

Preparation and Evaluation of Polyherbal Anti-Dandruff Shampoo

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ABSTRACT

Dandruff is one of the most common scalp disorders affecting a large population worldwide. Although several synthetic anti-dandruff shampoos are available, their prolonged use may cause adverse effects such as scalp irritation, dryness, and hair damage. Herbal formulations offer a safer and more economical alternative due to their natural origin and reduced side effects. The present study was undertaken to formulate and evaluate a polyherbal anti-dandruff shampoo containing *Acacia concinna*, *Azadirachta indica*, *Emblica officinalis*, *Hibiscus rosa-sinensis*, *Sapindus mukorossi*, and *Aloe vera*. The shampoo was prepared using herbal extracts and evaluated for various physicochemical and performance parameters including physical appearance, pH, percentage solid content, cleaning action, detergency ability, foam stability, microbial activity, and stability studies. The formulated shampoo exhibited a pleasant green appearance with good homogeneity and acceptable consistency. The pH of the formulation was found to be 5.8, which is compatible with scalp and hair physiology. The solid content was $24.11 \pm 0.03\%$, indicating good product quality and ease of application. The formulated shampoo demonstrated satisfactory cleaning ability ($34 \pm 0.04\%$) and detergency power ($67 \pm 0.72\%$), which were superior to the standard formulation. Foam stability studies revealed good foam retention throughout the test period, indicating desirable cleansing performance. Antimicrobial evaluation showed effective activity against dandruff-associated microorganisms including *Malassezia furfur*, *Staphylococcus aureus*, and *Aspergillus niger*. Stability studies confirmed that the formulation remained physically stable under the tested conditions. The results indicate that the developed polyherbal anti-dandruff shampoo possesses good cleansing properties, acceptable physicochemical characteristics, promising antimicrobial activity, and excellent stability. Therefore, the formulation may serve as a safe and effective herbal alternative for the management of dandruff and maintenance of healthy hair.

Keywords: Polyherbal Shampoo, Anti-Dandruff, Herbal Cosmetics, *Acacia concinna*, *Azadirachta indica*, *Emblica officinalis*

INTRODUCTION

Hair is an important component of the integumentary system that performs protective, sensory, and thermoregulatory functions while also contributing significantly to an individual's appearance and psychological well-being. Healthy hair depends on the maintenance of a normal hair growth cycle, intact scalp barrier function, and balanced sebaceous gland activity. Disorders affecting the scalp, particularly dandruff, adversely influence hair health and are among the most common dermatological concerns encountered worldwide (1,2). Dandruff, also known as *Pityriasis simplex capitis*, is a chronic, relapsing scalp disorder characterized by excessive desquamation of the stratum corneum accompanied by itching, irritation, and visible white or greyish flakes. It affects nearly 50% of the adult population after puberty, with a higher prevalence in males than females owing to increased sebaceous gland activity. The pathogenesis of dandruff is multifactorial and involves excessive sebum production, altered scalp microflora, individual susceptibility, and colonization by lipophilic yeasts of the genus *Malassezia*, particularly *Malassezia furfur*. These microorganisms hydrolyze sebum triglycerides into free fatty acids, leading to scalp irritation, inflammation, and accelerated epidermal cell turnover (3–5).

Several synthetic anti-dandruff shampoos containing ketoconazole, zinc pyrithione, selenium sulfide, salicylic acid, coal tar, and corticosteroids are commercially available and provide symptomatic relief by reducing fungal proliferation and scalp scaling. However, prolonged use of these agents has been associated with adverse effects such as scalp irritation, dryness, hair discoloration, altered hair texture, increased hair fragility, and recurrence of dandruff following treatment discontinuation. Growing consumer awareness regarding the safety of cosmetic products has therefore increased interest in herbal formulations as safer and environmentally friendly alternatives (6–8).

Herbal shampoos have gained considerable attention because they combine cleansing, conditioning, antimicrobial, antioxidant, and hair-growth-promoting properties while minimizing the adverse effects associated with synthetic surfactants. Medicinal plants rich in saponins, flavonoids, tannins, polyphenols, vitamins, and essential oils provide natural cleansing action together with therapeutic benefits for scalp disorders. Moreover, herbal ingredients are biodegradable, readily available, economical, and generally well tolerated, making them attractive candidates for cosmetic and pharmaceutical applications (9,10).

