Journal of Midwifery and Nursing, 8 (2) (2026) pp. 126-135

Published by: IOCSCIENCE

Journal of Midwifery and Nursing

Journal homepage: www.iocscience.org/ejournal/index.php/JMN

Utilization of bidara arab leaf extract (*Ziziphus mauritiana Lam.*) as an antibacterial agent and Its application in herbal liquid soap formulation

Yola Desnera Putri[1], Septiya Hasanah[2], Sohadi Warya[3], Adit Andriyannto[4]

[1,2,3,4]Pharmacy Study Program, Sekolah Tinggi Farmasi Indonesia, Bandung, Jawa Barat, Indonesia

ARTICLE INFO

Article history:

Received Apr 18, 2026
Revised Apr 26, 2026
Accepted May 11, 2026

Keywords:

Antibacterial;
Bidara Arab Leaf;
Escherichia Coli;
Liquid Soap;
Staphylococcus Aueus.

ABSTRACT

Bidara arab leaves (*Ziziphus mauritiana Lam.*) are known to contain bioactive compounds such as flavonoids, tannins, and alkaloids, which contribute to their antibacterial activity. These secondary metabolites make bidara arab leaves a promising natural source for antibacterial agents. In this study, the ethanol extract of bidara arab leaves was utilized and applied in the formulation of herbal liquid soap. The extraction process was carried out using the maceration method with 70% ethanol as the solvent. The extract was then evaluated for its Minimum Inhibitory Concentration (MIC) using the agar diffusion method against *Staphylococcus aureus* and *Escherichia coli*. Furthermore, the extract was incorporated into a liquid soap formulation prepared using the hot process method. The evaluation of the formulation included organoleptic properties, pH, specific gravity, free alkali, total fatty acid, microbial contamination, viscosity, and foam stability according to SNI 06-4085-1996.The results showed that the extract yield was 12.59% with an MIC value of 5.5%, which inhibited the growth of *Staphylococcus aureus* but not *Escherichia coli*. The formulated liquid soap met most quality parameters, except for pH and free alkali. Additionally, antibacterial testing showed an inhibition zone of 10.59 mm, indicating that the formulation exhibited effective antibacterial activity.

Corresponding Author:

Yola Desnera Putri,
Pharmacy Study Program,
Sekolah Tinggi Farmasi Indonesia,
Jl. Soekarno-Hatta No.354, Batununggal, Kec. Bandung Kidul, Kota Bandung, Jawa Barat, 40266, Indonesia
Email: yoladesnera@stfi.ac.id

1. Introduction

Bidara arab (*Ziziphus mauritiana Lam.*) is a shrub plant that commonly grows in dry and subtropical regions. In Indonesia, this plant is widely distributed across Java, Bali, and West Nusa Tenggara. Bidara arab belongs to the Rhamnaceae family and is known by various local names. Chemically, the leaves of bidara arab have been reported to contain approximately 13–17% protein and about 15% fiber. In addition to protein and fiber, the leaves also contain various bioactive compounds such as alkaloids, flavonoids, saponins, tannins, triterpenoids, and phenolic compounds, which are known to exhibit potential pharmacological activities (Umarella et al., 2025).

For generations, bidara arab (*Ziziphus mauritiana* Lam.) has seen extensive use in folk medicine. One key role is in deceased purification rites, cited in a Bukhari and Muslim hadith advocating bidara leaves for the bathing ritual (Lukman et al., 2023). Additionally, multiple research efforts confirm the antibacterial efficacy of bidara arab leaf extracts, with a minimum inhibitory concentration (MIC) of 0.1% that successfully curbs and eradicates pathogenic bacterial growth. Antibacterial assays employing the agar diffusion method indicated no activity from the ethanol extract of bidara leaves (*Ziziphus*

mauritiana L.) at 0.1%. However, at 0.4%, clear inhibition occurred, yielding zones of 7 mm for *Staphylococcus aureus*, 6.76 mm for *Bacillus subtilis*, and 7.04 mm for *Staphylococcus epidermidis* (Nurrahma, 2022).

The antibacterial activity is presumed to be associated with the presence of secondary metabolites, particularly tannins, which belong to the polyphenol group and are known to exhibit antibacterial mechanisms (Shufyani et al., 2022) In addition, the saponin content in bidara arab (*Ziziphus mauritiana Lam.*) leaves also plays an important role due to its natural surfactant properties, enabling foam formation and providing a cleansing effect (Rai et al., 2021). The combination of these bioactive compounds indicates that bidara arab leaves have strong potential to be developed into topical formulations, one of which is liquid soap.

