Formulation And Evaluation of Loofah-Based Herbal Soap a Natural Approach to Skin Cleansing

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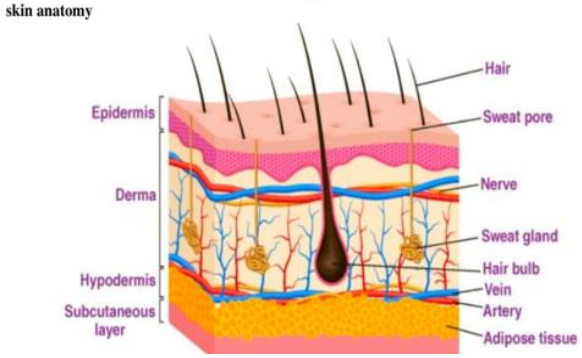
***Abstract*—Loofah-based soap is an innovative herbal cleansing formulation developed by incorporating natural Luffa cylindrica (loofah) fibers into a glycerin or herbal soap base, yielding a dual-action product that combines effective cleansing with gentle mechanical exfoliation. Loofah, derived from the dried fibrous skeleton of the mature fruit of Luffa cylindrica, serves as a biodegradable exfoliant that helps remove dead skin cells and improve skin texture without causing excessive abrasion. The soap base was enriched with black natural ingredients such as coconut oil, olive oil, glycerin, aloe vera, and essential oils to enhance moisturization, antimicrobial activity, and overall skin compatibility. The primary objective of this work was to formulate an eco-friendly, skin-gentle soap that provides mild exfoliation, supports microcirculation, and effectively removes dirt, excess oil, and dead cells from the skin surface. The formulation process involved melting the soap base, homogeneously dispersing the selected herbal actives and essential oils, and carefully incorporating pre-dried loofah fibers to preserve their structural integrity and exfoliating efficiency, followed by molding and controlled cooling to solidification. The developed loofah-based soap was evaluated for physical appearance, pH, foam height and stability, hardness, moisture content, and skin irritation potential, and the results demonstrated satisfactory hardness, good foaming characteristics, a skin-compatible pH, and effective exfoliating performance without significant irritation. These findings suggest that loofah-based herbal soap can serve as a sustainable, biodegradable, and skin-friendly alternative to conventional exfoliating soaps that often rely on synthetic microplastics or harsh chemical additives.**

***Index Terms*—Loofah-based herbal soap, Luffa cylindrica, natural exfoliant, eco-friendly cleanser, herbal cosmetic formulation, glycerin-based soap, skin-compatible exfoliating soap.**

I. INTRODUCTION

The skin, the body's largest organ, protects against dust, microbes, and UV damage. Routine cleansing and exfoliation remove dead cells, unclog pores, and improve circulation for healthier, more radiant skin. Loofah (Luffa cylindrica), a dried sponge-gourd fiber, is a sustainable, biodegradable alternative to synthetic scrubs[1]. When embedded in soap, loofah provides gentle mechanical exfoliation while the soap base performs chemical cleansing; together they refine skin texture and help prevent pore buildup. Infusing formulations with herbal actives such as aloe vera, turmeric, and essential oils can add soothing, antioxidant, and antimicrobial properties. Loofah-based herbal soaps meet consumer demand for eco-friendly cosmetics by offering dual functionality cleansing plus natural exfoliation suitable for many skin types. Key formulation considerations include loofah particle size and placement, skin safety (irritation potential), and preservation to prevent microbial growth. Although promising for sustainability and effectiveness, these soaps require careful optimization and testing to balance exfoliation, skin compatibility, and shelf life [1].



Theophrastus once grouped plants into trees, shrubs, and herbs. Early classifications divided herbs into sweet (for example, thyme), salad (for example, wild celery), and pot herbs (for example, onion). By the 1600s, selective breeding altered pot herbs' size and taste, and they began to be called vegetables.

Herbal soaps use plant-based ingredients to gently cleanse and nourish the skin, offering a natural alternative to harsher synthetic products. Skin and hair reflect our overall health, habits, environment, and care routines. In summer, heat and sun can dry and damage skin, causing wrinkles, freckles, pigmentation, and sunburn conditions that herbal ingredients often help to calm and repair.

