract and olive oil can be formulated into transparent solid soap preparations. Formulations F1, F2, and F3 met the requirements for organoleptic test evaluation, pH test, moisture content test, wetting power test, and hardness test, while the F3 foam stability test had longer foam stability than F1 and F2. The transparent solid soap formulation of sappan wood extract with variations in glycerin concentration had no significant effect on organoleptic, pH, the wetting power, but had a significant effect on moisture content, foam stability, and hardness of the preparation.

Conflict of Interest

We declare that there is no conflict of interest

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