VT INTERNATIONAL PRESS
VTIPJMRR | Journal of Multidisciplinary Research & Review
www.journal.vtinterpress.com

(Research Article)

Formulation and Evaluation of Herbal Hand Wash Using *Balanites aegyptiaca* (Hinganbet)

Ganesh Chaudhari [1], Vishwajeet Tupe[2], Shubham Rahinj[3], Suraj Sase[4], Najiya Shaikh [5], Nikita Sagar[6], Jagdish Sable[7]

[1-6] U.G. Student, Department of Pharmacy, Matoshri Miratai Aher College of Pharmacy, Ahilyanagar, Maharashtra, India – 414304
[7] Assistant Professor, Department of Pharmacy, Matoshri Miratai Aher College of Pharmacy, Ahilyanagar, Maharashtra, India – 414304
Corresponding Author: ganeshchaudhari9055@gmail.com

Received: 20.05.2026	Accepted: 27.05.2026	Published: 27.05.2026

ABSTRACT

Balanites aegyptiaca (L.) Del., which is also called "Hinganbet" or "Desert Date", has been documented as a medicinal plant from the family of Zygophyllaceae. It is extensively distributed throughout the arid and semi-arid regions of India, Africa and the Middle East. The plant contains a variety of bioactive phytoconstituents like saponins, flavonoids, tannins, alkaloids, and polyphenols. These phytoconstituents contribute to various biological activities, such as antimicrobial, antioxidant, and anti-inflammatory. With increasing public concern about synthetic surfactants, such as triclosan, parabens, and sodium lauryl sulphate (SLS), used in commercial hand wash products, there is now greater interest in using plant-based substitutes. This study provides information on the production of an aqueous extract of B. aegyptiaca fruits and the incorporation of this extract into a liquid hand washing formulation containing additives including glycerine, SLS, aloe vera gel, methylparaben, and citric acid. Physiochemical characteristics - appearance, pH, foam height/foam retention, viscosity/spreadability were tested, along with skin irritation testing, for this hand wash. In addition, the hand washing solution's ability to inhibit microbial growth was tested using the agar-well diffusion technique with E. coli and S. aureus. Foam height/retention was in a satisfactory range of 7-9 cm / 90% respectively; pH = 6.2 (acceptable skin pH range = 5.5-7.0); zones of inhibition for E. coli = 12mm; zones of inhibition for S. aureus = 14mm. No degradation in colour or odor, or phase separation occurred under accelerated storage condition stability tests. Therefore these data demonstrate that the formulated herbal hand cleaning product is a safe, effective, ecologically friendly and cost-effective replacement for commercially available synthetic hand cleansing products.

Keywords: *Balanites aegyptiaca; Hinganbet; herbal hand wash; saponins; antimicrobial activity; herbal cosmetics; medicinal plant.*

I. INTRODUCTION

Aqueous extracts from desert date (Balanites aegyptiaca L., Family: Zygophyllaceae), which contain high levels of steroidal saponins were incorporated into a stable liquid hand wash formulation. Physio-chemical evaluation of this formulation was carried out. Efficacy against several bacterial and fungal strains commonly found on the skin were assessed using standard methods. Physically, hand-washing is widely regarded as the best way to reduce the risk of getting sick and spreading illness. It can be one of the least expensive measures that you can take to prevent many types of illnesses. The skin on your hands is constantly exposed to pathogenic microorganisms such as fungi, gram positive & negative bacteria and viruses. Poor hand-hygiene has been linked to increased rates of gastrointestinal disease, respiratory disease, hospital acquired infection, skin disorders etc [2]. As part of its initiative to improve global health, the WHO has designated handwashing with either soap or a detergent containing surfactant as a major public health effort [1]. Commercially available products that are used for hand-washing primarily include synthetic detergents (sodium laureth sulphate) & antimicrobial agents (chlorhexidine, triclosan) and preservative agents (formaldehyde releaser, parabens). Exposure to these chemicals may result in irritation to the skin and/or disruption to the integrity of the epidermal barrier and possible allergic reaction [4] and contribute to environmental pollution. Triclosan is being targeted by regulatory bodies due to concerns regarding its potential as an endocrine disruptor and its contribution to the promotion of antibiotic resistance [5]. Herbs represent a large source of bioactive secondary metabolites. These compounds have demonstrated proven biological activity such as antimicrobial activity, free radical scavenging activity and anti-inflammatory activity [6]. Cosmetics based on herbs typically demonstrate improved tolerance to the skin compared to traditional synthetic-based cosmetics [7]. Balanites aegyptiaca L. (Desert Date, Hinganbet or Baobab Tree), represents a multi-purpose medicinal plant species native to the Indian subcontinent, Africa and parts of the Middle East. Historical ethnopharmacological uses include treatment for various skin diseases, jaundice, malaria, enteroparasitic infections and wounds [8]. Steroid saponins have been identified through chemical investigation as the primary constituents responsible for the bioactivity of B. aegyptiaca. Saponins possess surface-active properties that allow them to foam, emulsify and clean surfaces, while also exhibiting antimicrobial activity against both bacteria and fungi [9].