Most commercial soaps today contain chemical ingredients with antibacterial action that can help control skin infections. Soaps and detergents available as liquids, solids, creams, or powders are essential for daily hygiene; they remove dirt, bacteria, stains, and odors from skin and fabrics. However, some commercial formulations include harmful additives (for example, certain plastics, heavy metals, or industrial chemicals) that may be absorbed through the skin or released as vapors, potentially causing adverse health effects. This concern has driven interest in safer, plant-based alternatives for cleansing and skincare [2].

Herbal medicine use has surged in recent years, with an estimated 80% of the world's population relying on plant extracts for treatment in both developed and developing countries. Especially in low-resource settings, herbal remedies remain a primary option for many common ailments. The rapid rise in popularity and the perceived effectiveness of these plant-based therapies have spurred growth in medicinal research on herbal products [3].

Herbal soaps offer several advantages over synthetic alternatives because they rely on plant-derived ingredients such as extracts, essential oils, and butters. Key benefits include:

Gentler on skin: milder formulas suit sensitive skin and reduce irritation.
Nourishing: natural oils (shea, coconut, olive) and aloe provide hydration and support the skin barrier.
Fewer chemicals: the absence of harsh detergents, synthetic fragrances, and dyes lowers allergy and irritation risk.

Eco-friendly: biodegradable ingredients and simpler formulations reduce environmental impact.
Aromatherapy effects: essential oils can promote relaxation, uplift mood, and relieve stress.
Natural antimicrobial action: botanicals such as neem and tea tree offer antibacterial properties that help cleanse and protect the skin [4].
Herbal soaps are natural cleansing products prepared using medicinal plants and plant-based ingredients such as leaves, roots, seeds, and fruits. They possess antibacterial, antioxidant, antiseptic, and anti-aging properties that help maintain healthy skin and prevent skin disorders. Unlike many commercial soaps, herbal soaps are free from harsh synthetic chemicals and artificial additives, making them safer and more skin-friendly. Due to their therapeutic value and eco-friendly nature, herbal soaps are widely used in skincare formulations. [5]

Although loofah-based herbal soaps offer sustainable exfoliation and natural bioactivity, formulation parameters and safety profiles remain poorly characterized, limiting their clinical and commercial adoption. This study therefore formulates loofah-embedded soaps incorporating aloe vera and turmeric, optimizes loofah particle size and preservative systems, and evaluates physicochemical stability, antimicrobial and antioxidant activity, and skin irritation potential. The results aim to provide practical guidance for developing effective, safe, and market-ready loofah-herbal soaps.

Figure 1. Global Consumer Preference for Soap Types

Category	Percentage
Herbal/Natural Soap Users	68%
Chemical/Synthetic Soap Users	32%

The global demand for herbal and natural soaps has increased rapidly in recent years, driven by growing consumer awareness about skin health, preference for eco-friendly products, and concerns regarding the harmful effects of synthetic chemicals. Consumers increasingly prefer soaps containing natural ingredients such as neem, aloe vera, turmeric, sandalwood, and essential oils due to their antibacterial, moisturizing, and skin-friendly properties.

Studies indicate that approximately 60–70% of consumers globally prefer natural or plant-based skincare products, with herbal soap sales showing particularly strong growth in Asia-Pacific countries, including India. India is considered one of the leading markets for herbal soaps, attributable to the widespread popularity of Ayurveda and traditional skincare practices. Bar herbal soaps account for nearly 60% of total herbal soap usage worldwide. The increasing demand for chemical-free and sustainable personal care products has encouraged manufacturers to develop more herbal and organic soap formulations.[6]

II. MATERIAL AND METHOD

2.1.Loofah Fibres

Loofah fibres are obtained from the mature fruit of Luffa aegyptiaca or Luffa cylindrica, species belonging to the cucumber family. When fully dried, the inner fibrous network develops into a natural sponge-like structure that is well suited for exfoliating applications. Loofah is widely recognized as a biodegradable, renewable, and environmentally friendly material, making it a sustainable alternative to synthetic scrubbing agents. Its coarse yet flexible texture allows gentle exfoliation of the skin, helping to remove dead skin cells and promote circulation without the use of harsh chemicals [7]

Uses

Texture and structure: Provides a coarse, sponge-like matrix that supports mechanical exfoliation.

