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Formulation soap and antibacterial activity test of pulutan leaf (*Urena lobata* L.) extract hand soap against *Staphylococcus aureus*

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Abstract. This study aims to determine the physicochemical characteristics (pH and viscosity) and antibacterial activity of hand soap containing pulutan leaf (Urena lobata L.) ethanol extract against Staphylococcus aureus. The study employed a laboratory experimental method with variations in pulutan leaf extract concentrations of 0%, 4%, 8%, 16%, and 25%. Testing included moisture content, yield, pH, viscosity, and antibacterial activity using the well diffusion method. The results of the study showed that the moisture content of the crude drug was 7.6% and the extract yield was 85.33%. The pH values of all formulations ranged from 4.71 to 5.55 and met the standards. The highest viscosity was observed in F0 at 1,592.3 cPs and in F1 at 742.19 cPs, both of which met the standards, while the other formulations did not meet the standards. The highest viscosity was observed in F0 at 1,592.3 cPs and F1 at 742.19 cPs, which met the standard, while the other formulations did not meet the standard. Antibacterial activity showed an increase in inhibitory power as the extract concentration increased, namely F0 at 0.18 mm (weak), F1 at 8.42 mm (moderate), F2 at 9.16 mm (moderate), F3 at 10.33 mm (strong), and F4 at 14.11 mm (strong). Thus, pulutan leaf extract has the potential to serve as a natural antibacterial agent in hand soap.

Keywords: Pulutan leaft extract, hand soap, antibacterial, *Staphylococcus aureus*

INTRODUCTION

Skin infection is a common health problem in Indonesia and one of the leading causes of death worldwide. This infectious disease is generally caused by harmful microorganisms, one of which is the pathogenic bacteria *Staphylococcus aureus*. In Indonesia, the prevalence rate of infections caused by *Staphylococcus aureus* is relatively high, reaching 37% (Kementerian Kesehatan Republik Indonesia, 2024). These bacteria often cause diseases on the outer surface of the skin, survive between fingers or under nails, and are easily transmitted through direct contact. Therefore, the implementation of Clean and Healthy Living Behaviors (PHBS) through the habit of routinely washing hands with soap is crucial to break the chain of infection transmission.

Currently, commercial hand soaps generally contain synthetic active ingredients such as triclosan, benzalkonium chloride, and triclocarban which have strong antimicrobial capabilities. Although deemed effective in inhibiting the proliferation of pathogens, the continuous use of these synthetic substances has triggered serious health and environmental issues, one of which is the emergence of antimicrobial resistance in bacterial populations (Athaillah & Paramitha, 2022). To overcome the problem of resistance and environmental risks, innovation in developing

hand soaps using natural antibacterial agents is urgently needed.

One of the wild plants that has great potential as a natural substitute is the pulutan plant (*Urena lobata* L.). This plant generally thrives in tropical and subtropical areas and has long been used by local communities as a traditional medicine to heal skin wounds (Silalahi, 2020). Pulutan leaf extract is rich in phytochemical compounds or secondary metabolites such as flavonoids, alkaloids, tannins, and saponins (Cahya, 2021). These bioactive compounds have the potential to provide antibacterial effects by destroying bacterial cell walls and damaging cell membranes, making it highly suitable to be formulated into an eco-friendly hand soap.

Previous research by Aulia (2023) proved that pulutan leaf extract is effective in inhibiting the growth of *Staphylococcus aureus* bacteria. In addition, research conducted by Fitriani (2024) also confirms the strong antibacterial activity of pulutan herbs against these skin infection-causing bacteria. Even though its antibacterial potential has been proven, innovation and utilization of pulutan leaf extract in the form of practical liquid hand soap preparations that meet physicochemical standards (such as pH and viscosity) are still very limited.

Based on this background and potential, this study was conducted to formulate a liquid hand soap with the addition of pulutan leaf (*Urena lobata* L.) ethanol extract in various concentrations. This study aims to determine the physicochemical characteristics (viscosity and pH) of the soap preparation and analyze the effectiveness of its antibacterial activity against *Staphylococcus aureus* bacteria.

METHOD

This study utilized a quantitative approach with a laboratory experimental research design. The research was conducted from February to April 2026 at the Integrated Laboratory of UIN Mataram. The primary sample used in this study was the leaves of the pulutan plant (*Urena lobata* L.) collected from Penujak Village, Praya Barat District, Central Lombok Regency.

Extraction of Pulutan Leaves

The extraction process was carried out using the maceration method. A total of 150 g of pulutan leaf simplicia powder was macerated using 750 mL of 96% ethanol solvent. The maceration process was carried out for 2 days in a cool place protected from sunlight. The obtained macerate was then filtered, and the filtrate was concentrated using a Vacuum Rotary Evaporator at 60°C with a speed of 30-35 rpm until a thick extract was produced.