II. LITERATURE REVIEW

A. Phytochemistry and Pharmacology of Balanites aegyptiaca

Yadav and Panghal [10] provided an overall view on the traditional application; phytochemical composition and pharmacology of B. aegyptica and demonstrated that saponin, flavonoid, alkaloid and phenol compounds are likely responsible for the known (antimicrobial, antifungal, anti-inflammatory) biological effects of B. aegyptica as well as its ability to heal wounds. Chothani and Vaghasiya [8] have confirmed those results, identified seven additional steroidal saponins (Balanatin-1 through Balanatin-7), which could be responsible for their cleansing or cytotoxic activities. Siddhuraju et al. [11], found fruit extracts of B. aegyptica showed high levels of free radical scavenger activity associated with total phenols; thus, it has the potential to be used in products intended to protect skin from damage. Gautam et al., [12] recently performed another review focused primarily on B. aegyptica's use as a source of nano-based interventional agents with antibacterial and antioxidant activity and suggested that B. aegyptica may represent a new, naturally derived antimicrobial agent with potential for application in both pharmacy and cosmetics.

Figure 1. Balanites aegyptiaca.

B. Antimicrobial Activity Studies

Hena et al. [13], reported that methanolic root extracts of B. aegyptica exhibited notable inhibition zones on three species of bacteria (Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa). The methanolic fraction was found to be superior to the aqueous fraction; this is likely due to the presence of higher levels of flavonoids and tannins. Kumar et al. [14] subsequently confirmed that hydroalcoholic seed extracts displayed similar inhibitory activity on a wide range of bacterial (Gram-positive and Gram-negative) and fungal pathogens. In addition, Ibrahim et al. [15] have identified the phytochemicals present within the fruit extract of B. aegyptiac and its antibacterial activity. This has further enhanced the opportunity for use of fruit derived extracts as active ingredients in topical formulations.

C. Herbal Hand Wash Formulations

Patel & Trivedi [18] examined herbal cosmetics and found that plant extracts containing saponins produced hand washes (acceptable pH; >6 cm foam) that were compatible with the skin. Cowan [6], provided a mechanistic explanation for how plants inhibit microorganisms through their products, stating that saponins break down membrane permeability while tannins cause protein precipitation on the surfaces of organisms. Khilare et al. [19], developed a specific herbal hand wash from B. aegyptiaca and demonstrated satisfactory physical and chemical properties as well as strong antimicrobial activities against bacteria that infect the skin - all of which preceded this research. Sharma and Sharma [20] have completed a systematic review of the medicinal use of B. aegyptiaca, and concluded that it is a prime candidate for developing additional herbal pharmaceutical topical products. Overall, the literature suggests that B. aegyptiaca extract contains sufficient amounts of saponins to be used as an effective active ingredient in a safe to use herbal hand wash.

III. METHODOLOGY

A. Plant Material and Authentication

Fruits of *Balanites aegyptiaca* were procured from a local authenticated herbal supplier in Ahilyanagar, Maharashtra, India, and identified by a qualified botanist. The plant material was washed thoroughly with distilled water to remove extraneous matter, shade-dried for 5–7 days at ambient temperature, and then pulverised using a mechanical grinder to obtain a coarse powder [21]. (Figure 1 and Figure 3.)

B. Preparation of Aqueous Extract

Twenty grams (20 g) of powdered plant material were macerated in 100 mL of distilled water. The slurry was subjected to mild heat extraction at 60–70°C for 45 minutes with continuous stirring, allowed to cool, and filtered through Whatman No. 1 filter paper. The clarified filtrate was used directly as the active extract for formulation studies [22]. (Figure 2.)

Figure 2. Extraction Process.

C. Formulation of Herbal Hand Wash

The formulation was prepared following standard liquid hand wash manufacturing procedures described by Barel et al. [7] and Sharma [23]. The composition of the optimised formulation is given in Table 1.

Table 1. Composition of Herbal Hand Wash Formulation.

