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A Polyherbal Approach to Hair Care: Development and Evaluation of a Solid Shampoo Bar

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Abstract: The increasing demand for natural and eco-friendly hair care products has led to the development of herbal-based alternatives to conventional shampoos and conditioners. In ancient times, natural extracts and resources were widely used for health care and cosmetic purposes. In line with this tradition, there has been a tremendous increase in consumer demand for natural ingredients and additives—especially in cosmetic products—as replacements for synthetic compounds. This study focuses on the formulation and evaluation of a polyherbal solid shampoo bar using key herbal ingredients such as Emblicaofficinalis (Amla), Sapindusmukorossi (Soapnut), Hibiscus rosa-sinensis (Hibiscus), and Aloe vera, along with a minimal number of natural excipients. The formulation aims to provide effective cleansing, conditioning, and nourishment with fewer ingredients, making it cost-effective and environmentally sustainable. The prepared shampoo bar was evaluated for physicochemical properties including pH, foamability, cleansing efficiency, hardness, and stability. The results indicated that the simplified formulation exhibited good lathering capacity, acceptable pH suitable for scalp application, and stability under various storage conditions. This study suggests that a reduced-ingredient herbal shampoo bar can serve as an effective, safe, and sustainable alternative to conventional hair care products.

Keywords: *Herbal Cosmetics, Emblicaofficinalis, Sapindusmukorossi, and Shampoo Bar etc.*

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I. INTRODUCTION

Hair plays a significant role in personal grooming and self-perception. Beyond appearance, a person's hair condition frequently indicates their overall cleanliness and health. Healthy hair and a clean, well-maintained scalp boost self-esteem and have a good impact on both personal and professional relationships. As hair is highly visible, changes in its condition—such as thinning, greying, or loss—can lead to psychological stress, low self-esteem, and social withdrawal [1, 2].

Hair is primarily composed of keratin, which is a fibrous structural protein, consists of three main parts as follows: the cuticle (outermost protective layer), cortex (middle layer rich in melanin and structural integrity), and medulla (innermost, often hollow layer) [3]. The hair shaft emerges from the follicle, is embedded in the dermis of the scalp. Proper nourishment, hydration, and scalp care are essential for maintaining healthy hair growth as well as its appearance.

Various factors can influence hair health, including genetics, hormonal imbalances, environmental pollutants, aging, nutritional deficiencies, and stress [4, 5]. Common hair-related disorders include alopecia (hair loss), dandruff (seborrheic dermatitis), scalp psoriasis, and hair shaft abnormalities like breakage or split ends [6]. A recent study published in the Journal of Dermatological Reviews reported that 30% of males and 27% of females aged 18–30 in India experienced hair loss severe enough to impact their social lives, causing feelings of embarrassment, frustration, and isolation [7].

In daily hygiene routines, shampoos and conditioners are essential for scalp cleansing and hair healthy maintenance. Shampoos are surfactant-based formulations which are designed to remove excess sebum, dirt, environmental contaminants, and styling residues from the scalp and hair [8]. Conditioners are typically used post-cleansing to improve the hair’s softness, reduce static, enhance manageability, and minimize damage during combing [9]. However, most commercial hair care products contain synthetic surfactants like sodium laurel sulphate (SLS), preservatives (parabens), and silicones, which can strip the hair’s natural oils, disrupt scalp balance, and contribute to long-term damage or allergic reactions [10].

Along with growing awareness about the adverse effects of synthetic chemicals and the need for sustainable

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alternatives, there is an increasing consumer demand for herbal, eco-friendly hair care products [11]. Natural ingredients like Emblicaofficinalis (Amla), Sapindusmukorossi (Soapnut), Hibiscus rosa-sinensis (Hibiscus), and Aloe vera have long been used in traditional medicine for promoting hair health, preventing dandruff, and enhancing hair growth [12,13]. These botanicals are rich in bioactive compounds such as flavonoids, tannins, saponins, and mucilage, offering cleansing, conditioning, antimicrobial, and antioxidant properties [14].

