

Formulation and Physical Testing of Seaweed-Based Liquid Bath Soap Preparations (*Kappaphycus alvarezii*)

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ARTICLE INFORMATION

Received: 5 June 2026
Revised : 7 July 2026
Accepted: 10 August 2026
DOI:

KEYWORDS

Keywords: Evaluation, Formulation, Liquid Body Wash, Seaweed Slurry

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A B S T R A C T

Background: *Kappaphycus alvarezii* is a red seaweed species commonly farmed along Indonesian shores because of its bioactive chemical constituents including alkaloids and flavonoids, triterpenoids, tannin along with saponins recognized for antibacterial activity, in this case it has great potential as an active ingredient in skin care preparations. **Objective:** The research sought to design and assess liquid body soap based on *Kappaphycus alvarezii*. **Methods:** This study used four concentrations of *Kappaphycus alvarezii* seaweed: 0%, 20%, 25%, and 30%. The seaweed samples were processed by cleaning, blanching, soaking, and homogenizing the dried seaweed into a pulp using a blender. The samples were then formulated into a liquid body wash by mixing the active ingredients and additives through heating, mixing, and homogenization. Assessment involved organoleptic analysis, pH, homogeneity, stability, as well as foam stability, skin irritation assessment, and hedonic evaluation tests involving 12 panelists. **Results:** Research showed that all formulas met SNI physical standards, including pH, homogeneity, and foam stability. The 30% formula performed best in foam stability, panelists' preference for color, aroma, viscosity, and foam, and did not cause skin irritation. **Conclusion:** Thus, *Kappaphycus alvarezii* has potential as an active ingredient in safe and consumer-preferred liquid bath soap formulations

INTRODUCTION

The skin is a vital organ of the human body, serving as a protective barrier against various external disturbances such as mechanical stress, temperature changes, ultraviolet radiation and microbial infections. The high potential for exposure to these factors has led to a growing demand for skin care products, one of which is soap. Today, soap is not solely a cleanser; it is formulated to maintain moisture, softness, brightening and healthy skin. Furthermore, soap also functions as an antiseptic due to its ability to kill and inhibit the growth of pathogenic microorganisms (Handayani & Anjali, 2020).

Bath soap is a basic human need because almost every daily activity involves its use. Soap is composed of several reactions, including those between fatty acids and sodium. It is solid and can produce foam with or without additional ingredients. It can be formulated to prevent skin irritation. In addition to its hygiene function, soap also plays a role in treating skin infections caused by bacteria or fungi and helps prevent skin diseases. Soap is available on the market in a variety of shapes, colors, types, benefits and fragrances. Soaps on the market are generally divided into two main forms: solid soap and liquid soap (Tampubolon & Tarigan, 2019).

A natural source with the potential to be a natural active ingredient in skin care products is red algae. These red algae are divided into three groups based on the type of pigment they contain: brown algae (*Phaeophyta*), green algae (*Chlorophyta*) and red algae (*Rhodophyta*). Seaweed (*Kappaphycus alvarezii*) is a variety of red algae commonly found and cultivated in coastal areas of Indonesia. This algae is known to contain bioactive components such as alkaloids, flavonoids, tannins, saponins, steroids and triterpenoids, which act as antifungals (Fajar et al., 2023).

Since 1980, seaweed (*Kappaphycus alvarezii*) has been widely cultivated due to its diverse compounds, including alkaloids, flavonoids, triterpenoids, tannins and saponins, which have been shown to have antibacterial effects (Nafisyah et al., 2015). Where bacteria are one of the living creatures that can cause many diseases (Mustiqawati, 2021). *Kappaphycus alvarezii* marine algae has demonstrated antibacterial activity, particularly against *Staphylococcus aureus* bacteria (Putri et al., 2023). Furthermore, *Kappaphycus alvarezii* exhibits very high antioxidant activity, reaching 72.49 ppm. This antioxidant content can function to protect skin cells against skin damage caused by free radicals triggered by sunlight. Seaweed (*Kappaphycus alvarezii*) also contains very important nutrients in the form of water, minerals, protein, magnesium and vitamin C, which are very beneficial for the skin's metabolic processes. Other bioactive compounds, such as flavonoids, triterpenoids, saponins, alkaloids and phenols, are highly effective in supporting skin health and protection (Gintulangi et al., 2022).

By utilizing bioactive compounds from seaweed (*Kappaphycus alvarezii*) which is rich in vitamin C and has antioxidant activity, it is hoped that an innovative liquid soap product will be created that not only cleanses but also provides optimal moisturizing effects for the skin.

RESEARCH METHODS

Research Design

This research was conducted through laboratory experiments. These included sample preparation, seaweed (*Kappaphycus alvarezii*) slurry production, liquid soap formulation and evaluation of physical test parameters.

