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Research Article

Formulation and Characteristics Analysis of Soap with The Addition of *Spirulina Platensis*

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Abstract. Cleanliness has become an integral element of daily living. Soap is often used as a cleaning agent. Soap can remove grime and microorganisms that adhere to the skin. Various types of fats or oils are often utilized as soap's primary constituents. The usage of these diverse oils alters the properties of soap, beginning with its hardness, its impact on the skin, and the resultant foam. 3 grams and 5 grams of *Spirulina* are added to the soap formulation. The pH test, foam height test, and organoleptic test are the test parameters. The findings demonstrated that the pH of each solid soap preparation was nine, which was in agreement with national standard criteria. The foam stability formed was 75% and 25%, and that the soap formulation maintained its color, shape, and odor for a period of ten days during storage. This research concludes that *Spirulina platensis* can be made into a solid soap formulation. The effects of the addition of *Spirulina* to solid soap include a light green color, a solid shape or solid texture, and a distinct perfume of essential tea tree oil, as well as the production of quite a bit of foam and a little coarseness.

Keywords: soap; bioproduct; microalgae; foam

1. Introduction

Cleanliness has become an integral element of daily living. Numerous microbes attach and proliferate inadvertently inside the body, causing illness and attacking the body's metabolism. In today's world, when many viruses and illnesses are caused by microbes like germs and bacteria, cleanliness is also essential for human survival. Soap is often used as a cleaning agent (Gusviputri et al., 2017).

Soap can remove grime and microorganisms that adhere to the skin. The purpose of soap is not only to clean the skin, but also to whiten and soften it. Various types of fats or oils are often utilized as soap's primary constituents. The usage of these diverse oils alters the properties of soap, beginning with its hardness, its impact on the skin, and the resultant foam. Soap is a surfactant composed of natural oils or fats. Surfactants have a bipolar structure, with hydrophilic heads and hydrophobic tails. Because of this, soap may remove filth (often fat) from the body and clothing (Irmayanti, 2014). Soap is produced by a saponification process using oil and alkali; soap may be solids or liquids that generate foam without irritating the skin of the user.

Spirulina is a form of cyanobacteria or bacteria that are chlorophyll-containing and capable of photosynthesis. *Spirulina* is spiral-shaped and contains sufficient phycocyanin to provide a bluish-green hue (Ravi et al., 2010). *Spirulina* can grow in saltwater, fresh water, lake water, and soil. 67% - 70% protein, 20% -25% carbs, 3% -5% fat, 5% -8% minerals and vitamins, and 2% -5% water is found in *Spirulina* (Brown et al, 1997).

There are chemicals in antibacterial soap that impair skin health. In 2016, triclosan, a chemical often used as an antibacterial in soap, was prohibited in the United States. In addition, laboratory studies show that triclosan may cause bacteria to develop resistance to antibiotics (FDAU, 2016). Therefore, we need natural antibacterial substances that are skin-friendly and non-toxic.

The microalgae *Spirulina platensis* is one of the natural substances that may be added to soap as an antibacterial (Pandurangan et al., 2021). *Spirulina* was selected for use in soap because it includes phycocyanin, a naturally occurring

antibacterial (Pramadhanti & Dianursanti, 2019; Dianursanti & Pramadhanti, 2020). This soap's quality may be enhanced by the inclusion of *Spirulina*, which provides a natural anti-bacterial alternative to the chemical component triclosan, which is detrimental to skin health (Dianursanti et al., 2020). The objective of this study is to determine if *Spirulina platensis* can be formed into solid soap preparations and to determine the physical properties of soap containing *Spirulina platensis*.

2. Method

2.1. Equipment and Materials

Olive oil, palm oil, coconut oil, *Spirulina platensis*, sodium hydroxide, essential oil, and distilled water were used in this experiment. Hand mixers, silicone soap molds, spatulas, and big containers were employed for this research.

2.2. Soap Making Process

First, two components are combined to create this soap. The first combination had 120 ml of coconut oil combined with 3 g of *Spirulina platensis* as variation I and 5 g as variation II. This is done to ensure that *Spirulina* and coconut oil are uniform. 57.5 ml of caustic soda (NaOH) was dissolved in 200 ml of distilled water to form the second combination. Then, 120 ml of palm oil and 160 ml of olive oil were added to the original mixture, which was then mixed until uniform (Ameh et al., 2013). The first and second combinations were then homogenized by hand until traces were produced (Zubairu et al., 2021). After the two mixes were homogeneous, 1 ml of essential oil was added and the liquids were mixed again until they were homogeneous. The solution or soap mixture was poured into a silicone soap mold for the printing process once all the components have been well combined. After putting the soap into the mold, it is let to rest for 24 hours before being removed. After that, remove the soap and let it sit at room temperature for 1 to 2 weeks then the soap is ready to use. The complete formulation can be shown in Table 1.