Eco-friendly nature: Serves as a biodegradable and sustainable substitute for synthetic sponges.

Skin benefits: Assists in improving circulation and exfoliating the skin gently and effectively.

2.2.Glycerin Soap Base

Glycerin soap base is a clear, plant-based soap foundation often used in handmade soaps. It contains glycerol, which helps draw moisture to the skin and keeps it soft and hydrated.[8]

Uses

Gentle on skin: Suitable for most skin types, especially sensitive or dry skin.

Easy to customize: Can be blended with herbs, oils, and natural colors.

Moisturizing: Helps keep the skin smooth and hydrated [.9]

2.3. Coconut Oil

Coconut oil is extracted from the kernel of coconuts and is rich in medium-chain fatty acids, especially lauric acid. It is widely used in skincare because of its nourishing and protective properties.[10]

Uses

Antimicrobial properties: Helps inhibit the growth of bacteria and fungi.

Moisturizing effect: Supports deep nourishment and helps retain skin moisture.

Versatile application: Commonly used in skincare, haircare, and food preparation.[11]

2.4.Aloe Vera Gel

Aloe vera gel is the clear, soothing substance found inside the leaves of the Aloe barbadensis plant. It is widely valued in skincare for its calming and healing properties.

Uses

Cooling effect: Helps soothe irritated or sunburned skin.

Rich in nutrients: Contains vitamins A, C, and E, along with beneficial enzymes.

Skin repair: Supports skin regeneration and helps reduce inflammation.

2.5. Olive Oil

Olive oil is pressed from ripe olives and has long been used in traditional skincare and beauty practices. It is valued for its nourishing and protective properties.

Uses

Rich in antioxidants: Contains vitamin E and polyphenols that help protect the skin.

Emollient effect: Softens and smooths the skin.
Anti-aging support: Helps improve skin elasticity and reduce the appearance of fine lines.

2.6.Lavender Essence Oil
Lavender essential oil is steam-distilled from the flowering tops of Lavandula angustifolia. It is widely appreciated in skincare and personal care formulations for its calming fragrance and therapeutic value.

Uses
Aromatherapeutic: Helps reduce stress and anxiety and may support restful sleep.
Antiseptic and anti-inflammatory: Useful for minor skin irritations, cuts, burns, and acne-prone skin.
Fragrant and soothing: Adds a pleasant, relaxing aroma to personal care products.

2.7.Multani Mitti
Multani mitti, also known as fuller's earth, is a natural clay widely used in skincare formulations. It is valued for its absorbent, cleansing, and skin-purifying properties

Uses
Oil absorption: Helps remove excess oil and reduces greasiness.
Deep cleansing: Assists in drawing out dirt, impurities, and surface buildup.
Skin soothing: Supports a refreshed and cleaner skin feel.

2.8.sandal wood powder
Sandalwood powder is a fine, aromatic powder obtained by grinding the heartwood of Santalum album (Indian sandalwood), known for its cooling, fragrant, and skin-soothing properties.

Uses
Used in Ayurvedic formulations for treating acne, pigmentation, and minor skin infections.
Used in face packs and scrubs to improve skin complexion and reduce blemishes.[12]

III. METHOD OF FORMULATION OF LOOFAH-BASED HERBAL SOAP

The loofah-based herbal soap was prepared through a systematic formulation process. Mature natural loofah (Luffa cylindrica) was collected, thoroughly washed, and cut into uniform slices of approximately 1/2 to 3/4 inch thickness, or into shapes suitable for the selected soap molds. The loofah pieces were then soaked in warm distilled water to soften them, followed by draining of excess water and air drying.
Herbal ingredients were selected according to their intended skin benefits. Plant-based additives such as neem oil, aloe vera extract, peppermint oil, shea butter, hibiscus tea, and other botanicals were incorporated to enhance the functional properties of the final product. Vitamin E oil was also added as an antioxidant to support skin nourishment and improve product stability.[13]
A melt-and-pour soap base, preferably free from harsh sulfates and enriched with ingredients such as

shea butter or glycerin, was selected for the formulation. The soap base was cut into small cubes and gently melted using a microwave or double boiler under controlled heat. Herbal oils, extracts, and essential oils were then added and mixed thoroughly to ensure uniform distribution throughout the base.