Research Time and Location

The research was conducted in July 2025, with samples collected in Bandar Batauga Village, South Buton Regency. This study was conducted in the Halu Oleo Faculty of Pharmacy Laboratory and the Baubau Polytechnic Pharmacy Laboratory.

Tools and Materials

Tools

The research instruments consisted of a pH meter, measuring cylinder, stirring rod, dropper, analytical balance, blender, beaker, volumetric flask, porcelain cup, magnetic stirrer, hot plate and sample container.

Materials

The materials used in this study included seaweed porridge (*Kappaphycus alvarezii*), distilled

water, virgin coconut oil (VCO), potassium hydroxide (KOH), hydroxypropyl methyl cellulose (HPMC), citric acid, butyl hydroxytoluene (BHT), glycerin, vanilla perfume and sodium lauryl sulfate (SLS).

Research Procedure

Sample Preparation

The sample used in this experiment was dried seaweed (*Kappaphycus alvarezii*) harvested in Bandar Batauga Village, South Buton Regency.

Seaweed Porridge Preparation (*Kappaphycus alvarezii*)

The test sample, *Kappaphycus alvarezii* seaweed, was rinsed with clean running water to remove any remaining dirt or salt. The bleaching process was carried out using distilled water for 30 minutes, accompanied by squeezing to accelerate the bleaching reaction. The soaking process was repeated at a 1:10 ratio for 12 hours, then rinsed and drained. Next, it is made homogeneous by blending with a ratio of 1:2 for 3-5 minutes (Fajar, 2022).

Liquid Body Wash Formula

The liquid body wash formula will be formulated with concentration variations of 0%, 20%, 25%, and 30% (Fajar, 2022).

Table 1. Liquid Bath Soap Formula from Seaweed Extract (*Kappaphycus alvarezii*)

Name Of Material	Formula (%)				Function
	FI	FII	FIII	FIV	
Virgin Coconut Oil (mL)	30	30	30	30	Oil Phase
Seaweed Porridge <i>Kappaphycus alvarezii</i> (g)	0	20	25	30	Active Ingredients
BHT (g)	1	1	1	1	Antioxidants
KOH 20% (mL)	20	20	20	20	Saponification
SLS (g)	1	1	1	1	Surfactants
Gliserin (g)	5	5	5	5	Humectants
HPMC (g)	0,25	0,25	0,25	0,25	Gelling Agent
Asam Sitrat (g)	0,5	0,5	0,5	0,5	pH Stability
Perfume (mL)	qs	qs	qs	qs	Fragrances
Aquadest (mL)	Ad 100 mL	Ad 100 mL	Ad 100 mL	Ad 100 mL	Solvents

Liquid Bath Soap Formulation

All components used in the liquid soap preparation were weighed. The oil phase was prepared by dissolving BHT in VCO oil, then gradually adding a 20% KOH solution while heating at a constant temperature of 50°C until a paste-like soap base was formed. HPMC was then added, followed by hot distilled water and stirred until homogenous. The water phase was prepared by dissolving SLS in distilled water, adding glycerin, and then adding the oil phase mixture and stirring until homogeneous. The citric acid solution was added, followed by seaweed pulp (*Kappaphycus alvarezii*) and stirred until homogeneous. The remaining distilled water was added to 100 mL and homogenized. Finally, vanilla perfume was added and homogenized. The mixture was then transferred to a storage container (Umayati et al., 2023).

Physical Testing of Liquid Bath Soap Preparations

Organoleptic Testing

Organoleptic testing was conducted to assess the quality of liquid soap made from *Kappaphycus alvarezii* extract based on its physical characteristics, including shape, color and distinctive odor (Indriaty et al., 2019).

pH Testing

The pH was analyzed using a pH meter. SNI standards stipulate that the ideal pH for liquid bath soap preparations is in the range of 8-11 (Indriaty et al., 2019).

Homogeneity Testing

The test was conducted by applying the preparation to a clear glass surface, and the preparation must display a homogeneous structure (Indriaty et al., 2019).

Foam Height and Stability Testing

One gram of sample was dissolved in 9 mL of water, placed in a test tube, and shaken for 30 seconds. The foam height was measured at 5 minutes. The sample was then left to stand for 30 minutes and the foam volume was determined again. The criteria for adequate foam stability are characterized by a range of $60 \pm 70\%$ within 5 minutes (Indriaty et al., 2019).

Irritation Test

The irritation testing method used was a patch test with 12 panelists. The formulation was applied to the forearm and left for 30 minutes, followed by skin irritation reactions such as itching, redness and burning (Rahmi, 2023).