Hand Soap Formulation

The liquid hand soap base was formulated by dissolving 90 g of texapon and 60 g of sodium sulfate using distilled water gradually. Furthermore, metain (25 mL) for thickening, Cocamidopropyl betaine / CAPB (6 mL) as a foam stabilizer, fragrance, and EDTA (4 g) were added. The mixture was stirred until homogeneous and left until the foam disappeared. The thick extract of pulutan leaves was then added into the soap base formulation with five concentration treatment variations, namely:

- F0: Hand soap with 0% extract concentration (as a control).
- F1: Hand soap with 4% extract concentration.
- F2: Hand soap with 8% extract concentration.
- F3: Hand soap with 16% extract concentration.
- F4: Hand soap with 25% extract concentration.

Physicochemical Characteristic Evaluation

Physicochemical testing of the soap preparations included pH and viscosity tests. The pH test was performed by diluting 1 mL of the soap sample with 10 mL of distilled water, which was then measured using a pH meter indicator at room temperature. The viscosity test was

conducted to determine the thickness of the preparation by measuring the flow time of the soap using an Ostwald viscometer.

Antibacterial Activity Test

The testing of antibacterial effectiveness against *Staphylococcus aureus* was conducted using the well diffusion method with a hole diameter of 7 mm on Nutrient Agar (NA) media. The turbidity of the test bacterial suspension was adjusted to the 0.5 McFarland standard. A total of 50 µl of the sample from each formulation was inserted into the wells, then incubated for 1x24 hours at 37°C. The antibacterial activity was determined by measuring the diameter of the inhibition zone (clear zone) around the wells using a caliper.

RESULT AND DISCUSSION

This study focuses on evaluating the physicochemical characteristics and the antibacterial effectiveness of liquid hand soap formulations enriched with the ethanol extract of pulutan leaves (*Urena lobata* L.). The physicochemical parameters evaluated included pH and viscosity, while the antibacterial activity was tested using the well diffusion method against the pathogenic bacteria *Staphylococcus aureus.* The summary of the test results for each formulation is presented in Table 1.

Table 1. Physicochemical Evaluation and Antibacterial Activity Results of Hand Soap

Formulation	Extract Concentration	pH	Viscosity (cPs)	Inhibition Zone (mm)	Inhibition Category
F0	0%	5.55	1592.30	0.18	Weak
F1	4%	5.05	742.19	8.42	Moderate
F2	8%	4.81	404.46	9.16	Moderate
F3	16%	4.71	314.08	10.33	Strong
F4	25%	4.76	314.08	14.11	Strong
C+	Positive Control (Dettol)	-	-	17.46	Strong

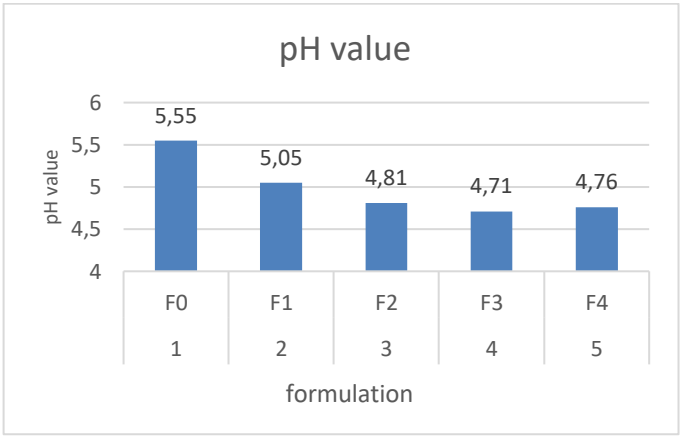

Figure 1. pH test results

The pH test was carried out to ensure that the acidity level of the soap is safe, non-irritating, and compatible with the characteristics of human skin upon application. As shown in Table 1, all formulations (F0 to F4) possessed pH values ranging from 4.71 to 5.55. These values have met the quality requirements for liquid soap based on the Indonesian National Standard

(SNI) 2588:2017, which stipulates a range of 4–10. The analysis indicated a declining trend in pH values as the concentration of pulutan leaf extract increased. This decrease is attributed to the presence of natural secondary metabolites within the extract, such as flavonoids and saponins, which exhibit acidic properties (Darma & Marpaung, 2020).