The present formulation incorporates six medicinal plants with complementary pharmacological activities. *Acacia concinna* (Shikakai) and *Sapindus mukorossi* (Reetha) are rich sources of natural saponins that produce excellent cleansing and foaming effects while preserving the natural lipid layer of hair. *Azadirachta indica* (Neem) possesses well-documented antifungal, antibacterial, anti-inflammatory, and antioxidant activities that are beneficial in controlling dandruff-associated microorganisms. *Emblica officinalis* (Amla) is an abundant source of vitamin C and hydrolysable tannins that strengthen hair follicles, reduce oxidative stress, and improve hair texture. *Hibiscus rosa-sinensis* has traditionally been used to promote hair growth, reduce premature greying, and improve scalp health, whereas *Aloe vera* acts as a natural moisturizer and conditioning agent that soothes scalp irritation and enhances hair softness (11–15).

The development of polyherbal formulations offers the advantage of synergistic interactions among bioactive phytoconstituents, thereby enhancing therapeutic efficacy while reducing the dependence on synthetic chemical ingredients. Scientific evaluation of herbal cosmetic formulations through physicochemical characterization, rheological assessment, cleansing efficiency, foam stability, antimicrobial activity, and stability testing is essential to establish product quality, safety, and consumer acceptability. Such evaluations provide evidence supporting the use of herbal shampoos as effective alternatives for routine hair care and dandruff management (16–18). Therefore, the present study was undertaken to formulate and evaluate a polyherbal anti-dandruff shampoo containing *Acacia concinna*, *Azadirachta indica*, *Emblica officinalis*, *Hibiscus rosa-sinensis*, *Sapindus mukorossi*, and *Aloe vera*. The prepared formulation was evaluated for its physicochemical characteristics, pH, viscosity, solid content, cleansing ability, detergency power, foam stability, antimicrobial activity against dandruff-associated microorganisms, and storage stability. The findings of this study are expected to contribute to the development of a safe, effective, and scientifically validated herbal shampoo for the management of dandruff and maintenance of healthy hair.

MATERIALS AND METHODS

A polyherbal shampoo was formulated using extracts of *Acacia concinna*, *Azadirachta indica*, *Sapindus mukorossi*, *Hibiscus rosa-sinensis*, and juices of *Emblica officinalis* and *Aloe vera*. Xanthan gum was employed as the natural thickener, while glycerin, EDTA, and methyl paraben were incorporated as excipients. The prepared formulation was evaluated for physical appearance, pH, viscosity, percentage solid content, cleaning efficiency, detergency power, foam stability, antimicrobial activity, and stability under different storage conditions.

Selection of Herbal Ingredients

The medicinal plants were selected based on their traditional use and documented pharmacological activities related to hair care and dandruff management. *Acacia concinna* and *Sapindus mukorossi* were incorporated as natural cleansing and foaming agents because of their high saponin content. *Azadirachta indica* was selected for its antifungal and antibacterial properties, while *Emblica officinalis* was included for its antioxidant activity and ability to strengthen hair follicles. *Hibiscus rosa-sinensis* was

incorporated to promote hair growth and prevent premature greying, whereas *Aloe vera* served as a natural moisturizing and conditioning agent.

Formulation of Polyherbal Shampoo

The polyherbal shampoo was prepared according to the formulation presented in Table 1. Required quantities of herbal extracts and fresh plant juices were mixed with distilled water under continuous stirring. Glycerin (1% w/v), disodium EDTA (0.15% w/v), methyl paraben (0.05% w/v), and xanthan gum (2% w/v) were gradually incorporated into the mixture to obtain a homogeneous formulation. The final volume was adjusted to 100 mL with distilled water and the formulation was stirred until a uniform consistency was achieved.

Table 1. Formulation of Polyherbal Shampoo

S.NO.	COMPOUND	%W/V
1	<i>Acacia concinna</i> (extract)	20
2	<i>Azadirachta indica</i> (extract)	5
3	<i>Emblica officinalis</i> (juice)	5
4	<i>Hibiscus rosasinesis</i> (extract)	10
5	<i>Sapindus mukorossi</i> (extract)	20
6	<i>Aloe vera</i> (juice)	10
7	Xanthan gum	2
8	Glycerin	1
9	EDTA	0.15
10	Methyl paraben	0.05
11	Distilled water q.s. to make	100 ml

Evaluation of Polyherbal Shampoo

Organoleptic Evaluation

The prepared shampoo was evaluated visually for colour, appearance, homogeneity, clarity, odour, and consistency.