Hedonic Test

The hedonic test on liquid body soap was conducted to measure panelists' preferences for color, viscosity, aroma and foaming, with an additional assessment of the feeling of dryness on the skin. This test involved 12 panelists (Rahmi, 2023).

RESULTS & DISCUSSION

Organoleptic testing was conducted to evaluate the physical characteristics of the liquid soap, including color, shape and aroma. The test results are presented in Table 2.

Table 2. Organoleptic Test Results of Liquid Bath Soap

Formula	Color	Form	Smell	Information
F1	Clear	Liquid	Distinctive	Qualify
F2	Brownish Clear	Liquid	Distinctive	Qualify
F3	Slightly Brown	Liquid	Distinctive	Qualify
F4	Brown	Liquid	Distinctive	Qualify

The organoleptic test was intended to assess the quality of liquid soap based on *Kappaphycus alvarezii* extract based on its physical characteristics, including shape, color and distinctive odor (Indriaty et al., 2019). The organoleptic test revealed an increasing color variation from clear in Formula 1 to brown in Formula 4, due to the increased seaweed content. Observations on the shape indicated that the preparation was liquid. Aroma analysis revealed that the liquid soap made from seaweed (*Kappaphycus alvarezii*) had a distinctive aroma across all formulations. These findings align with studies that state that color, shape, and distinctive odor are key organoleptic requirements for skin-friendly liquid soap (Hutauruk et al., 2020).

Homogeneity testing was conducted to ensure that the preparation exhibited no phase separation, clumps, or sediment.

Table 3. Liquid Bath Soap Homogeneity Test Results

Formula	Homogeneity	Information
F1	Homogeneous	Qualify
F2	Homogeneous	Qualify
F3	Homogeneous	Qualify
F4	Homogeneous	Qualify

Homogeneity testing revealed visually homogeneous results for all four formulas. No phase separation, clumps, or sediment were observed during the test period. This indicates that the formulations exhibited consistent components (Indriaty et al., 2019).

The pH test aims to assess the acidity and alkalinity of the liquid soap formulation, with the standard pH value according to the Indonesian National Standard (SNI) for liquid bath soap being 8-11. The results of the pH observations are shown in Table 4.

Table 4. Liquid Bath Soap pH Test Results

Formula	pH	SNI Standard	Information
F1	8,47	8-11	Qualify
F2	9,18		Qualify
F3	9,39		Qualify
F4	9,18		Qualify

In pH testing, the ideal pH value for liquid bath soap preparations that meet SNI standards is 8–11 (Indriaty et al., 2019) and all liquid bath soap formulas with seaweed added met this standard. F1 had the lowest pH at 8.47, F2 had a pH of 9.18, F3 had the highest at 9.39, and F4 was 9.18. However, data showed that all liquid soap formulas made met quality liquid soap standards, as they were in the pH range of 8–11 (Widyasanti & Rohani, 2017).

Foam stability testing was conducted to determine the foaming power and foam durability of the liquid bath soap preparations. Results were shown by the initial foam height at 5 minutes and the foam volume after 30 minutes. Good foam stability according to SNI standards is $60 \pm 70\%$ at 5 minutes.

Table 5. Liquid Bath Soap Foam Stability Test Results

Formula	Initial Foam Height (cm)	Final Foam Height (cm)	Foam Stability (%)	Foam Stability Criteria	Informtaion
F1	7,0	4,6	65,71%	60±70%	Qualify
F2	8,0	7,0	87,50%		Qualify
F3	9,0	7,5	83,33%		Qualify
F4	9,5	8,0	84,21%		Qualify

In foam stability and height testing, a good formulation has a foam stability range of around 60–70% in the 5th minute (Indriaty et al., 2019). In the foam stability test, it showed that the foam stability calculation results obtained by F1 were 65.71%, meeting the requirements, while F2, F3, and F4 showed high values, respectively, above 80%, where the three formulations have shown that all three meet the foam stability requirements (Murti et al., 2017). Meanwhile, according to the SNI standard for liquid soap, the foam height is 13–220 mm, where all four liquid bath soap formulations have met the requirements. This phenomenon is related to the saponin content in seaweed, so increasing the concentration of seaweed in the formula has the potential to increase the amount of foam produced. Other ingredients also contribute to increased foam durability, one of which is SLS. SLS is a surfactant additive added to achieve long-lasting foam over a certain period and at a maximum concentration, while maintaining the recommended concentration of no more than 1% (Usman & Baharuddin, 2023).

The skin irritation test aimed to determine whether the formulation caused adverse reactions in the skin areas, including redness, heat and itching, in 12 panelists. The data is shown in the following table.