In terms of viscosity testing, the thickness of the preparation is a crucial factor to ensure ease of use and pourability. Formulations F0 and F1 exhibited viscosity values of 1592.30 cPs and 742.19 cPs, respectively, fulfilling the liquid soap quality standards (SNI 06-4085-1996) set between 500–20,000 cPs. However, the incorporation of pulutan leaf extract at higher concentrations (F2, F3, and F4) resulted in viscosity values falling below the standard (314.08–404.46 cPs). This reduction in viscosity is influenced by the addition of the extract which contains a liquid solvent; the more diluted the solvent added to the soap base, the lower the final viscosity of the preparation becomes.

Table 2. viscosity test results

Repetition	F_0	F_1	F_2	F_3	F_4
1	1,791,1	834,97	606,7	314,08	314,08
2	1,492,9	556,64	303,35	314,08	314,08
3	1,492,9	834,97	303,35	314,08	314,08
Total(cps)	4.776,9	2.226,58	1.213,4	942,24	942,24
Average	1.592,3	742,1933	404,466	314,08	314,08
Information	MS	MS	TMS	TMS	TMS

Note: MS = Meets Standards
TMS = Does Not Meet Standards

The inhibition zone test demonstrated that the addition of pulutan leaf extract significantly inhibited the growth of *Staphylococcus aureus*. Based on the data in Table 1, higher concentrations of the added extract resulted in larger diameters of the inhibition zones formed. Formulation F4 (25% concentration) showed the best efficacy with a strong inhibition zone of 14.11 mm, followed by F3 (10.33 mm). This antibacterial activity is supported by the high extract yield (85.33%) and the presence of phytochemicals such as flavonoids, alkaloids, saponins, and tannins in pulutan leaves (Cahya, 2021). These compounds disrupt the bacterial cell walls and membranes, leading to the death of the pathogenic microorganisms.

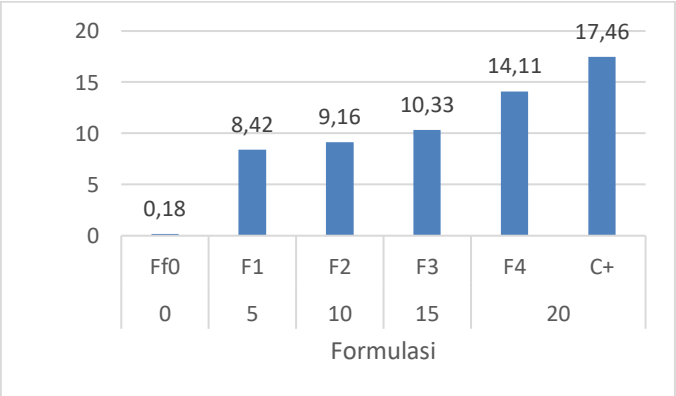

Figure 3. inhibitory power results

In the negative control formulation (F0), a minimal and very weak inhibition zone (0.18 mm) was observed. This slight inhibition is caused by the activity of surfactant agents such as texapon and sodium sulfate, which can mechanically break down the lipid envelopes of bacterial

cell walls. This is combined with the acidic pH condition of the preparation (5.55), which creates a suboptimal environment for the survival of *Staphylococcus aureus* (optimal growth pH is 7.0–7.4).

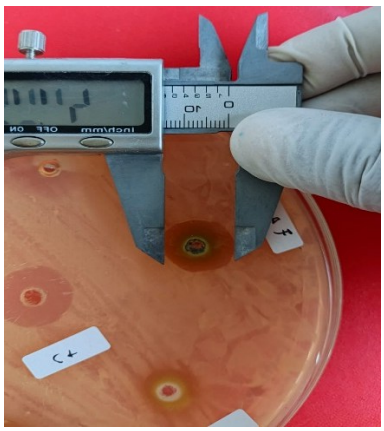

Figure 4. resistance measurement

CONCLUSION

The addition of pulutan leaf (*Urena lobata L.*) ethanol extract to liquid hand soap formulations significantly enhanced its antibacterial activity against *Staphylococcus aureus*. Based on physicochemical evaluations, all formulations (F0-F4) met the pH quality standards (4.71–5.55) ; however, only lower extract concentrations (F0 and F1) met the viscosity standards. Formulation F4 (25% extract concentration) exhibited the strongest and most optimal antibacterial inhibition zone (14.11 mm). Theoretically, the bioactive compounds in pulutan leaves demonstrate tremendous potential as an eco-friendly natural antibacterial agent. Recommendations**:** Future research should focus on optimizing the formulation by adjusting the thickening agents to ensure that soaps with higher extract concentrations meet viscosity standards. Furthermore, community education and training on utilizing pulutan leaves as an alternative natural sanitation product are highly recommended to help reduce the prevalence of skin infections.

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