Preparation and characterization of binahong (*Anredera cordifolia*) leaves extract-based liquid hand soap

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Abstract. The need for hand soap is increasing along with the increase of public awareness to maintain cleanliness and health. Commercial hand soaps are made from various chemical mixtures which often give side effects in the form of allergies in people who have sensitive skin. The production of soap with natural ingredients can be a way to solve these problems. In this paper, we report an observational study of the effect of adding binahong leaf oil extract, which is known to have antiseptic properties and is often used as an itching remedy, on the characteristics of liquid hand soap. The research was carried out with the steps of preparation of binahong leaf, binahong leaf oil extract, and production of soap based-binahong leaf extract oil with various concentrations of mixing ingredients. The analysis carried out in this experiment were the analysis of physical and chemical properties as well as the effectiveness of the soap against bacteria after the use of the liquid hand soap. The addition of binahong leaf extract oil in the liquid hand soap can increase the antibacterial properties of the liquid hand soap and has the potential to be used as a soap that is safer for daily use.

1. Introduction
Recently, people are getting more aware to maintain their health. Especially at this time where many diseases come from various sources such as viruses and bacteria. One of the things that can be done to prevent disease is to preserve a clean environment. Practices to keep the body and the environment clean can be done in various ways, and one of them is to keep hands clean by washing them with hand soap.

Commercial hand soaps sometimes contain a lot of chemical mixtures. With different levels of sensitivity, users of these hand soaps are not infrequently exposed to side effects in the form of allergies to some of the chemicals contained. In order to overcome these problems, the production of hand soap based on natural ingredients could be a potential solution.

As a tropical country, Indonesia has many natural resources that can be utilized, especially for health purposes. Binahong plant which can be easily planted or found in various regions in Indonesia is one of the resources that can be processed as medicine or other health needs [1]. This plant contains antiseptic substances as well as saponins, alkaloids, tannins, steroids, triterpenoids, flavonoids, and ascorbic acid which have an important role in activating the prolyl hydroxylation enzyme which supports the hydroxylation stage in the formation of collagen, so that it can accelerate the wound healing process [2-3]. Clinically, extracts from this plant have also been shown to have antibacterial properties against several bacteria such as *S. aureus*, MRSA, *B. subtilis*, P. aeruginosa, and *E. coli* [4-
This bio-activity is obtained from the content of saponins and tannins which have the ability to damage cell membranes or bacterial cell walls, inhibit bacterial cell wall protein synthesis, and damage bacterial cell nucleic acids, thereby interfering with bacterial cell permeability. As a result, the activity of bacterial cell growth will be inhibited, and even gradually will damage the cell membrane and cause the release of cell organelles [6-7].

The study in this article discusses the potential of binahong leaf extract to be used as hand soap and the characteristics of the prepared soap. The characteristics of binahong leaf-based hand soap that will be evaluated are physical and biological characters.

2. Materials and Methods

2.1. Materials
In this study, fresh binahong leaves, olive oil, and coconut oil were used from Semarang, Indonesia. Another chemical used was potassium hydroxide (KOH) which was purchased from Indrasari, Semarang, Indonesia.

2.2. Methods

2.2.1. Binahong oil extraction. Fresh binahong leaves are dried in the sun for three days. After drying process, the binahong leaves were ground to a powder size and sieved to obtain a uniform size. A total of 100 grams of binahong leaf powder was prepared and soaked in 800 mL of 70% v/v ethanol solution for 24 hours covered with black plastic, then stored in a dark place to avoid sunlight. The mixture was then filtered using a cloth and put into a glass bottle. The liquid was then put into an incubator at 80°C for 6 hours.

2.2.2. Preparation of hand soap. Mixture of oil (300 g coconut oil, 200 g olive oil) was heated until it reaches a temperature of 70°C. At the same time, KOH solution was made by dissolving 127 g of KOH in 380 g distilled water. After that, the KOH solution was poured on the oil mixture and stirred until it homogeneous and solidified (±45-60 minutes). The mixture was then heated and stirred slowly until it turned to colorless gel and had a neutral pH. Then distilled water with a weight ratio of 1: 1 was poured to the mixture. The mixture was then stirred until it was perfectly mixed. After homogeneous, into a 25 g of the mixing result, binahong extract solution with the amount of concentration according to variations mentioned in Table 1. (0; 2.5; 5; 7,5%) was added as much as 4.5% w/v and then stirred and heated on low heat until it became a homogeneous liquid.

| Code | Binahong extract concentration (% w/v) |
|------|----------------------------------------|
| C0   | 0                                      |
| C1   | 2.5                                    |
| C2   | 5                                      |
| C3   | 7.5                                    |

2.2.3. Analysis and Characterization. The soap that has been prepared is analyzed and evaluated in the form of organoleptic tests, viscosity and pH tests, and antiseptic property tests using the Plate Count Agar method.

