

Formulation and Evaluation of Herbal Shampoo

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Abstract:

Growing consumer preference for plant-based personal care products has driven increased scientific inquiry into the development of herbal shampoo formulations. The present investigation describes the preparation and systematic characterization of a shampoo incorporating five botanically active plant materials: neem (*Azadirachta indica*), hibiscus (*Hibiscus rosa-sinensis*), amla (*Phyllanthus emblica*), shikakai (*Acacia concinna*), and aloe vera (*Aloe barbadensis* Miller). Each ingredient was selected for its documented contribution to hair and scalp wellness, including antimicrobial activity, conditioning capacity, dandruff suppression, and stimulation of follicular regeneration. Concentrated extracts were blended into a base containing compatible natural surfactants and excipients. The resulting formulation underwent comprehensive physicochemical assessment, covering parameters such as visual appearance, pH, rheological behaviour, lather volume, lather persistence, wetting capacity, total solid content, surface tension, dirt-suspension ability, and scalp compatibility. Outcomes indicated that the product delivered efficient cleansing, produced sustained foam, registered a pH within the physiologically acceptable range for scalp contact, and retained stability across varied storage environments without evidence of irritation. The findings support the conclusion that herbal shampoos represent a scientifically credible, consumer-friendly alternative to synthetically formulated products, combining therapeutic value with environmental sustainability.[1-5]

Keywords: Herbal shampoo, plant-based cosmetics, neem, hibiscus, amla, shikakai, aloe vera, physicochemical evaluation, hair care.

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1. Introduction

Hair occupies a central place in human identity, influencing both personal confidence and social perception. Beyond its aesthetic role, hair functions as a physical barrier for the scalp against mechanical stress, ultraviolet radiation, microbial colonisation, and environmental debris. Because of this dual significance, maintenance of healthy hair through appropriate cleansing and nutritive routines has been an enduring human practice across diverse cultures and historical periods.[1,2]

Among the array of hair care preparations in contemporary use, shampoo holds a preeminent position. Its principal function is the removal of sebum, perspiration residue, desquamated epithelial cells, environmental particulates, and microbial matter from the hair shaft and scalp surface. The term itself originates from the Sanskrit-derived Hindi word champo, describing the act of massage or kneading, reflecting the product's South Asian cultural roots.[3] Conventional shampoos achieve their cleansing action via synthetic surfactants, which disrupt the interfacial tension between oily contaminants and water, enabling rinsing. While effective, these agents have been associated, particularly under conditions of frequent or long-term use, with adverse outcomes including scalp dryness, disruption of the cuticular structure of the hair fibre, follicular irritation, and sensitisation reactions linked to preservative systems and synthetic fragrance components.[4,6]

This recognised risk profile has encouraged both researchers and the broader consumer market to explore botanical alternatives. Herbal shampoos draw upon the rich legacy of traditional medicine systems worldwide, incorporating extracts of medicinal plants that supply not merely surface-active cleansing chemistry but also a range of bioactive constituents. Phytochemicals such as flavonoids, tannins, alkaloids, saponins, terpenoids, glycosides, and phenolic compounds confer antioxidant, anti-inflammatory, antimicrobial, and tissue-conditioning properties to such formulations.[11,12] The practical result is a product capable of simultaneously cleansing the hair while delivering targeted benefits to the scalp and follicular apparatus.[7,8]

The medicinal plants selected for this study each bring a distinct functional contribution. Neem is well established for its broad-spectrum antimicrobial and antifungal capacity, making it particularly valuable against dandruff-associated organisms. Amla, with its high ascorbic acid and polyphenol content, strengthens follicular structures and retards premature pigmentation loss.[9] Hibiscus promotes anagen phase prolongation, reducing shedding and improving surface sheen. Shikakai, whose pods are naturally saponin-rich, serves as a gentle yet effective cleansing and conditioning agent.[10] Aloe vera contributes moisturising, anti-inflammatory, and scalp-soothing properties through its characteristic polysaccharide matrix.[5,21]

The purpose of the present study was to translate the known pharmacological properties of these botanicals into a stable, well-characterised shampoo formulation and to evaluate its performance against established physicochemical and quality standards, thereby generating evidence to support its potential as a commercially viable herbal hair care product.[13-18]

2. Objectives

1. To develop a herbal shampoo utilising standardised extracts of selected medicinal plants - specifically aloe vera, amla, neem, shikakai, hibiscus, and reetha - as functional active ingredients.
2. To evaluate the prepared formulation against a comprehensive set of physicochemical, performance, and stability parameters so as to confirm its quality and suitability for routine scalp application.
3. To compare the performance profile of the developed herbal product with that of a commercially available synthetic shampoo, highlighting advantages in safety and tolerability.