Soap is a preparation used to cleanse the skin from dirt, oil, and microorganisms. Liquid soap is a more practical and hygienic dosage form compared to solid soap, making it more preferred by the public. According to the Indonesian National Standard (SNI) 06-4085:1996, liquid bath soap is defined as a liquid preparation made from soap or detergent bases with the addition of permitted ingredients, and is safe for use without causing skin irritation. In its manufacturing process, soap is produced through a saponification reaction, which involves the reaction between fatty acids and a strong alkali to form fatty acid salts (soap) and glycerol (Nurhajawarsi, 2023; Zahro et al., 2023).

To produce high-quality liquid soap, it is necessary to comply with quality standards, including organoleptic parameters (appearance, color, and odor), pH, free alkali content, specific gravity, active ingredient content, and microbial contamination, in accordance with the Indonesian National Standard (SNI) 06-4085:1996. In addition, the formulated liquid soap is expected to exhibit effective antibacterial activity and be safe for use on the skin (Rosmainar, 2021).

This study contributes to the advancement of natural antibacterial product development by demonstrating the potential of *Ziziphus mauritiana* leaf extract as an effective antibacterial agent in liquid soap formulations. In addition, it provides formulation insights that ensure both physicochemical stability and antimicrobial efficacy. This research also supports the exploration of plant-derived compounds as sustainable and safer alternatives to synthetic antibacterial agents in personal care products.

2. Methods

Tools and Material

The instruments used in this study included maceration equipment, a rotary evaporator (IKA Basic 05®), an incubator (Memmert®), test tubes, a micropipette, an analytical balance (Ohaus®), Petri dishes, an Erlenmeyer flask, a spirit burner, a pH meter (Mettler Toledo Seven Compact), a separatory funnel, a pycnometer, a viscometer (Brookfield), a burette, an inoculating loop, a porcelain dish, a furnace (Barnstead Thermolyne), an autoclave (My Life®), a UV-Vis spectrophotometer (Genesys 10s Thermo), and standard laboratory glassware. The plant material used in this study was bidara arab leaves (*Ziziphus mauritiana Lam.*) obtained from Talango, Sumenep, East Java. The chemicals used included 70% ethanol, distilled water (aquadest), 0.9% NaCl, olive oil, potassium hydroxide (KOH), butylated hydroxytoluene (BHT), stearic acid, sodium benzoate, glycerin, hydroxyethyl cellulose (HEC), propylene glycol, cocamide DEA, citric acid, hydrochloric acid, sodium tetraborate, n-hexane, and reagents for phytochemical screening. The materials used for microbiological testing included Nutrient Agar and Plate Count Agar, while the bacterial strains employed were *Staphylococcus aureus* and *Escherichia coli*.

Plant Identification

The leaves of bidara arab (*Ziziphus mauritiana* Lam.) sourced from Sumenep underwent botanical verification at the Plant Taxonomy Laboratory, Biology Department, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran, Jatinangor.

Characterization of Simplisia

Fresh bidara arab leaves (*Ziziphus mauritiana Lam.*) obtained from Talango, Sumenep, East Java, were initially subjected to wet sorting by removing impurities and separating the leaves from stems and

fruits, followed by washing, draining, drying, and dry sorting. The physicochemical evaluation of simplisia included determination of total ash content, moisture content, water-soluble extractive value, ethanol-soluble extractive value, and loss on drying (Dzulfadhli Utomo et al., 2022; Handayani et al., 2022; Putri & Lubis, 2022).

Extraction

The extraction of bidara arab leaves (*Ziziphus mauritiana Lam.*) was carried out using a cold extraction method, namely maceration. The dried leaves were powdered using a blender and placed into a maceration container. Subsequently, 70% ethanol was added until the simplisia was completely immersed. The extraction process was conducted for 3 × 24 hours with occasional stirring. The filtrate produced was subsequently passed through filter paper. The resulting macerate was then condensed via a rotary evaporator at 40–50°C to yield a viscous extract. Afterward, the extract was measured by weight, and the yield percentage was determined (Ajemain et al., 2022; Nurrahma, 2022).

Phytochemical screening

Phytochemical analysis was performed to detect secondary metabolites in the bidara arab leaf powder (*Ziziphus mauritiana* Lam.), encompassing alkaloids, flavonoids, tannins, saponins, phenolics, quinones, monoterpenoids and sesquiterpenoids, along with steroids and triterpenoids (Handayani et al., 2022; Razoki et al., 2023; Sari et al., 2019).