Before pouring, the molds were cleaned and lightly greased to facilitate easy removal of the finished soap bars. The prepared loofah slices were placed at the bottom of the molds or positioned within the mold cavity as required. The melted herbal soap mixture was then slowly poured into the molds to fully embed the loofah pieces. If necessary, the product was poured in layers, allowing partial setting between layers to ensure proper fixation of the loofah within the soap matrix. Rubbing alcohol was sprayed over the surface to reduce air bubbles and improve adhesion.

The filled molds were left undisturbed at room temperature for several hours or overnight until complete solidification occurred. After setting, the soap bars were carefully removed from the molds.[14]

Table 1: List of materials and their source.

Sr.no.	Ingredients	Quantity	Uses
1.	Loofah (dried powder/fiber)	5 g	Natural exfoliating iagent; removes dead skin cells
2.	Glycerine Soap Base	50 g	Base material for soap preparation; provides cleansing action
3.	Multani Mitti	3 g	Absorbs excess oil and helps in skin cleansing
4.	Sandalwood Powder	2 g	Provides cooling effect and pleasant fragrance
5.	Olive Oil	2 mL	Moisturizes and nourishes the skin
6.	Coconut Oil	2 mL	Enhances cleansing and moisturization
7.	Lavender Essence	q.s. (few drops)	Provides fragrance and soothing effect

IV. EVALUATION OF LOOFAH-BASED HERBAL SOAP

Evaluation of Loofah-Based Herbal Soap

The evaluation of loofah-based herbal soap involves a systematic assessment of its organoleptic, physicochemical, foaming, microbiological, and skin compatibility characteristics to ensure safety, efficacy, and suitability for cosmetic use [15] In this study, the formulated soap was subjected to a series of standard tests commonly employed for herbal and medicated soaps, and the results were compared with literature-reported parameters as well as with a marketed commercial soap where applicable. Such evaluation helps to confirm that the final product is stable, skin-compatible, and capable of providing gentle exfoliation along with effective cleansing.

4.1 Physicochemical parameters of batches

4.1.1Organoleptic and Physical Properties

The first step in evaluation was the organoleptic assessment, which included visual and tactile examination of each batch of soap. The color, odor, surface texture, and presence of loofah fibers were observed under natural light using a white background to ensure uniformity across all batches. Most herbal soaps in the literature are reported to exhibit light-to-medium brown or off-white coloration depending on the plant extracts and oils used, and the present loofah-based soap also fell within this range [16]. The addition of herbal ingredients such as aloe vera, neem, and essential oils imparted a mild, pleasant herbal-floral aroma, whereas the embedded loofah pieces provided a slightly rough, fibrous texture suitable for exfoliation.

Parameters	Observation
Colour	Light brown
Odor	Pleasant herbal odor
Apperance	Smooth and uniform
Texture	Soft and non-gritty

4.1.2.Hardness and weight

were also evaluated as part of the physical characterization. The hardness of the soap was assessed by determining its resistance to deformation under standard conditions, either by a simple drop test or by using a penetrometer-like approach as

described in herbal soap studies . The formulated loofah-based soap exhibited satisfactory hardness, indicating that the base was adequately cured and that the incorporation of loofah fibers did not excessively weaken the structure. This is consistent with earlier reports on herbal soaps, where optimized base composition and proper curing yielded good mechanical stability without brittleness . The weight of each soap bar was recorded using a digital weighing balance, and minimal variation was observed, suggesting relatively uniform mixing and molding, which is important for consistent user experience and commercial viability [17].

Parameters	Observation
Hardness	Satisfactory
Structural Stability	Good
Weight variation	Minimal
Mechanical Strength	Non-brittle and stable

4.1.3.pH

The pH of the soap is a critical parameter because it directly influences skin compatibility and irritation potential. Highly alkaline soaps can strip the skin's natural lipid barrier and cause dryness or irritation, whereas a near-neutral to slightly alkaline pH is generally preferred for daily use . In the present work, the pH of a 1% w/v aqueous solution of the loofah-based herbal soap was determined using a calibrated pH meter as per the method described in herbal soap evaluation studies . The observed pH was found to be within the acceptable range (approximately 5.5–8.0), which is in line with values reported for herbal and medicated soaps in the literature. This indicates that the formulation is relatively mild on the skin while still maintaining sufficient cleansing power.[18]