Ingredient	Quantity	Function
Balanites aegyptiaca aqueous extract	20 mL	Active antimicrobial / cleansing agent
Distilled water	50 mL	Solvent / vehicle
Glycerin	10 mL	Humectant / moisturiser
Sodium lauryl sulfate (SLS)	5 mL	Auxiliary foaming / surfactant
Aloe vera gel	5 mL	Soothing / moisturising agent
Citric acid	q.s.	pH adjustment (target 5.5–7.0)
Methyl paraben	0.2% w/v	Preservative
Rose water	q.s.	Fragrance / mild astringent
Carbopol 940	0.5% w/v	Viscosity-enhancing / gelling agent
Triethanolamine (TEA)	q.s.	pH neutraliser / viscosity modifier

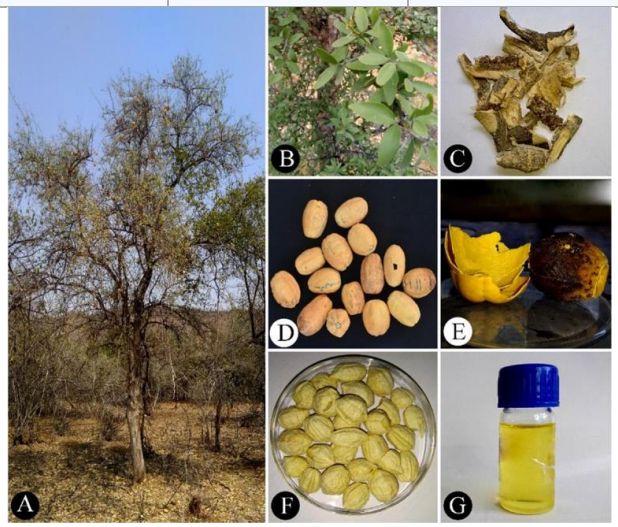

Figure 3. Balanites aegyptiaca parts.

D. Preparation Procedure

- Step 1: Carbopol 940 was dispersed in distilled water with continuous stirring and allowed to swell completely.
- Step 2: Glycerin was added slowly to the Carbopol dispersion with continuous mixing.
- Step 3: The clarified B. aegyptiaca aqueous extract was incorporated with stirring.
- Step 4: Aloe vera gel was blended into the mixture.
- Step 5: SLS was added gradually to build the foam base while avoiding excessive aeration.

- Step 6: Methyl paraben (dissolved in a small volume of warm alcohol) was incorporated as the preservative system.
- Step 7: Rose water was added as fragrance.
- Step 8: Triethanolamine was added dropwise with stirring to neutralise Carbopol and achieve target pH of 5.5–7.0 while simultaneously building viscosity.
- Step 9: The final formulation was mixed until a homogeneous, translucent gel was obtained, transferred into sterilised amber containers, and labelled.

IV. RESULTS

A. Physicochemical Evaluation

The formulation was evaluated for standard physicochemical parameters as per guidelines of the Indian Pharmacopoeia [24] and WHO [1]. Results are summarised in Table 2.

Table 2. Physicochemical Evaluation of Herbal Hand Wash.

Parameter	Test / Procedure	Result / Observation
Physical appearance	Visual inspection under daylight	Light brownish-yellow colour, pleasant herbal odor, smooth homogeneous texture
pH	Calibrated digital pH meter (25 °C)	6.2 (skin-compatible; range 5.5–7.0)
Foam height	10 mL sample + 90 mL distilled water, shaken 10 times; measure foam column	7–9 cm (good foamability)
Foam retention	Foam volume measured at 0 min vs 5 min	90% retention at 5 min
Viscosity	Brookfield viscometer, spindle S64, 20 rpm	Moderate (suitable for pump dispensing)
Spreadability	Parallel plate method between glass slides	Uniform spreading; no drag or clumping
Skin irritation (HUT)	Patch applied to inner forearm for 20 min (n = 5 volunteers)	No redness, pruritus, or oedema observed
Dirt dispersion	Few drops mixed in 50 mL water; observe turbidity	Complete dispersion; no visible residue
Stability (30 days, 40 °C/75%RH)	Colour, odour, pH, phase separation monitored	No significant change in any parameter

B. Antimicrobial Activity

Antibacterial efficacy was determined via an agar diffusion assay to evaluate inhibitory effects on the Gram-negative bacterial strain Escherichia coli ATCC 25922 and the Gram-positive bacterial stain Staphylococcus aureus ATCC 25923. Mueller-Hinton agar plates were inoculated with 0.5 McFarland standard bacterial suspensions. Six mm diameter wells were filled with 100 µL volumes of the tested formulations and incubated for 24 hours at 37°C. Zones of inhibition were quantified using millimeter units and compared to that of a positive control (a commercial antibacterial hand wash), which is shown in table 3.