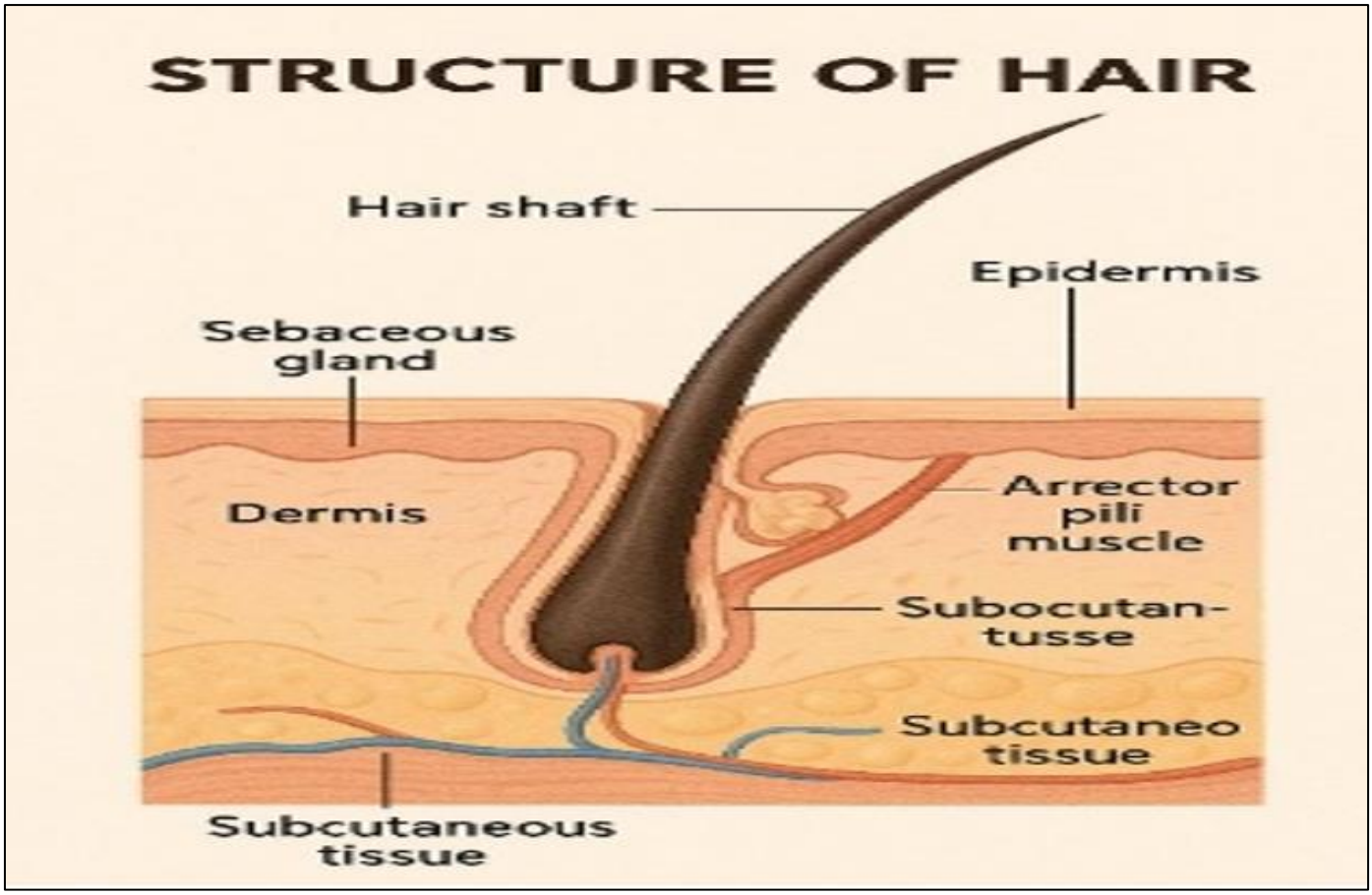

Fig 1 Structure of Hair

Solid shampoo bars have emerged as a popular alternative to conventional liquid shampoos, offering benefits such as concentrated formulation, reduced packaging waste, improved shelf-life, and portability [15]. When formulated with herbal ingredients, these bars offer a synergistic combination of cleansing and conditioning properties while aligning with the principles of green chemistry and sustainable living [16].