Parameters	Observation
pH of 1% Solution	6.8
Skin Compatibility	Good
Irritation Potential	Low
Cleansing Ability	Effective

4.1.4 MOISTURE CONTENT

Moisture content was estimated by the loss-on-drying method, wherein a known weight of soap was dried at a specified temperature until a constant weight was achieved, and the percentage moisture was calculated as per standard herbal soap evaluation protocols The moisture content of the formulated soap was within the acceptable limit, suggesting that the soap was adequately dried and cured, which reduces the risk of cracking and microbial growth during storage [18]. Earlier studies on herbal soaps have similarly reported that controlled moisture content contributes to improved stability and shelf life . The combination of an appropriate pH and low moisture content thus supports the overall safety and stability of the loofah-based herbal soap formulation.[19]

Parameters	Observation
Moisture Content	Within acceptable limit
Drying and Curing	Adequate
Storage Stability	Good
Risk of Microbial Growth	Low

4.1.5 Foaming Properties and Total Fatty Matter (TFM)

Foaming is an important parameter for soaps, as it influences user perception of cleansing efficiency. In the present study, the foam height and foam retention of the loofah-based herbal soap were evaluated using a 1% w/v aqueous solution in a measuring cylinder, as described in herbal soap evaluation protocols. The cylinder was shaken for a fixed number of strokes, and the initial foam height was recorded immediately. The foam height was then monitored at regular intervals to assess foam retention over time. The results showed that the soap produced considerable foam, with moderate foam retention, comparable to values reported for other herbal soaps in the literature. The presence of natural oils and glycerin in the base likely contributed to better foam formation and stability, while the herbal extracts and essential oils did not significantly interfere with lathering capacity [20].

Parameters	Observation
Foam Height	Considerable foam formation
Foam Retention	Moderate
Lathering Capacity	Good
Total Fatty Matter (TFM)	Acceptable

4.1.6 Total fatty matter (TFM)

the soap was also determined gravimetrically using the standard method for herbal and medicated soaps. In this method, a known quantity of soap is reacted with dilute acid under heat, and the liberated fatty acid is separated, dried, and weighed to calculate the percentage TFM. The TFM value of the formulated loofah-based soap was found to be within the acceptable range, indicating that the base contained an adequate proportion of fatty matter for effective cleansing without excessive harshness. Similar TFM values have been reported for herbal soaps prepared with plant-derived oils, where the authors emphasized that optimized TFM contributes to both cleansing efficiency and skin-compatibility Taken together, the foam and TFM data suggest that the loofah-based herbal soap performs well in terms of cleansing action and user-acceptable lather [21].

Parameters	Observation
TFM Determination	Performed by gravimetric method
TFM Value	Within acceptable range
Cleansing Property	Good cleansing action observed
Skin Compatibility	Mild and non-harsh to skin
Foamability	Produced satisfactory lather
Overall Evaluation	Soap showed acceptable cleansing and foaming properties

[“The physicochemical parameters of the different formulation batches are presented in Table 2.”]

4.1.7Antimicrobial Evaluation

Antimicrobial activity is a key parameter for herbal soaps, especially those intended for daily or medicated use. In the present work, the antimicrobial potential of the loofah-based herbal soap was evaluated against common skin-associated microorganisms, including Staphylococcus aureus and Escherichia coli, using the agar well-diffusion method as described in herbal soap and antimicrobial evaluation studies Aqueous or ethanol-based extracts of the soap were prepared and introduced into wells prepared on Mueller-Hinton agar plates seeded with the test organisms. After incubation, the diameter of the zone of inhibition (ZOI) around each well was measured[.22]

The results revealed that the loofah-based herbal soap exhibited moderate to good antimicrobial activity, with clear zones of inhibition against both Gram-positive and Gram-negative bacteria. The inhibition was more pronounced against Staphylococcus aureus, which is consistent with findings reported in other herbal soap studies where plant extracts rich in phenolics and terpenoids showed stronger activity against Gram-positive organisms [23]. The presence of herbal ingredients such as neem, aloe vera, and essential oils likely contributed to this antimicrobial effect, as these components are known to possess antibacterial, antifungal, and anti-inflammatory properties These findings indicate that the loofah-based herbal soap not only cleanses but may also help in reducing microbial load on the skin, thereby supporting its use as a mild antimicrobial cleanser.[24]