Antibacterial Assay

a. Preparation the antibacterial testing commenced with reactivating the test bacteria. All equipment and supplies were sterilized in an autoclave at 121°C for 15 minutes, covering Petri dishes, test tubes, stirrers, vials, Erlenmeyer flasks, and beakers; inoculating loops were flame-sterilized. Nutrient Agar (23 g) was suspended in 1 liter of distilled water, heated to full dissolution, and autoclaved similarly. Once cooled to about 50°C, the medium was aliquoted (5 mL) into sterile tubes, plugged with cotton and gauze, slanted, and solidified. Employed strains included *Staphylococcus aureus* (Gram-positive) and *Escherichia coli* (Gram-negative). Bacteria were streaked on Nutrient Agar and incubated at 37°C for 18 hours. Bacterial suspensions were then created by transferring 1–2 loops of growth into 0.9% NaCl, mixing thoroughly, and calibrating turbidity via spectrophotometer to the target level (Asthyananda & Bakri, 2024; Dewi et al., 2025; Irwanto et al., 2022).
b. Determination of Minimum Inhibitory Concentration (MIC), the minimum inhibitory concentration (MIC) for bidara arab leaf extract (*Ziziphus mauritiana* Lam.) was assessed via the agar diffusion approach. Preparations included extract concentrations of 5.5%, 6%, 6.5%, and 7%. A 50 µL aliquot of bacterial suspension was added to sterile Petri dishes, followed by Nutrient Agar, and swirled in a figure-eight pattern for even distribution. Once solidified, wells were punched into the agar. Each well received 70 µL of extract via micropipette. Plates were incubated at 37°C for 24 hours, with sterile distilled water serving as the negative control. Antibacterial effects were evaluated by gauging the clear zone diameters surrounding the wells (Ajemain et al., 2022; Nurrahma, 2022; Temerk, 2017).

Formulation and Preparation of Bidara Arab Leaf Extract Liquid Soap

The formulation of liquid soap containing bidara arab leaf extract (*Ziziphus mauritiana Lam.*) consisted of extract at a concentration of 2×MIC, olive oil (20 mL), KOH (5.6 g), stearic acid (0.75 g), cocamide DEA (2 g), hydroxyethyl cellulose (1 g), BHT (1 g), glycerin (5 mL), propylene glycol (15 mL), citric acid (1 g), sodium benzoate (0.1 g), and distilled water (56 mL). All ingredients were accurately weighed prior to preparation. Hydroxyethyl cellulose was first dispersed in hot distilled water until fully swollen. Olive oil and BHT were heated together, after which KOH previously dissolved in hot distilled water was added gradually while maintaining the temperature at approximately 50°C until a soap base was formed. Melted stearic acid was then incorporated into the soap base, followed by the addition of the hydrated hydroxyethyl cellulose. Citric acid dissolved in hot distilled water was added subsequently. Glycerin and propylene glycol were introduced gradually with continuous stirring. Sodium benzoate dissolved in distilled water was then added, followed by cocamide DEA. Finally, bidara arab leaf extract

was incorporated, mixed until homogeneous, and distilled water was added to adjust the volume. The mixture was stirred until uniform and then transferred into a suitable container (Yulianti et al., 2015). Liquid soap formula presented in Table 1.

Table 1.
Liquid Soap Formula

Ingredients	Concentration
Bidara arab leaf extract (*Ziziphus mauritiana Lam.*)	2 X KHM
Olive oil	20 mL
KOH	5,6 g
Stearic acid	0,75 g
Cocamide DEA	2 g
Hydroxyethyl cellulose	1 g
BHT	1 g
Glycerin	5 mL
Propylene glycol	15 mL
Citric acid	1 g
Sodium benzoate	0,1 g
Distilled water	56 mL

Evaluation of Liquid Soap

The evaluation of liquid soap was conducted based on SNI (1996) standards, including the following parameters: Organoleptic test procedure, The liquid soap was visually observed for its physical characteristics, including form, odor, and color (Rosmainar, 2021). Calibration of the pH meter was performed with standard buffer solutions, followed by rinsing the electrode in distilled water. The electrode was then dipped into the liquid soap sample, and the displayed pH reading was noted from the device (Rosmainar, 2021; Zahro et al., 2023). Viscosity The sample was placed into a cylindrical container, and the spindle was inserted into the liquid soap. The viscometer was turned on, ensuring proper spindle rotation. The viscosity reading was recorded when the indicator stabilized (Sari et al., 2024) Foam Height Assessment, 1 g of liquid soap was added to a test tube and diluted to 10 mL with distilled water. The tube was inverted vigorously to generate foam, with height measured right away. A repeat measurement was taken after 5 minutes. (Murti et al., 2017; Zahro et al., 2023).