3. Result and Discussion

3.1. Physical characteristic
Physical character is a property that is an important parameter in the soap testing process. In this study, evaluation of the physical characteristics was carried out by measuring pH, viscosity and
observing the homogeneity of the hand soap samples that had been obtained. The results of measuring pH for each sample can be seen in Figure 1. According to the Indonesian National Standard, the pH for hand washing soap ranges from 8 to 10 [8]. From the data obtained, it is known that all samples are within that range. However, as is known, the smaller or higher the pH value, the more likely it is to cause irritation. The pH of all samples produced ranged in a neutral state with the lowest number belonging to the C3 sample which had the highest extract content. The addition of binahong leaf extract decreases the alkalinity of the soap obtained. The increase in acid levels in the soap that was prepared was caused by the content of binahong leaves such as flavonoids, ascorbic acid, and oleanolic acid [9-10].

![Figure 1. Acidity level of hand soaps](image1)

![Figure 2. Viscosity number of hand soaps](image2)

Another physical character measured in this study is viscosity. The level of acidity and viscosity affect the stability of hand soap, so these two parameters are very important to evaluate. According to the Indonesian National Standard, the viscosity of liquid hand soap ranges from 500 to 20000 cPs. The viscosity of the sample as can be seen in Figure 2 shows the results that the samples that have been made have met these standards. As for the homogeneity test, all the samples prepared showed that the resulting soap was well blended with a homogeneous arrangement and invisible presence of coarse grain.

3.2. Organoleptic tests
20 panelists participated in this test to assess the quality of the hand soap that had been made. In this study, the quality parameters are odor, texture, and color. Each parameter was tested with the results in the form of a value between 50 to 100, where a value of 50 means the most unpleasant odor, the coarsest texture, and the most unattractive color. The results of the organoleptic tests that have been carried out can be seen in Table 2.

| Parameter | C0 | C1 | C2 | C3 |
|-----------|----|----|----|----|
| Smell     | 70 | 80 | 90 | 80 |
| Texture   | 70 | 80 | 80 | 70 |
| Color     | 80 | 90 | 90 | 70 |

From the tests that have been carried out and the results that can be seen in Table 2, it can be concluded that the most preferable is sample C2. The addition of binahong leaf extract generally improves the quality of the soap produced based on the parameters tested. However, it can be seen in sample C3, that the excessive amount of extract can reduce the value, especially in terms of
appearance. The addition of large amounts of binahong extract makes the soap cloudy and less attractive.

3.2.1. Antiseptic properties. Antiseptic is the ability of a material to inhibit the growth and reproduction of many microorganisms, including bacteria, as well as fungi, protozoa, and viruses. In this study, an antiseptic ability test was carried out by counting bacterial colonies before and after the application of hand washing soap that had been made. The results of these tests can be seen in Table 3. From these data, it can be seen that the ability of soap to inhibit the growth of microorganisms is increasing along with the addition of the concentration of binahong leaf extract. This is evidenced by the decrease in the percent increase in the number of microorganisms counted at 10 minutes after the application of soap. This inhibition can occur due to the increasing number of antiseptic substances, namely saponins and tannins contained in soap [8-10]. This proves the effectiveness and potential of the soap that has been made.

| Sample Code | Before soap application (CFU/mL) | After 10 minutes of soap application (CFU/mL) |
|-------------|---------------------------------|---------------------------------------------|
| C0          | $6.5 \times 10^6$               | $7.8 \times 10^6$                           |
| C1          | $6.6 \times 10^6$               | $7.5 \times 10^6$                           |
| C2          | $5.9 \times 10^6$               | $6.5 \times 10^6$                           |
| C3          | $6.3 \times 10^6$               | $6.7 \times 10^6$                           |

4. Conclusion
In this study, hand washing soap based on binahong leaf extract has the potential to be used as an antiseptic soap. Several test parameters have been carried out and the soap that has been made has been at a predetermined standard. Sample C2 soap, soap with 5% w/v addition of binahong extract had the best performance in organoleptic and antiseptic activity tests.

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