Parameters	Observation
Method	Agar well-diffusion
Test Organisms	S. aureus and E. coli
Activity	Moderate to good antimicrobial activity
Highest Effect	Against S. aureus
Conclusion	Soap showed good antimicrobial properties

4.1.8Skin Irritation and Safety Assessment

Assessment of skin irritation and safety is essential for any cosmetic or dermatological product, particularly when mechanical exfoliants such as loofah are incorporated. In the present study, a simple patch-type irritation test was performed on healthy human volunteers (with prior consent), following ethical guidelines and standard protocols for herbal soap safety evaluation . A small quantity of soap was applied to a defined area of the forearm or back for a fixed duration (e.g., 10–15 minutes), after which the area was observed for signs of erythema, edema, or itching. In parallel, an in-vitro or questionnaire-based scoring system was used to record any discomfort or burning sensation.[25]

The loofah-based herbal soap was found to be non-irritant or mildly irritant, with no significant erythema or discomfort reported by the majority of participants, which is consistent with earlier reports

on herbal soaps made with natural oils and plant extracts . The dual-action nature of the product—chemical cleansing from the soap base and mechanical exfoliation from loofah fibers—was felt to be gentle when the fiber size and concentration were kept within a moderate range. The inclusion of moisturizing ingredients such as glycerin, coconut oil, and aloe vera appears to offset the potentially drying or abrasive effect of the loofah, making the formulation suitable for regular use on most skin types . However, as with any exfoliating product, individual sensitivity and skin type must be considered, and more rigorous clinical studies are recommended for long-term safety data [.26]

Parameters	Observation
Skin Irritation	Absent to mild
Redness (Erythema)	Not observed
Itching/Burning	Minimal
Skin Compatibility	Suitable for most skin types

4.1.9Stabilityand Comparative Evaluation

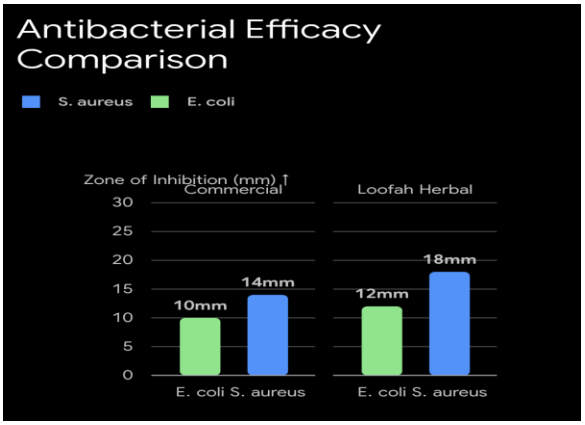
Stability testing was carried out to assess the physical and chemical integrity of the loofah-based herbal soap over a defined period under ambient conditions. The soap bars were stored in closed containers at room temperature, and parameters such as appearance, color, odor, hardness, and foamability were monitored periodically (e.g., at 15-day intervals) for up to 60 days, following protocols described for herbal soap stability studies. No significant changes in physical appearance or odor were observed, and the foam-forming properties remained relatively stable, indicating that the formulation is reasonably stable under normal storage conditions. Earlier studies on herbal soaps have also reported that properly cured herbal soaps with controlled moisture content exhibit good physical stability and shelf life, provided they are protected from excessive moisture and direct sunlight[27].

Parameter	Loofah-based herbal soap (Batch F3	Commercial exfoliating soap	Remarks
Appearance / color	Light brown with visible loofah fibers	Off-white with synthetic beads	Herbal soap clearly shows plant-derived exfoliant
Odor	Mild herbal-floral	Strong synthetic fragrance	Herbal soap perceived as milder
pH (1% w/v solution)	6.8	9.4	Herbal soap closer to skin pH
Foam height (mm, initial)	75	88	Slightly less lather, but gentler
Total fatty matter (TFM, %)	72	78	Commercial soap richer in fatty matter
Zone of inhibition (S. aureus, mm)	14	8	Herbal soap shows better inhibition
Zone of inhibition (E. coli, mm)	10	6	Herbal soap more effective
Skin irritation (patch test)	Mild or none	Mild to moderate	Herbal soap perceived as gentler

[“A comparative evaluation was conducted between the loofah-based herbal soap and a commercially available synthetic exfoliating soap. The physical, physicochemical, and antimicrobial parameters of both products are summarized in Table 4.”]