Table 1. Composition of *Spirulina* soap

Materials	Variation I (wt. %)	Variation II (wt. %)
Olive oil	24.2	24.11
Coconut oil	18.14	18.08
Palm oil	18.14	18.08
Essential oil	0.15	0.15
Spirulina platensis	0.45	0.75
NaOH	8.69	8.66
Aquadest	30.23	30.14

2.3. Characteristic Analysis

2.3.1. pH Analysis

This test is performed to verify whether the pH of the soap conforms with Indonesian national standard quality standards for bath soap (Standar Nasional Indonesia, 2016). The pH of this soap will be measured using a pH meter. Beginning by calibrating the pH meter with a 9-11 pH buffer solution (Sari, 2018). The sample of soap was then weighed to 1 gram and dissolved in 10 ml of distilled water in a beaker. The sample solution was then heated. The pH meter is then dipped into the sample solution-containing beaker glass. The value shown by the pH meter is steady and is recorded.

2.3.2. Analyzing the Foam Height Produced by Soap

This test was conducted to get a high level of foam stability in soap. The used procedure was straightforward, with proper computations. 1 gram of the material was weighed and dissolved in 10 milliliters of distilled water before being boiled (Agustini & Winarni, 2017). After allowing it to room temperature, shake it until froth develops. The height of

the created foam is then measured, and it is measured again 5 minutes later until 25 minutes. Then, the height stability of the foam was computed.

2.3.3. Organoleptic Test

This test observes the color, shape (texture), and scent of a 10-day-old soap mixture to determine whether or not they have changed.

3. Result and Discussion

This test was evaluated immediately in terms of color, form (texture), and scent of the soap generated for 10 days, whether there was a change or not. This formulation has the correct dose. Olive oil is a greater measure since it moisturizes the skin after using soap, preventing it from drying out. Additionally, the combination of coconut oil and palm oil acts as a soap hardener. The concentration of NaOH employed to speed the saponification process was 7.18 M. The essential oil used as a soap fragrance is tea tree oil; the calming aroma of tea tree oil is well suited for blending with a variety of soaps. With the inclusion of *Spirulina*, the physical properties of solid soap take on a light green hue, a thick or solid consistency, and the perfume of essential tea tree oil (Figure 1). This *Spirulina* soap foams quite a lot and is quite abrasive. This demonstrates that *Spirulina*-type microalgae may be manufactured as a solid soap component. After the soap has been effectively manufactured, research-based testing is conducted. Tests carried out were in the form of a pH test on soap, a test for the height of the foam created by soap and an organoleptic test for soap.

Figure 1. Results of *Spirulina* Soap Products

3.1. pH Analysis

The pH test is performed so that the pH of the manufactured soap conforms to the pH standard for soaps in circulation. The average pH of variation I soap with the addition of 3 grams of *Spirulina* was 9.45, while the average pH of variation II soap with the addition of 5 grams of *Spirulina* was 9.47. The pH of each soap conforms to the Indonesian national standard for soap, which is between 9 and 11.

3.2. Soap Foam Height Analysis

The height test of the producing foam was conducted to determine the heigh stability of the resulting foam on soap. Variation I of the soap foam had an initial height of 4 cm and a final height of 1 cm after 30 minutes. While the beginning height of variety II soap foam was 4 cm, the end height was just 2.5 cm after 30 minutes (Figure 2a). Soap version I with 3 grams of *Spirulina* has a foam stability of 75%, whereas soap variation II with 5 grams of *Spirulina* has a foam stability of 37.5% (Figure 2b). As a result of this test, the stability of the foam in variation I tends to be better owing to the steady drop in foam height every minute, but the stability of the foam in variant II is lower due to the modest fall in soap height every minute. This may occur when shaking for too long, resulting in foam that is overly thick.

3.3. Organoleptic Analysis

From the first to the tenth day of the organoleptic test, none of the soap formulas changed in color, form, or scent (Table 2). The soap's hue is still light green, its form or texture is still solid, and its scent is still characteristic of essential tea tree oil. From the findings of this organoleptic test, it can be inferred that the formulation of each solid soap product has not changed.