3. Research Hypotheses

1. The formulated herbal shampoo will demonstrate satisfactory cleansing efficiency and scalp compatibility without causing irritation.
2. The herbal shampoo will exhibit acceptable foam volume, foam stability, viscosity, and wetting ability comparable to marketed shampoo formulations.
3. The formulation will maintain a scalp-compatible pH (5.0–7.0) and physicochemical stability during accelerated storage studies.
4. The herbal ingredients (amla, neem, hibiscus, shikakai, aloe vera, and reetha) will contribute to improved conditioning performance, including combability and gloss, compared with untreated hair samples.

4. Advantages of Herbal Shampoo

4.1 Reduced Toxicological Burden

Plant-derived ingredients typically exhibit superior dermal compatibility compared to petroleum-derived synthetic counterparts, resulting in a lower incidence of contact dermatitis, follicular occlusion, and systemic absorption of harmful chemical residues.[19]

4.2 Nutritive Enrichment of Hair

The mineral, protein, vitamin, and polyphenolic constituents naturally present in herbal extracts exert direct trophic effects on the hair cortex and follicular dermal papilla, supporting stronger, more resilient fibre growth.[20]

4.3 Dandruff Suppression

Plants such as neem and tea tree that contain thymoquinone, nimbidin, terpinen-4-ol, and related secondary metabolites have been shown to inhibit the proliferation of *Malassezia furfur* and other scalp fungi implicated in seborrheic dermatitis and flaking.[21]

4.4 Promotion of Hair Regeneration

Several botanicals, including bhringraj (*Eclipta prostrata*) and hibiscus, exert vasodilatory and mitogenic effects at the follicular level, enhancing blood perfusion of the dermal papilla and prolonging the growth phase of the hair cycle.[22]

5. Botanical Ingredients and Their Properties

5.1 Amla (*Phyllanthus emblica*)

Amla fruit is distinguished by one of the highest recorded concentrations of ascorbic acid among natural sources, supplemented by ellagitannins, emblicanin, and a range of phenolic acids. These constituents collectively reinforce the cysteine disulphide bonds within the hair cortex, delay melanin depletion, and protect against oxidative follicular damage.[23]

5.2 Reetha / Soapnut (*Sapindus mukorossi*)

The pericarp of *Sapindus mukorossi* contains saponin glycosides that generate a stable, mild lather upon agitation with water. Unlike sodium lauryl sulphate, these natural surfactants do not significantly alter the scalp's native microbiome or disrupt the lipid film protecting the hair cuticle.[24]

5.3 Shikakai (*Acacia concinna*)

Shikakai pods yield a finely balanced combination of saponins, ascorbic acid, and polyphenols that cleanse with minimal pH elevation, thereby reducing cuticle swelling and tangling. Its conditioning action leaves hair manageable without synthetic silicone deposition.[25]

5.4 Hibiscus (*Hibiscus rosa-sinensis*)

Hibiscus petals and leaves contain hibiscetin, quercetin, anthocyanins, and mucilaginous polysaccharides. These compounds support keratinocyte proliferation within the follicle, reduce telogen entry, and contribute a natural gloss to the treated hair shaft.[26]

5.5 Neem (*Azadirachta indica*)

The terpenoid nimbidin and the limonoid azadirachtin in neem leaf and seed extracts exert potent antifungal and antibacterial activity. Incorporation into shampoo formulations provides a sustained

antimicrobial environment at the scalp surface without the sensitisation potential associated with synthetic antifungal agents.[27-29]

6. Herbal Cosmetics: Background and Market Context

The domain of herbal cosmetics encompasses topical preparations whose active functional components are obtained from plant raw materials rather than petrochemical synthesis. Public awareness of the potential for cumulative toxicity from long-term exposure to parabens, sodium laureth sulphate, synthetic colourants, and artificial fixatives has generated measurable market expansion in naturally formulated alternatives.[30-32]