Table 6. Liquid Body Wash Irritation Test

Formula	Irritation Test Indicator			Information
	Redness	Hot Feeling	Itchy	
F1	x	x	x	No Signs of Irritation
F2	x	x	x	No Signs of Irritation
F3	x	x	x	No Signs of Irritation
F4	x	x	x	No Signs of Irritation
Information: X = No Signs of Irritation √ = Irritation				

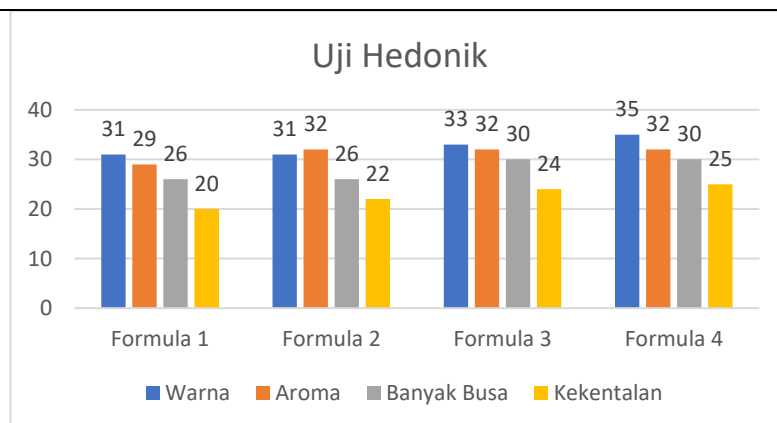
In this study, irritation testing was conducted on 12 panelists using direct observation of the skin areas treated with the soap. Observation parameters included itching, burning, and redness. Based on the observations, all panelists showed no signs of irritation across all three parameters. These results indicate that the tested formulation did not cause skin irritation and is safe for use on human skin under normal conditions (Rahmi, 2023).

The hedonic test was intended to evaluate the panelists' assessment of the formulation, including color, aroma, foaming rate and viscosity, using 12 panelists. The observation data are listed in Table 7.

Table 7. Hedonic Test of Liquid Bath Soap

Informationt: The assessment standard is very like = 3
 Like rating standards = 2
 The assessment standard is somewhat like = 1

Sample	Hedonic Test Indicator				Amount
	Color	Aroma	Lots of Foam	Viscosity	
F1	31	29	26	20	106
F2	31	32	26	22	111
F3	33	32	30	24	119
F4	35	32	30	25	122

**Diagram 1.** Hedonic Test of Liquid Bath Soap

The results of the hedonic test on 12 panelists, including preferences for color, aroma, viscosity, and foam (Dewi et al., 2025) showed that formula F4 scored the highest in color preference, with a score of 35, indicating that panelists preferred the color appearance of this formula. F1 tended to have a lower color preference, likely due to its clearer color compared to the other formulas. Aroma showed a gradual increase from F1 to F4, indicating that formula F4 was the most preferred by panelists. The aroma appeared consistent, but the intensity or longevity of the aroma was better in the final formula.

Formulas F3 and F4 scored the highest for foam, indicating that panelists found these formulas to produce the most abundant and pleasant foam when used. Viscosity was gradually favored, with the highest score being found in F4. Ideal viscosity plays a crucial role in the product user experience. Stable values in F2 and F3 indicate that the texture of the soap preparation has been satisfactory since F2.

Formula F4 showed the highest overall scores in almost all parameters, indicating that this formula was most preferred by panelists from an organoleptic perspective. Formula F1 received the lowest score, likely due to its clearer appearance and less intense aroma.

CONCLUSION

Based on the results of the research on the formulation and physical evaluation of seaweed (*Kappaphycus alvarezii*)-based liquid bath soap, it can be concluded that seaweed (*Kappaphycus alvarezii*) can be formulated into liquid bath soap using concentrations of 0%, 20%, 25% and 30%. All four formulas demonstrated results that met physical requirements, including organoleptic properties, homogeneity, pH, stability and foam height, irritation tests and hedonic tests. Therefore, seaweed (*Kappaphycus alvarezii*) has been proven to be suitable for use in liquid bath soap preparations. The best formula obtained was F4, with the highest seaweed pulp concentration of 30%, as it demonstrated the highest score in the panelists' preference test.

The limitation of this study is that it only assessed the stability of organoleptic tests, homogeneity, pH and foam in a short time, so long-term storage tests are needed to determine the shelf life and quality of the product in a certain period.

ACKNOWLEDGEMENTS

At this moment, the author expresses his deepest gratitude to all parties, including his parents, family, friends, and supervisors, who have provided encouragement, guidance and assistance, both tangible and intangible, making it possible for this research to be successfully completed.

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