To assess free alkali content, 5 g of liquid soap was accurately weighed into a 250 mL Erlenmeyer flask. This was followed by adding 100 mL of neutralized 96% ethanol, boiling chips, and a few drops of phenolphthalein indicator. The contents were heated on a water bath to boiling for 30 minutes. Should the solution develop a red hue, it was titrated with 0.1 N HCl in alcohol until the coloration vanished (Umarella et al., 2023). The free alkali content was calculated using the following formula:

$$\text{Free alkali content} = \frac{V \times N \times 0{,}04}{W} \times 100\%$$

Where:
V = Volume of HCl used (mL)
N = Normality of HCl
0.04 = Equivalent weight of NaOH
W = Weight of sample (g)

Specific GravitynThe pycnometer was cleaned, dried, and weighed. It was then filled with liquid soap and weighed again. The procedure was repeated using distilled water (Murti et al., 2017; Sari et al., 2024). The specific gravity at 25°C was calculated using the following formula:

$$\text{Specific gravity (25°C)} = \frac{W}{W1}$$

Where:
W = Weight of liquid soap

W1 = Weight of distilled water

Total Fatty Acid Content, 5 g of liquid soap was weighed and combined with 50 mL distilled water, 6 drops of methyl orange indicator, and 0.1 N HCl until a red tint emerged, signaling the release of fatty acids. The blend was poured into a separatory funnel, where 100 mL n-hexane was introduced and extracted in three successive steps. (Horwitz, 2006; Ndumuye et al., 2022; Pertiwi et al., 2022). The solvent phase was rinsed with 10 mL distilled water to achieve neutrality. Subsequently, the solvent was evaporated and oven-dried at 105°C to a stable weight.

$$\text{Total fatty acid content} = \frac{W2-W1}{W} \; x \; 100\%$$

Where:
W = Weight of sample
W1 = Weight of empty flask
W2 = Constant weight of sample

Total Plate Count (TPC), equipment was fully sterilized before testing. Plastic containers had their openings wiped with 70% alcohol and were aseptically accessed. A 25 mL sample was blended with 225 mL diluent for a 1:10 dilution. Further serial dilutions were made as needed. In duplicate, 1 mL from each dilution was transferred via pipette to sterile Petri dishes. Within 15 minutes, 12–15 mL of 45°C Plate Count Agar (PCA) was overlaid, gently rotated for mixing, and allowed to set. Inverted plates were incubated at 35°C for 24–48 hours. Post-48 hours, colonies (25–250 per plate) were enumerated, and TPC derived by averaging counts and applying the dilution factor (Kusumaningtyas et al., 2026).

Antibacterial efficacy was assessed through agar diffusion. Test bacteria were spread uniformly on Nutrient Agar. Following solidification, wells were created and loaded with liquid soap samples. Incubation occurred at 37°C for 24 hours. Clear zones around wells signified activity, with diameters recorded. The process included commercial antiseptic soap (positive control), soap base (negative control), and sterile distilled water (Yulianti et al., 2015).

3. Results and Discussion

Plant Determination and Simplisia Characterization

Verification of bidara arab leaves (*Ziziphus mauritiana* Lam.) verified that the plant sample employed here was taxonomically correct and suitable for subsequent testing. This authentication process is vital to uphold raw material genuineness and uniformity, since errors in identification could compromise product quality, safety, and performance (Galingging et al., 2022).

Table 2.
Characterization Results of Bidara Arab Leaf Simplisia

Type of Characterization	Result (%)
Moisture content	4
Total ash content	8
Water-soluble extractive	16
Ethanol-soluble extractive	13
Loss on drying	6

Simplisia evaluation assessed quality attributes of the raw material before extraction and formulation stages. As shown in Table 2, total ash reached 8%, reflecting inorganic elements like mineral remnants. Such levels offer insights into material purity, with elevated ash potentially signaling impurities or adulteration (Devitria et al., 2023). Extractive value results indicated that water-soluble extract (16%) exceeded ethanol-soluble extract (13%). This suggests that the majority of chemical constituents in bidara arab leaves are more polar in nature and are more readily extracted with water compared to ethanol. These results provide preliminary information regarding the solubility profile of active compounds present in the simplisia (Devitria et al., 2023; Handayani et al., 2022).

Simplisia moisture level was 4%, satisfying the quality benchmark of under 5%. Low moisture content is crucial to prevent microbial growth and enzymatic degradation, thereby ensuring better stability and shelf life of the raw material. Additionally, the loss on drying was recorded at 6%, reflecting the total amount of volatile substances, including water and other compounds that may evaporate during the drying process (Handayani et al., 2022; Noviyanti et al., 2020). Overall, the characterization results indicate that the simplisia of bidara arab leaves meets the general quality requirements and is suitable for further extraction and formulation processes

Phytochemical Screening Results

Phytochemical screening identified secondary metabolites in bidara arab leaf simplisia and ethanol extract (*Ziziphus mauritiana* Lam.). The assessment confirmed that extraction and drying preserved active constituents. Findings are detailed in Table 3.