Hair care constitutes one of the most commercially significant segments within this category, encompassing shampoos, conditioners, scalp tonics, hair masks, herbal oils, and colour treatments. Within this segment, herbal shampoos occupy a unique position because they combine the mechanical and chemical cleansing function of conventional products with the bioactive supplement delivered by plant extracts. This dual action satisfies the contemporary consumer demand for products that are not merely cosmetically effective but that also actively improve the biological condition of the scalp and follicular environment over time.[32,33]

7. Selected Herbal Ingredients - Summary Table

S. No.	Common Name	Botanical Name	Part Used	Functional Role
1	Hibiscus	Hibiscus rosa-sinensis	Flower	Conditioning agent
2	Amla	Emblia officinalis	Fruit	Anti-dandruff agent
3	Shikakai	Acacia concinna	Powder	Natural detergent
4	Soapnut (Reetha)	Sapindus mukorossi	Fruit	Foam booster / detergent
5	Cassia	Cassia auriculata	Leaves	Anti-dandruff agent
6	Bhringraj	Eclipta prostrata	Leaves & Flower	Hair growth stimulant
7	Aloe Vera	Aloe barbadensis	Leaf gel	Coolant / moisturizer

8. Formulation Methodology

Designing a herbal shampoo requires careful reconciliation of several competing technical demands: adequate surface-active cleansing power, aesthetically acceptable viscosity and opacity, stable foam, a pH compatible with the scalp's mildly acidic mantle, preservation against microbial contamination, and maintenance of the biological activity of the incorporated herbal extracts throughout shelf life.[37,38]

The general compositional framework of the present formulation comprised the following ingredient categories:

1. Concentrated herbal extracts (active botanical components)
2. Primary and secondary natural surfactants (cleansing and lathering agents)
3. Thickening and rheology-modifying agents
4. Conditioning and film-forming agents
5. Broad-spectrum preservative system
6. Approved colorant and fragrance materials
7. Purified water (vehicle)

Plant materials were sourced, authenticated by a certified botanist, dried, reduced to powder, and subjected to solvent extraction using optimised procedures appropriate to the chemical class of target constituents. Extract yield, organoleptic character, and physicochemical parameters were recorded before incorporation. Blending was conducted under controlled temperature conditions to minimise degradation of heat-sensitive phytochemicals, and the pH of each intermediate and final batch was monitored to ensure conformity with the target range of 5.0 to 7.0.[13,14]

9. Evaluation Parameters

Quality assurance of the finished formulation required assessment across multiple parameter categories. The evaluation protocol applied in this study included the following: [14,39,40]

9.1 Physical and Organoleptic Evaluation

1. Visual appearance and optical clarity
2. Characteristic colour and any deviation on storage
3. Odour profile and its retention over time
4. Textural consistency and pourability

9.2 Physicochemical Evaluation

1. pH determination using a calibrated digital pH meter
2. Viscosity measurement by Brookfield or Ostwald viscometry
3. Surface tension determination (stalagmometer method)
4. Percentage total solid content (gravimetric)
5. Wetting time assessment (canvas disc method)
6. Dirt dispersion capacity (standard soil suspension test)

9.3 Foam Performance

1. Foam volume at defined time intervals post-agitation
2. Foam stability expressed as percentage retention over 30 minutes

9.4 Conditioning Performance

Hair tress testing assessed wet and dry combability scores and assessed any improvement in surface texture, sheen, or static charge relative to an untreated control and a marketed reference product.

9.5 Stability Studies

Samples were subjected to accelerated and real-time stability protocols at temperatures of 4 °C, 25 °C, 40 °C, and 50 °C over a period of four weeks. Aliquots were evaluated at weekly intervals for changes in pH, viscosity, colour, odour, and microbial count to establish the formulation's resistance to physical and chemical degradation.[14]

10. Conclusion

The present study demonstrated the successful formulation of a polyherbal shampoo containing amla, neem, hibiscus, shikakai, reetha, and aloe vera using standard pharmaceutical formulation principles. The prepared formulation exhibited acceptable physicochemical characteristics, including suitable appearance, satisfactory lathering ability, appropriate viscosity, and a scalp-compatible pH range. Stability assessment under different storage conditions indicated no major variation in physical parameters during the study period. [1,11,14, 17, 18]

The findings suggest that the developed herbal shampoo possesses potential as a natural hair cleansing formulation with acceptable quality characteristics. However, further investigations involving dermatological safety assessment, controlled comparative studies with marketed formulations, and clinical evaluation in human subjects are necessary to establish long-term efficacy, scalp compatibility, and therapeutic benefits. [5,9,10, 21,26]

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