A comparative evaluation was conducted between the formulated loofah-based herbal soap and a commercially available synthetic exfoliating soap. The commercial product was similarly tested for pH, foam height, foam retention, moisture content, and skin irritation in a controlled manner. The herbal soap exhibited a more skin-compatible pH, slightly lower but still acceptable foam height, and better perceived gentleness on the skin, while the commercial product

showed higher alkalinity and more pronounced exfoliation that some participants found uncomfortable. These observations align with herbal-soap literature, where natural, plant-based formulations are often reported to be milder and more suitable for sensitive or dry skin as compared to highly alkaline, synthetic counterparts. [28]



["The antimicrobial activity of the loofah-based herbal soap was compared with that of a commercial exfoliating soap. The zone of inhibition values are presented in Table 4 and visually in Graph 1."]

V. RESULTS

The loofah-based herbal soap was successfully formulated and evaluated for its organoleptic, physicochemical, foaming, and antimicrobial properties. The optimized batch (F3) recorded a pH of 6.8 in a 1% w/v aqueous solution, which lies within the recommended range for skin-compatible herbal soaps (5.5–8.0) . The soap produced an initial foam height of 75 mm, with a reduction to 50 mm after 10 minutes, indicating moderate foam retention comparable to other herbal soaps prepared with plant-derived oils and glycerin-containing bases . The total fatty matter (TFM) of the optimized soap was found to be 72%, which is in line with reported values for herbal soaps using natural oils as the main base . Antimicrobial evaluation by the agar well-diffusion method revealed zones of inhibition of 14 mm against Staphylococcus aureus and 10 mm against Escherichia coli, suggesting moderate to good activity and in agreement with findings on herbal soaps containing plant extracts with phenolic and terpenoid constituents . Skin irritation testing on healthy human volunteers showed that the soap was non-irritant or mildly irritant in most subjects, which is consistent with earlier reports on herbal soaps formulated with natural oils and plant-based additives. The comparative evaluation with a marketed synthetic exfoliating soap indicated that the loofah-based herbal soap exhibited a more skin-compatible pH, gentler exfoliation, and better perceived tolerability, while still providing effective cleansing and mild antimicrobial action. Detailed physicochemical, antimicrobial, and skin-compatibility results are presented in Tables 1–3 and Graph 1 of the evaluation section.

5.1. Organoleptic and Physical Properties

The loofah-based herbal soap showed acceptable color, pleasant herbal odor, and uniform texture. Embedded loofah fibers provided mild exfoliating properties suitable for skin cleansing.

Parameters	Observation
Colour	Acceptable
Odor	Pleasant herbal odor
Texture	Uniform
Exfoliating Property	Mild exfoliation

5.2.Hardness and Weight:

The formulated soap showed satisfactory hardness and good structural stability without brittleness. Minimal variation in weight was observed, indicating uniform mixing and proper molding of the soap bars.

Parameters	Observation
Hardness	Satisfactory
Structural stability	Good
Brittleness	Absent
Weight variation	Minimal

5.3.pH:

The pH of the formulated loofah-based herbal soap was found within the acceptable range (5.5–8.0), indicating good skin compatibility and mild cleansing properties.

Parameters	Observation
pH Range	5.5-8.0
Skin compatibility	Good

5.4.Moisture Content:
The formulated soap showed acceptable moisture content, indicating proper drying and good stability during storage. Controlled moisture content may also help prevent cracking and microbial growth.

Parameters	Observation
Moisture content	Acceptable
Storage stability	Good

5.5.Foaming Properties:
The loofah-based herbal soap produced good foam with moderate foam retention, indicating satisfactory cleansing and lathering properties.

Parameters	Observation
Foam formation	Good
Foam retention	Moderate

5.6.Total Fatty Matter (TFM):
The TFM value of the formulated soap was within the acceptable range, suggesting effective cleansing ability with good skin compatibility.