II. AIMS AND OBJECTIVES

The primary aim of this study is to formulate and evaluate a polyherbal solid shampoo bar using traditional herbal ingredients known for their hair cleansing and conditioning properties.

➢ *The Objectives Include:*

- To develop a stable, eco-friendly solid shampoo bar incorporating selected herbal extracts.
- To evaluate its physicochemical properties such as pH, foamability, cleansing efficiency, hardness, and stability.
- To assess its safety and effectiveness for routine hair care.

III. MATERIALS AND METHODS

➢ *Collection of Materials:*

The ingredients used in the formulation of the polyherbal solid shampoo bar include Acacia concinna (Shikakai), Phyllanthusemblica (Amla), and Sapindusmukorossi (Reetha) powders, which were sourced from the local market or purchased from Jainson Pharmaceuticals Pvt. Ltd., Mumbai. Fresh Azadirachtaindica (Neem) leaves were collected from the garden, shade-dried, and powdered. Lawsoniainermis (Henna) powder was obtained from a local supplier. Hibiscus rosa-sinensis (Hibiscus) flowers were collected from the garden and dried. Fresh Aloe barbadensis Miller (Aloe vera) leaves were also collected from the garden, and their mucilaginous pulp was extracted and filtered. The Goat milk soap base was purchased from an online market. Additional ingredients like rose essential oil were used to enhance fragrance. All ingredients were chosen for their known beneficial effects on hair and scalp health.

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➢ *Method of Preparation:*

The preparation of the polyherbal shampoo bar involved multiple steps. Initially, all herbal powders were passed through sieves of appropriate mesh sizes to obtain fine powders for uniform blending. The pod-like fruits of Acacia concinna were procured from the market, cleaned, and blended to coarse powder using a clean blender. The powder was first passed through sieve no. 22 and subsequently through sieve no. 85 to obtain a finer consistency. Similarly, powders of Phyllanthusemblica, Sapindusmukorossi, Azadirachtaindica, Lawsoniainermis, and Hibiscus rosa-sinensis were either procured or prepared through shade drying, grinding, and sieving as needed. Fresh Aloe barbadensis Miller leaves were cleaned, and the mucilaginous pulp was extracted using a knife. The pulp was then homogenized with an electric stirrer and filtered through double-layered muslin cloth to obtain clear juice (Patil et al., 2022; Deshmukh et al., 2021).

Goat milk soap base was melted using the double boiler method with the help of a water bath. Once the soap base was liquefied, all the fine herbal powders except Acacia concinna and Sapindusmukorossi were added to the molten base under continuous stirring to ensure homogeneity. Following this, Aloe barbadensis juice was added on low flame. The beaker was then removed from the water bath, and *Acacia concinna* and *Sapindus mukorossi* powders were carefully incorporated, avoiding foam formation that could otherwise affect the consistency and structure of the shampoo bar. Finally, fragrance oil (rose essential oil) was added and mixed thoroughly. The molten blend was poured into pre-lubricated molds of desired shape and kept aside to solidify for about 2 hours at room temperature (Kumar & Singh, 2020; Sharma et al., 2021).

➢ *Evaluation Tests:*

To evaluate the quality of prepared formulations several quality-controlled tests including visual assessment.Physicochemical controls condition in performance tests were performed.

- *Organoleptic Characters and Physical Appearance*

The organoleptic and physicochemical parameters such as colour, odour, appearance, and pH were tested. Colour was determined by comparing with standard colour charts, odour by smelling, appearance by visual assessment.

- *PH:*

The PH of formulations were determined by producing foam with distilled water onshampoo bar. The PH paper was placed on foam produced and determined by standards.

- *Foam Forming Ability:*

For the determination of the Polyherbal shampoo bar for its ability to form foam about 1.0 gm of bar was taken and was dissolved in distilled water (about 50ml) in a 100 ml graduated measuring cylinder. It the measuring cylinder was then shaken for about 2-3 minutes and it was allowed to stand for about 10 min. Foam height was measured after 10 minutes. Record the observation for three consecutive experiment and the mean was taken.

- *Retention Time of Foam:*

Foam retention time refers to the time for which the foam produced by the shampoo bar retains. The above procedure was repeated and the foam interval was measured for about 5-10 minutes.