Table 3.
Phytochemical Screening Results of Simplisia and Extract

Compound Group	Simplisia	Extract
Polyphenols	+	+
Flavonoids	+	+
Tannins	+	+
Saponins	+	+
Quinones	+	+
Alkaloids	+	+
Monoterpenes and sesquiterpenes	+	+
Steroids and triterpenoids	-	-

Note: (+) Detected; (–) Not detected

The results indicate that the secondary metabolites present in the extract are consistent with those found in the simplisia, suggesting that the extraction process did not damage or significantly alter the phytochemical constituents of *Ziziphus mauritiana* leaves. Maceration using 70% ethanol was supported by previous studies demonstrating its ability to optimally extract bioactive compounds and produce higher antibacterial activity. Due to its semi-polar nature, 70% ethanol can effectively extract both polar and non-polar compounds, including alkaloids, saponins, tannins, steroids, and flavonoids. In contrast, 96% ethanol tends to extract fewer polar compounds, which may reduce the extraction efficiency of antibacterial constituents. Previous studies reported that the 70% ethanol extract exhibited a larger inhibition zone (12.88 mm) compared to the 96% ethanol extract (10.36 mm), indicating stronger antibacterial activity (Kusumaningsih et al., 2021).

These findings are consistent with the phytochemical screening results of the present study, which confirmed the presence of several secondary metabolites such as flavonoids, alkaloids, and phenolic compounds that may contribute to the antibacterial activity of the extract. The extraction process yielded a viscous brown extract with a yield of 12.59%, reflecting the proportion of extract obtained relative to the initial weight of the simplisia. This value meets the general requirement for viscous extract yield, which should not be less than 10%, indicating that the extraction process was efficient (Badriyah et al., 2022).

Assessment of Minimum Inhibitory Concentration (MIC) for Bidara Arab Leaf Ethanol Extract on *Staphylococcus aureus* and *Escherichia coli*

The MIC assay identified the lowest bidara arab leaf extract (*Ziziphus mauritiana* Lam.) concentration inhibiting *Staphylococcus aureus* and *Escherichia coli* growth. Agar well diffusion was selected for its straightforwardness and clear zone visualization. Here, 10% DMSO acted as negative control, with tetracycline HCl (2.5 mg/mL) as positive control. No zones formed with the negative control, confirming DMSO's neutrality toward bacterial proliferation thus, all activity stemmed purely from the extract. Each Petri dish received 20 mL Nutrient Agar; post-solidification, 5 mm wells were punched using a sterile perforator.

Based on the data in Table 4, the extract at a concentration of 5.5% exhibited an inhibition zone of 16.8 mm against *Staphylococcus aureus*, indicating that this concentration can be considered as the MIC. This value was subsequently used as a reference for determining the extract concentration in the liquid soap formulation

Table 4.
Minimum Inhibitory Concentration (MIC) for Bidara Arab Leaf Ethanol Extract

Sample	Concentration (%)	Inhibition Zone (mm)	
		Staphylococcus aureus	*Escherichia coli*
Bidara arab leaf extract	5.5	16.8	-
	6	22.9	-
	6.5	23	-
	7	22	-
Negative control	-	-	-

Note: Negative control = 10% DMSO; (–) = no inhibition zone observed

Findings reveal robust antibacterial effects of bidara arab leaf extract against *Staphylococcus aureus*, with inhibition zones of 10–20 mm. Conversely, no suppression occurred against *Escherichia coli*, implying greater potency against Gram-positive versus Gram-negative strains. This efficacy arises from bioactive agents like flavonoids and alkaloids-phenolic derivatives that impair bacterial cell wall synthesis and compromise membrane stability, thereby curbing microbial proliferation (Ajemain et al., 2022; Nurrahma, 2022; Shufyani et al., 2023).

Evaluation of Liquid Soap

The organoleptic evaluation was conducted through visual observation of the liquid soap preparation, including its physical form, color, and odor. Based on Table 5, the liquid soap without the addition of *Ziziphus spina-christi* leaf extract (F0) exhibited a homogeneous liquid form, light yellow color, and was odorless. In contrast, the formulation containing the extract (F1) showed a homogeneous liquid form, brown color, and a characteristic odor. These results indicate that the addition of the extract influences the color and odor of the formulation without affecting its homogeneity. According to the Indonesian National Standard (SNI), the acceptable pH range for liquid soap is 8–11. The pH of the formulation containing *Ziziphus spina-christi* leaf extract was 13.17, which exceeds the acceptable range.