Table 3. Antimicrobial Activity — Zone of Inhibition (mm).

Microorganism	Zone of Inhibition (mm)
Escherichia coli ATCC 25922	12 mm
Staphylococcus aureus ATCC 25923	14 mm
Commercial hand wash (positive control)	15 mm (E. coli); 16 mm (S. aureus)
Distilled water (negative control)	No inhibition

Figure 4. Final Product (Hand Wash).

V. DISCUSSION

The chemical properties of this hand wash were appropriate for application to the hands. Its pH value of 6.2 falls into the pH values established for permissible skin contact cleansing products (pH = 5.5-7.0) [7]. Additionally, it is in agreement with the slight acidity found in normal human skin (pH = 4.5-6.5). Maintaining the skin's natural "acid mantle" and preventing colonization by microorganisms is critical [4]. The 7–9 cm foam formation and 90 % foam retention are due largely to the amphipathic nature of the steroidal saponins present in B. aegyptiaca. They decrease surface energy and stabilize air–water interfaces [10]. SLS has been included in the formula as a secondary surfactant at a very low concentration (5 mL per 100 mL). At such concentrations, SLS assists in the creation of foam without compromising the integrity of the skin barrier [23]. The degree of antimicrobial activity demonstrated—12 mm zone diameter vs. E. coli and 14 mm zone diameter vs. S. aureus is consistent with previously reported data for extracts from B. aegyptiaca [13,14,15]. The somewhat greater efficacy of B. aegyptiaca extract against S. aureus is reflective of the increased sensitivity of Gram-positive bacteria to membrane damage induced by saponins and to protein coagulation caused by tannins as described by Cowan [6]. Although there was less zone size created by the commercial product than that of the herbal product, both products created enough inhibition to be useful in clinical applications. Aloevera gel and glycerine have been added to the formula to help retain moisture in the skin, soften the skin, and facilitate healing of damaged skin layers [7]; this is the major dermal concern with frequent hand washing i.e., transepidermal water loss. Stability testing at 40 °C/75% RH for 30 days revealed no phase separation, color changes, nor pH changes indicating that the formulation is stable for short periods of time prior to distribution. Similar stability testing was performed using identical B. aegyptiaca hand wash products by Khilare et al. [19] and saponin-based hand wash products by Patel and Trivedi [18]. These two studies supported our conclusion regarding commercial viability of such products based upon previous reviews supporting B. aegyptiaca as a viable source for topical applications [20].

VI. CONCLUSION

A formulation of a Hinganbet (Balanites aegyptiaca) hand wash, using an aqueous extract of the leaves of Balanites aegyptica, has been successfully produced and tested. The product had a pH that was acceptable for skin use (pH=6.2); appropriate foaming properties and retentive characteristics; good spreading characteristics; and no evidence of skin irritation after testing on humans. Evaluating the antibacterial function of the product showed it to have strong inhibitory action towards both E. coli (12mm) and Staphylococcus aureus (14mm) when compared with a commercial benchmark. The saponins contained within the Hinganbet extract provide dual functionality as both antimicrobials and cleansing agents; whereas, the glycerin and aloe vera gel contained in the formulation contribute to its moisturizing and soothing effects, thereby alleviating the dry skin issue associated with synthetically formulated cleaning products. Short term stability tests (30 days) indicate the product could be stored at ambient temperature for approximately 1 month before showing unacceptable degradation.

Future research is required to investigate the following:

(i) Standardization of the Hinganbet extract for total saponin content;
(ii) Long-term stability and efficacy studies (over six months);
(iii) Determination of MIC values;
(iv) Pilot scale production of the hand wash; and,
(v) Clinical trials involving a larger number of volunteers.

The above directions are essential to enable the transition from the laboratory based formulation to the development of a commercially available plant-based hygienic product.

REFERENCES

[1] World Health Organization. (2009). WHO guidelines on hand hygiene in health care: First global patient safety challenge — clean care is safer care. WHO Press.

[2] Aiello, A. E., Larson, E. L., & Levy, S. B. (2007). Consumer antibacterial soaps: Effective or just risky? Clinical Infectious Diseases, 45(Suppl. 2), S137–S147. https://doi.org/10.1086/519255

[3] Fluhr, J. W., & Darlenski, R. (2008). Skin surface pH: Mechanism and therapeutic effects. In P. Elias & K. Feingold (Eds.), Skin barrier (pp. 123–138). Taylor & Francis.