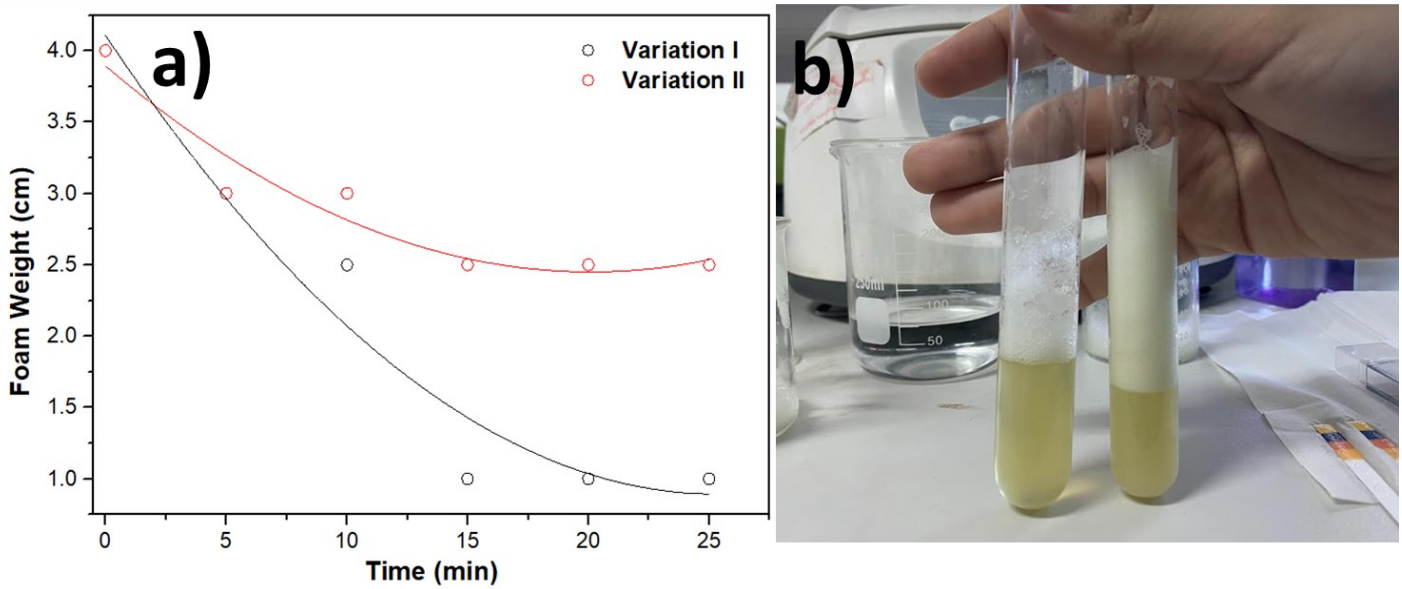

Figure 2. a) a) Height of foam soap each time and b) photograph of foam soap after 25 minutes

Table 2. Organoleptic analysis of *Spirulina* soap

Parameter	Variation	Day									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Colour	I	Light green	Light green	Light green	Light green	Light green	Light green	Light green	Light green	Light green	Light green
Texture		Solid	Solid	Solid	Solid	Solid	Solid	Solid	Solid	Solid	Solid
Flavor		typical	typical	typical	typical	typical	typical	typical	typical	typical	typical
Colour	II	Light green	Light green	Light green	Light green	Light green	Light green	Light green	Light green	Light green	Light green
Texture		Solid	Solid	Solid	Solid	Solid	Solid	Solid	Solid	Solid	Solid
Flavor		typical	typical	typical	typical	typical	typical	typical	typical	typical	typical

4. Conclusion

Based on the research conducted, this study concludes that *Spirulina platensis* may be made into a solid soap product. With the inclusion of *Spirulina*, the physical properties of solid soap include a pale green hue, a solid form or texture, and a unique perfume of essential tea tree oil. The created foam is extremely abundant and rather coarse, the pH of the soap is nine, and the stability of the soap foam is between 75% and 37%. Based on the above results, the author makes many recommendations. Future study should focus on incorporating *Spirulina* into additional formulations, such as liquid soap and dish soap. Investigate further the influence of foam stability on soap compositions. Learn more about

soap antimicrobial testing. Concerning the examination of soap's water content, further study is required. Investigate further the formulation of soaps using different microalgae.

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