Table 5.
Evaluation of Liquid Soap *Bidara Arab Leaf Ethanol Extract*

Test Parameter	Result	SNI Requirement
pH	13.37	8–11
Specific gravity	1.07	1.01–1.10
Free alkali	2.032%	Maximum 0.1%
Total fatty acid	32.8%	Minimum 15%
Viscosity	2700 cps	400-4000
Foam height	84.61%	>70%
Organoleptic Observation		
Form	Homogeneous liquid	Homogeneous liquid
Color	Brown	Characteristic
Odor	Characteristic	Characteristic

The viscosity of the liquid soap containing *Ziziphus spina-christi* leaf extract was measured at 2700 cps using a viscometer at various speeds. This test was conducted to determine the consistency of the formulation. The foam height test was performed by measuring foam height at 0 and 5 minutes after shaking. The foam stability of the formulation was 84.61%, indicating good stability as it exceeds 70%. This stability is attributed to the presence of Cocamide DEA, which acts as a foam stabilizer. Cocamide DEA is a nonionic surfactant known for its ability to enhance viscosity and foam stability while

being relatively mild and less irritating to the skin, making it suitable for use in formulations intended for sensitive skin (Cholifah et al., 2021). However, the observed increase in pH in the formulation may indicate the presence of residual alkaline components, which are more likely derived from the base ingredients rather than cocamide DEA itself.

The specific gravity test, conducted using a pycnometer, showed that the formulation containing *Ziziphus spina-christi*leaf extract had a value of 1.07. This result complies with the SNI requirement of 1.01–1.10, indicating that the formulation meets the standard for density. The free alkali content in the formulation containing the extract was found to be 2.032%, which exceeds the SNI maximum limit of 0.1%. This may be due to an imbalance between potassium hydroxide and olive oil, leading to incomplete saponification. The insufficient amount of oil may have resulted in unreacted potassium hydroxide remaining in the formulation. Although stearic acid can act as a neutralizing agent, its low concentration in this formulation was insufficient to fully neutralize the excess alkali. Increasing the amount of stearic acid may reduce free alkali levels; however, it could also alter the consistency of the product, making it more solid. The total fatty acid content of the formulation containing the extract was 32.8%, which meets the SNI requirement of a minimum of 15%. This indicates that the formulation contains an adequate amount of active fatty acid components. The antibacterial activity of the liquid soap formulation containing *Ziziphus spina-christi* leaf extract was evaluated against *Escherichia coli* and *Staphylococcus aureus*. The results are presented in Table 6.

Table 6.
Antibacterial Activity of Liquid Soap Formulations

Formula	Inhibition Zone (mm)	
	Staphylococcus aureus	*Escherichia coli*
Fo	6.5	–
F1	10.9	–
Positive Control	25.5	23
Negative Control	–	–

Notes
Fo : Formulation without *Ziziphus spina-christi* leaf extract
F1 : Formulation with *Ziziphus spina-christi* leaf extract
Positive control : Commercial antiseptic liquid soap (Antiseptic Soap X)
Negative control : Sterile distilled water

The formulation containing the extract (F1) demonstrated antibacterial activity against *Staphylococcus aureus*, as indicated by an inhibition zone of 10.9 mm, which can be categorized as strong antibacterial activity. In contrast, the formulation without the extract (F0) also exhibited a smaller inhibition zone of 6.5 mm against *Staphylococcus aureus*. This activity is likely attributed to the presence of sodium benzoate used as a preservative in the formulation. The positive control, a commercial antiseptic liquid soap, produced a significantly larger inhibition zone of 25.5 mm against *Staphylococcus aureus*, indicating superior antibacterial effectiveness compared to the tested formulations. Meanwhile, no inhibition zone was observed in the negative control (sterile distilled water), confirming that the observed antibacterial activity was due to the active components in the formulations.

Figure 1. Antibacterial Activity of Liquid Soap Formulations

For *Escherichia coli*, neither the formulations (F0 and F1) nor the negative control showed any inhibitory effect, whereas the positive control exhibited an inhibition zone of 23 mm. This suggests that the formulated liquid soap containing *Ziziphus spina-christi* leaf extract is more effective against Gram-positive bacteria (*Staphylococcus aureus*) than Gram-negative bacteria (*Escherichia coli*), likely due to differences in cell wall structure that influence antibacterial susceptibility. The microbial contamination test showed a result of <10 colonies/g, which meets the SNI requirement of a maximum of 1×10^5 colonies/g. This indicates that the liquid soap formulation is hygienic and has minimal microbial contamination.

4. Conclusion

Based on the results, *Ziziphus spina-christi* leaf extract showed antibacterial activity against *Staphylococcus aureus* with an MIC value of 5.5% and its activity was maintained in the liquid soap formulation, indicating its potential as an antibacterial herbal soap ingredient. However, the formulated product did not fully meet SNI standards, particularly in terms of pH and residual content. Therefore, further studies are required to optimize pH through appropriate adjustment of alkalizing agents or buffer systems, reduce residual content by improving formulation processes and raw material selection, and conduct broader antimicrobial as well as skin irritation tests to ensure the safety and effectiveness of the product for topical use.