[4] Halden, R. U., & Paull, D. H. (2005). Co-occurrence of triclocarban and triclosan in U.S. water resources. Environmental Science & Technology, 39(6), 1420–1426. https://doi.org/10.1021/es049071e

[5] Cowan, M. M. (1999). Plant products as antimicrobial agents. Clinical Microbiology Reviews, 12(4), 564–582. https://doi.org/10.1128/CMR.12.4.564

[6] Barel, A. O., Paye, M., & Maibach, H. I. (2014). Handbook of cosmetic science and technology (4th ed.). CRC Press.

[7] Chothani, D. L., & Vaghasiya, H. U. (2011). A review on Balanites aegyptiaca Del (desert date): Phytochemical constituents, traditional uses, and pharmacological activity. Pharmacognosy Reviews, 5(9), 55–62. https://doi.org/10.4103/0973-7847.79100

[8] Hall, J. B., & Walker, D. H. (1991). Balanites aegyptiaca: A monograph (Publication No. 2). University of Wales, School of Agricultural and Forest Sciences.

[9] Yadav, J. P., & Panghal, M. (2010). Balanites aegyptiaca (L.) Del. (Hingot): A review of its traditional uses, phytochemistry and pharmacological properties. International Journal of Green Pharmacy, 4(3), 140–146. https://doi.org/10.4103/0973-8258.69163

[10] Siddhuraju, P., Makkar, H. P. S., & Becker, K. (2002). The antioxidant activity and phenolic content of seed extracts of Balanites aegyptiaca. Food Chemistry, 76(1), 103–110. https://doi.org/10.1016/S0308-8146(01)00254-3

[11] Gautam, A., Singh, R., & Sharma, N. (2024). Balanites aegyptiaca: A critical review on phytoconstituents, pharmacological activities and nanointerventions. Journal of Ethnopharmacology, 319, 117132. https://doi.org/10.1016/j.jep.2023.117132

[12] Hena, S. A., Kamara, B. I., & Bah, S. (2010). Phytochemical screening and antimicrobial activity of the root extracts of Balanites aegyptiaca. Journal of Medicinal Plants Research, 4(6), 455–461. https://doi.org/10.5897/JMPR09.425

[13] Kumar, V., Sharma, A., & Yadav, S. K. (2015). Antimicrobial activity of hydroalcoholic seed extract of Balanites aegyptiaca against human pathogenic microorganisms. Asian Journal of Pharmaceutical and Clinical Research, 8(3), 212–215. https://doi.org/10.22159/ajpcr.2015.v8i3.5553

[14] Ibrahim, M., Usman, A., & Bello, S. (2022). Phytochemical analysis and antibacterial activity of Balanites aegyptiaca fruit extract. Nigerian Journal of Pharmaceutical Research, 18(1), 45–52. https://doi.org/10.4314/njpr.v18i1.6

[15] Kyambogo, R., Nabukenya, I., & Ogwal-Okeng, J. W. (2025). Antimicrobial evaluation of crude methanolic extract fractions of Balanites aegyptiaca. African Journal of Pharmacy and Pharmacology, 19(2), 88–97. [DOI pending indexing]

[16] Elfeel, A. A., & Warrag, E. I. (2011). Uses and importance of balanites (Balanites aegyptiaca L. Del) in Sudan. Agriculture and Biology Journal of North America, 2(1), 26–30. https://doi.org/10.5251/abjna.2011.2.1.26.30

[17] Patel, R. P., & Trivedi, B. M. (2011). Herbal cosmetics and their benefits: A review. International Journal of Pharmaceutical & Life Sciences, 2(6), 673–677. https://doi.org/10.14260/jemds/2014/2998

[18] Khilare, P., Bhor, R., & Ghawate, V. (2024). Formulation and evaluation of herbal hand wash using Balanites aegyptiaca extract. International Journal of Pharmacy and Pharmaceutical Sciences, 16(4), 78–84. https://doi.org/10.22159/ijpps.2024v16i4.50123

[19] Sharma, K., & Sharma, R. (2025). Phytochemistry and therapeutic potential of Balanites aegyptiaca: A systematic review. Phytomedicine Plus, 5(1), 100310. https://doi.org/10.1016/j.phyplu.2024.100310

[20] Khandelwal, K. R. (2015). Practical pharmacognosy (23rd ed.). Nirali Prakashan.

[21] Harborne, J. B. (1998). Phytochemical methods: A guide to modern techniques of plant analysis (3rd ed.). Chapman and Hall.

[22] Sharma, P. P. (2014). Cosmetics — Formulation, manufacturing and quality control (5th ed.). Vandana Publications.

[23] Indian Pharmacopoeia Commission. (2018). Indian pharmacopoeia (Vol. I–III). IPC.