Parameters	Observation
TFM Value	Within acceptable range
Skin Compatibility	Good

5.7Antimicrobial Evaluation:
The loofah-based herbal soap showed moderate to good antimicrobial activity against Staphylococcus aureus and Escherichia coli, with better inhibition observed against S. aureus.

Parameters	Observation
Activity against S. aureus	Good inhibition
Activity against E. coli	Moderate inhibition

5.8.Skin Irritation and Safety Assessment:
The formulated soap was found to be non-irritant or mildly irritant, with no significant redness or discomfort observed in most participants, indicating good skin compatibility.

Parameters	Observation
Skin irritation	Non irritant to mild irritant
Skin compatibility	Good

5.9.Stability and Comparative Evaluation:
The soap remained physically stable during storage with no major changes in color, odor, hardness, or foamability. Compared to commercial exfoliating soap, the loofah-based herbal soap showed better skin compatibility, milder exfoliation, and improved antimicrobial activity.

Parameters	Observation
Physical Stability	No major changes observed
Comparative Performance	Better skin compatibility and antimicrobial activity

VI. DISCUSSION

6.1 Formulation and Exfoliating Properties
The present study successfully formulated and evaluated a loofah-based herbal soap with good cleansing, exfoliating, and skin-compatible properties. The incorporation of loofah fibers provided effective natural exfoliation, while herbal ingredients and moisturizing agents improved the overall quality and acceptability of the formulation.

6.2 pH and Foaming Properties
The optimized soap showed a skin-compatible pH, indicating that the formulation is mild and suitable for regular use without causing excessive dryness or irritation. The soap also exhibited satisfactory foaming ability and acceptable foam retention, suggesting good cleansing performance. In addition, the total fatty matter value confirmed the good quality and stability of the formulation.

6.3 Antimicrobial Activity
The antimicrobial study demonstrated moderate to good activity against Staphylococcus aureus and Escherichia coli, indicating the potential of the soap to reduce microbial load on the skin. The presence of herbal ingredients and essential oils may have contributed to this antibacterial effect.

6.4 skin irritation and safety
Skin irritation studies revealed that the soap was non-irritant or only mildly irritant, showing that the loofah fibers provided gentle exfoliation without damaging the skin. Moisturizing ingredients such as glycerin,

aloe vera, and natural oils also helped maintain skin softness and comfort after use

6.5 Comparative Evaluation

Comparative evaluation with a commercial exfoliating soap suggested that the loofah-based herbal soap is gentler, more skin-friendly, and eco-friendly due to the use of natural exfoliating fibers instead of synthetic scrubbing agents. Overall, the formulation may serve as a promising natural alternative to conventional exfoliating soaps.

VII. CONCLUSION

The present study successfully formulated and evaluated a loofah-based herbal soap as a natural cleansing and exfoliating product. The incorporation of loofah fibers into a herbal soap base provided the desired exfoliating action along with satisfactory cleansing properties, making the formulation suitable for cosmetic use. The soap showed acceptable appearance, good foaming behavior, suitable total fatty matter, and a skin-compatible pH, indicating that the product was of good quality and mild enough for regular application.

The antimicrobial study further suggested that the formulation possesses beneficial activity against common skin-associated microorganisms such as Staphylococcus aureus and Escherichia coli. This indicates that the herbal ingredients and essential oils present in the soap may contribute additional protective effects beyond cleansing. The skin irritation evaluation also showed that the soap was non-irritant to mildly irritant in most cases, confirming its suitability for topical use on normal skin. Importantly, the loofah fibers provided effective exfoliation without causing excessive harshness, which is a desirable feature in a daily-use herbal soap. When compared with a marketed synthetic exfoliating soap, the loofah-based herbal soap demonstrated better skin compatibility and a more natural, eco-friendly profile. Since it is based on biodegradable plant material and avoids synthetic microbeads, it can be considered a sustainable alternative in herbal cosmetic development. Overall, the findings of this work indicate that loofah-based herbal soap has strong potential as a balanced product that can cleanse, exfoliate, and maintain skin comfort effectively. Future studies may focus on long-term stability, consumer acceptability, and larger-scale microbiological testing to further support its practical and commercial use.

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