References

Ajemain, M., Azis, A., Yamasi, A., & Sukirawati, M. (2022). Uji aktivitas ekstrak etanol daun bidara Arab (*Ziziphus spina-christi* L.) terhadap pertumbuhan *Staphylococcus aureus*. *Jurnal Farmasi*, 1(1), 1–7. Doi: https://doi.org/10.51577/papsjournals.v1i2.374

Asthyananda, M., & Bakri, D. F. F. (2024). Formulasi clay mask daun binahong (*Anredera cordifolia*) dan uji inhibisi *Staphylococcus aureus*. *Kartika: Jurnal Ilmiah Farmasi*, 9(2), 105–114. DOI**:** https://doi.org/10.26874/kjif.v9i2.680

Badriyah, L., & Farihah, D.A. (2022). Optimalisasi ekstraksi kulit bawang merah (Allium cepa L) menggunakan metode maserasi. J. Sintesis, 3(1), 30-37. https://doi.org/10.56399/jst.v3i1.32

Cholifah, U., Nafiunisa, A., Aryanti, N., & Wardhani, D.H. (2021). The influence of cocamide DEA towards the characteristics of transparent soap. *IOP Conference Series: Materials Science and Engineering*, 1053, 012016. https://doi.org/10.1088/1757-899X/1053/1/012016

Devitria, R., Wulandari, R., & Elfia, M. (2023). Water soluble ash and acid insoluble ash content of guava seed simplicia (*Syzygium malaccense*). *Jurnal Ilmu Kesehatan Abdurrab*, 1(2), 12–16. Retrieved from https://jurnal.univrab.ac.id/index.php/jika/article/view/3601

Dewi, N. A. R., Rahmawati, I., & Purnamasari, N. A. D. (2025). Clay mask formulation with *Moringa oleifera* leaf extract and antibacterial activity against *Staphylococcus aureus*. *Indonesian Journal of Pharmaceutical Education*, 5(1). DOI: https://doi.org/10.37311/ijpe.v5i1.26870

Dzulfadhli Utomo, H., Kiromah, N. Z. W., & Rahayu, T. P. (2022). Formulasi krim anti jerawat ekstrak metanol daun mangga (*Mangifera indica* L.) dan uji antibakteri *Staphylococcus aureus*. *Jurnal Farmasi Klinik dan Sains*, 2(2). doi: 10.26753/jfks.v2i2.796

Friska Pertiwi, A., Taufik, E., & Arief, I. I. (2022). Karakteristik kefir susu sapi dengan penambahan ekstrak bunga telang (*Clitoria ternatea*). *Jurnal Ilmu Pertanian Indonesia*, 28(1), 34–45. DOI: https://doi.org/10.18343/jipi.28.1.34

Gaby Syahanaya Butar-Butar, R., Neswita, E., Sembiring, N. B., Novriani, E., Simanjuntak, N. J. P., Halimahtussa, E., & Pakpahan, D. (2023). Skrining fitokimia dan kadar flavonoid ekstrak paku (*Nephrolepis biserrata*). *Journal of Pharmaceutical and Sciences*, 6(1). DOI: https://doi.org/10.36490/journal-jps.com.v6i3.185

Galingging, A., Ratnaningsih, A. T., & Lestari, I. (2022). Kunci determinasi famili Dipterocarpaceae. *Jurnal Penelitian Kehutanan Bonita*, 4(1). DOI:10.55285/bonita.v4i2.1605

Handayani, R., Auliasari, N., & Hasanah, H. U. (2022). Formulasi dan evaluasi tablet hisap ekstrak biji kopi (*Coffea arabica* L.). *Jurnal Ilmiah Manuntung*, 8(1), 82–88. DOI:10.51352/jim.v8i1.496

Handayani, R., Qamariah, N., Sartika, F., & Nugroho, S. A. (2022). Uji parameter non spesifik simplisia umbi sarang semut. *Jurnal Farmasi*, 5(2). DOI: https://doi.org/10.53864/jifakfar.v7i2.199

Horwitz, W. (2006). *Official methods of analysis of AOAC International*. AOAC International.

Irwanto, R., Dewi, S., Girsang, A., Ginting, W. M., & Novia, R. (2022). Formulasi sabun cair ekstrak etanol daun seledri (*Apium graveolens* L.). *Jurnal Farmasi Medistra*, 5(2). http://ejournal.medistra.ac.id/index.php/JFM

Kusumaningsih, T., Sidarningsih, & Putra, A.A., Aljunaid, M. (2021). Antibacterial differences effect between purple leaves (*Graptophyllum pictum* (L.) Griff.) 70% and 96% ethanol extract against *Aggregatibacter*

actinomycetemcomitans bacteria. *Journal of International Dental and Medical Research*, 14(2), 519–524. https://doi.org/10.31004/jptam.v10i1.37241

Kusumaningtyas, A. A., Kharin, A. N., Oktariana, A., Kusuma, B. A., Karyadiva, B. R., Mardiningtyas, D., … Rahmadani, O. K. C. (2026). Analisis Cemaran Mikroba ALT (Angka Lempeng Total) dan AKK (Angka Kapang Khamir) Pada Sediaan Kosmetik Bedak Tabur dan Bedak Padat . *Jurnal Pendidikan Tambusai*, *10*(1), 6628–6639. https://doi.org/10.31004/jptam.v10i1.37241

Lukman, J., & Hadits, L. (2023). Penggunaan bidara dalam masyarakat Aceh Tengah. *Jurnal Studi Hadis Nusantara*, 5(1).