- *Stability Testing:*

The prepared herbal shampoo bar was subjected to stability testing by storing it under two different conditions: room temperature (37°C) and refrigerated conditions (2–8°C). At regular intervals, samples were observed for changes in visual appearance, texture, and pH using a calibrated pH meter.

- *Conditioning Performance Evaluation:*

Conditioning performance was assessed using hair tresses obtained from an Indian salon. The tresses were first washed with the herbal shampoo bar, and the conditioning effect was evaluated manually based on softness and smoothness after drying.

- *Moisture Content Determination:*

Approximately 5 g of the shampoo bar was weighed into a pre-dried moisture dish and placed in a hot air oven at 105°C ± 2 for 1 hour. After drying, the sample was cooled in a desiccator and reweighed. This process was repeated until a constant weight was attained. Moisture content was calculated using:

Moisture content (%) = (Loss in weight / Weight of sample) × 100

- *Dirt Dispersion Test:*

To test dirt dispersion ability, 10 mL of distilled water and 2 drops of the shampoo solution were taken in a wide-mouthed test tube. One drop of Indian ink was added, and the tube was shaken for 10 minutes. The level of ink in the foam was visually assessed and graded as none, slight, moderate, or heavy.

- *Antimicrobial Testing:*

The antimicrobial potential of the herbal ingredients was acknowledged based on literature. Herbs such as Acacia concinna, Azadirachta indica, and Phyllanthus emblica have been previously reported to exhibit antibacterial and antifungal activities, contributing to scalp hygiene.

- *Skin Irritation Test:*

A patch test was performed by applying a small amount of the herbal shampoo bar on the inner forearm of a human subject. The area was observed for five minutes to detect any signs of irritation, redness, or rash.

IV. RESULTS AND DISCUSSION

The formulated shampoo bars were evaluated to determine their suitability as effective hair cleansing products. All four formulations demonstrated acceptable organoleptic properties such as characteristic odour, dark brown colour, and solid consistency, though slight

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differences in texture were observed, likely influenced by the ratio of herbal powders and soap base.

The pH values of the formulations were within the permissible range of 5.5 to 8.5 as per BIS standards, making them safe and gentle for scalp application. The foamability of the shampoo bars was consistent across batches, indicating effective surfactant action suitable for cleansing. Foam retention over a 5-minute period suggests that the formulations maintain lather long enough for practical use.

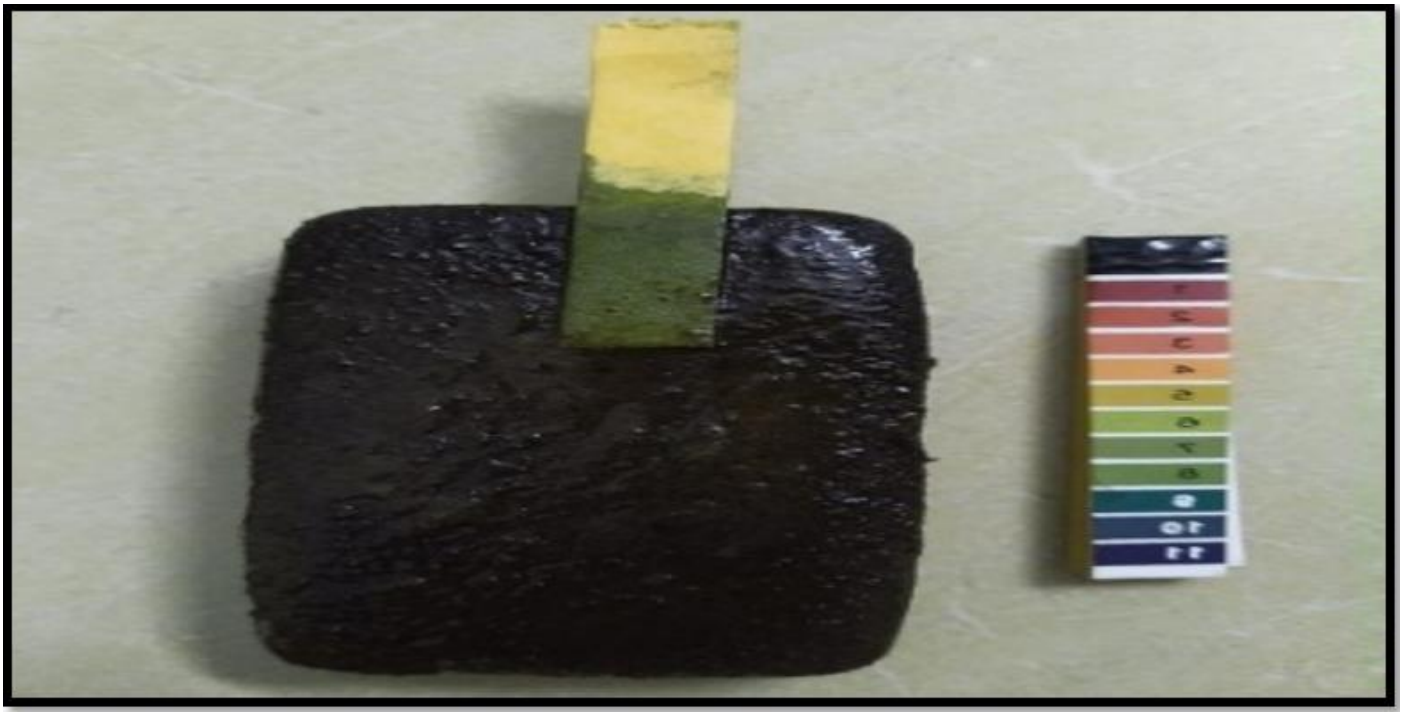

Fig 2 pH Determination

Fig 3 Foam Forming Ability

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Stability testing revealed that all formulations remained stable in terms of appearance, odour, and consistency over 30 days at both room and refrigeration temperatures. However, thermal sensitivity was noted, with softening occurring at temperatures above 50°C, which should be considered during storage and packaging. Conditioning performance was generally satisfactory, with hair feeling smooth and manageable after application, although this parameter was inherently milder than a dedicated conditioner. The moisture content varied among formulations, with lower levels indicating better stability and shelf life. The dirt dispersion test confirmed effective cleansing, with minimal ink retention in the foam, which is a positive sign of rinsing efficiency.

No adverse reactions were noted in the skin irritation test, suggesting the shampoo bars are safe for regular external use. These findings collectively indicate that the shampoo bar formulations possess desirable characteristics and are promising for sustainable and herbal-based hair care applications.

Table 1 Results of Evaluation Tests

Parameter	F1	F2	F3	F4
Colour & Odour	Dark brown, pleasant	Light brown, slight herbal	Dark brown, strong herbal	Brown, mild herbal
Consistency	Solid	Slightly soft	Solid	Solid
pH	7	6.5	7	6.8
Foamability (mm)	68	70	65	67
Foam Retention (min)	5	4	5	4
Stability (30 days)	Stable	Stable	Stable	Stable
Thermal Stability	Melts at >50°C	Melts at >45°C	Melts at >50°C	Melts at >48°C
Conditioning Effect	Good	Moderate	Good	Satisfactory
Moisture Content (%)	15.12	12.34	5.40	13.60
Dirt Dispersion	Light	Light	None	Light
Skin Irritation	None	None	None	None

V. CONCLUSION

The present study focused on the formulation and evaluation of polyherbal solid shampoo bars using traditional herbal ingredients known for their hair care benefits. All four formulations were subjected to organoleptic, physicochemical, performance, and safety evaluations. The results demonstrated that the shampoo bars had acceptable colour, odour, and consistency, with pH values within the recommended range for scalp health. Foamability and foam retention were adequate, indicating good cleansing ability, and the formulations were stable under storage and thermal conditions. Moisture content values were within suitable limits, contributing to better shelf life, while the dirt dispersion and skin irritation tests confirmed the safety and effectiveness of the bars for routine use. Among all, Formulation F3 emerged as the most optimized batch due to its excellent foaming, lowest moisture content, effective dirt removal, superior conditioning performance, and complete absence of skin irritation. This suggests that F3 is highly suitable for further development as a natural, eco-friendly, and effective herbal shampoo bar.

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