Murti, I. K. A. Y., Putra, I. P. S. A., Suputri, N. N. K. T., Wijayanti, N. P. D., & Yustiantara, P. S. (2017). Optimasi olive oil pada sabun cair. *Jurnal Farmasi Udayana*, 6(2).

Ndumuye, E., Langi, T. M., & Taroreh, M. I. R. (2022). Chemical characteristics of muate flour (*Pteridophyta filicinae*) as traditional food for the community of Kimaam Island. *Jurnal Agroekoteknologi Terapan (Applied Agroecotechnology Journal)*, 3(2), 261–268. DOI:10.35791/jat.v3i2.44440

Nurhajawarsi. (2023). Formulation and analysis of solid bath soap with the addition of seaweed (Formulasi dan analisis mutu sabun mandi padat dengan penambahan rumput laut). *SATERA: Jurnal Sains dan Teknik Terapan*, **1**(1), 27–40. Retrieved from https://journal.akom-bantaeng.ac.id/index.php/jstt/article/view/11

Nurrahma, E. A. (2022). Antibacterial activity of bidara leaves (*Ziziphus mauritiana* L.). *Journal of Microbiology Science*, 2(2). DOI: https://doi.org/10.56711/jms.v2i2.867

Puspita Sari, R., Laoli, M. T., & Tim Studi (2019). Karakterisasi simplisia dan skrining fitokimia daun lemon. KLOROFIL Jurnal Ilmu Biologi dan Terapan *2(1):7*. doi: https://doi.org/10.30821/kfl:jibt.v2i1.1802

Putri, D. M., & Lubis, S. S. (2022). Skrining fitokimia ekstrak daun kalayu. *AMINA (Ar-Raniry Chemistry Journal) 2(3):120-125* DOI:10.22373/amina.v2i3.1384

Rai, S., Acharya-Siwakoti, E., Kafle, A., Devkota, H. P., & Bhattarai, A. (2021). Plant-derived saponins: Surfactant properties and applications. *Sci*, 3(4). DOI:10.3390/sci3040044

Rosmainar, L. (2021). Formulasi sabun cair daun jeruk purut dan kopi robusta. *Jurnal Kimia Riset*, 6(1):58DOI:10.20473/jkr.v6i1.25554

Sari, P. I., Malahayati, S., & Kurniawati, D. (2024). Stabilitas sabun cair ekstrak jeruk nipis. *Jurnal Surya Medika*, 10(3), 149–156. DOI:10.33084/jsm.v10i3.9007

Shufyani, F., & Dominica, D. (2023). Aktivitas antibakteri ekstrak daun bidara terhadap *Streptococcus mutans*. *Journal of Pharmaceutical Sciences*, 5(1):128-135. DOI:10.36490/journal-jps.com.v5i1.108

Temerk, H. (2017). Antibacterial effect of *Ziziphus spina-christi*. *Egyptian Journal of Botany*. DOI:10.21608/ejbo.2017.665.1035

Umarella, S., Bamahry, A. R., & Lantara, A. M. H. D. (2023). Literature review: Kandungan dan manfaat daun bidara (*Ziziphus mauritiana*). *Borneo Journal of Medical Laboratory Technology*. 8(1):922-931. DOI:10.33084/bjmlt.v8i1.10605

Yanti, N., Sativa, N., & Perdana, F. (2023). Parameter spesifik dan nonspesifik daun *Ziziphus nummularia (Burm.F.)* serta kandungan senyawa metabolit sekunder. *Jurnal Farmako Bahari*, 10(3), 197-. DOI:10.52434/jfb.v10i2.660

Yulianti, R., Nugraha, D. A., & Nurdianti, L. (2015). Formulasi sediaan sabun mandi cair ekstrak daun kumis kucing (*Orthosiphon aristatus* (Bl.) Miq.). *Kartika: Jurnal Ilmiah Farmasi*, 3(2), 1-11. DOI:10.26874/kjif.v3i2.98

Zahro, K., Salsabila, A., Azahra, S., Zaevany, A., Margaretha, C., & Naila, J. (2022). Sabun cair berbasis VCO dengan essential oil. *Indonesian Journal of Health Science*, 3(2a):199-203. DOI:10.54957/ijhs.v3i2a.457