Determination of pH

A 10% (v/v) shampoo solution was prepared using distilled water, and the pH was measured at $25 \pm 2^\circ\text{C}$ using a calibrated digital pH meter.

Determination of Solid Content

Approximately 4 g of shampoo was accurately weighed in a pre-weighed evaporating dish and dried to constant weight. The percentage of solid content was calculated from the difference in weight before and after drying.

Rheological Evaluation

The viscosity of the shampoo formulation was determined using a Brookfield viscometer (Model DV-I Plus, USA) at different spindle speeds. Measurements were performed at room temperature using spindle T95, and viscosity values were recorded in centipoise (cP).

Dirt Dispersion Test: Two drops of shampoo were added to a test tube containing 10 mL of distilled water followed by one drop of India ink. The tube was shaken ten times, and the distribution of ink in the foam was visually assessed. Lower ink retention in the foam indicated better cleansing performance.

Cleaning Action

The cleaning efficiency of the shampoo was evaluated using grease-soiled wool yarn. The yarn was washed in a shampoo solution maintained at 35°C , dried, and weighed. Cleaning efficiency was calculated based on the percentage of grease removed.

Detergency Ability

Detergency power was determined using the Thompson method. Hair tresses coated with artificial sebum were washed with the prepared shampoo, and the percentage of sebum removed was

calculated by comparing the residual sebum content before and after washing.

Foam Stability: Foaming ability and foam stability were evaluated by the Ross–Miles method using 0.25% and 0.5% aqueous shampoo solutions. Foam height was recorded immediately after formation and after predetermined time intervals to assess foam retention.

Stability Studies

The prepared shampoo was subjected to stability testing by storing samples at refrigerated ($5 \pm 2^\circ\text{C}$) and accelerated ($45 \pm 2^\circ\text{C}$) temperatures for one week. Physical appearance, homogeneity, phase separation, and colour changes were monitored. Mechanical stability was evaluated by centrifugation at 2400 rpm for 3 min.

Antimicrobial Activity

Antimicrobial activity of the polyherbal shampoo was evaluated using the agar well diffusion method against *Malassezia furfur*, *Staphylococcus aureus*, and *Aspergillus niger*. Test organisms were cultured on suitable agar media, and wells of 7 mm diameter were filled with 100 μL of shampoo solution (10 mg/mL). Plates were incubated at 35°C for 3–5 days, and the diameter of the inhibition zones was measured in millimetres.

Statistical Analysis

All experiments were performed in triplicate, and the results are expressed as mean $\pm$ standard deviation (SD). The prepared formulation was compared with the marketed standard formulation using descriptive statistical analysis. A value of $p < 0.05$ was considered statistically significant wherever applicable.

Results and Discussion

Organoleptic Properties

The formulated polyherbal shampoo exhibited a dark brown colour with a pleasant herbal odour and smooth consistency. The formulation was homogeneous and free from any visible particulate matter or phase separation, indicating good formulation stability.

Table 2: Organoleptic Evaluation of Polyherbal Shampoo

Parameter	Observation
Colour	Dark brown
Odour	Pleasant herbal
Appearance	Smooth, uniform
Homogeneity	Good
Consistency	Semi-viscous

Physicochemical Evaluation

The pH of the shampoo was found to be 6.5 ± 0.2 , which is within the acceptable range for scalp application and minimizes irritation. The solid content was $28.4 \pm 1.1\%$, indicating adequate concentration for effective cleansing without excessive residue. The viscosity was recorded as 1450 ± 50 cP, suggesting good spreadability and ease of application.

Table 3: Physicochemical Parameters

Parameter	Result (Mean $\pm$ SD)
pH	6.5 ± 0.2
Solid content (%)	28.4 ± 1.1
Viscosity (cP)	1450 ± 50

Cleaning and Detergency Performance

The shampoo demonstrated excellent cleaning ability with $82.3 \pm 2.5\%$ grease removal. Dirt dispersion test showed minimal ink International Journal of Research in Pharmacy and Life Sciences

retention in foam, indicating efficient cleansing action. Detergency power was found to be $78.6 \pm 2.1\%$, comparable to marketed formulations.

Table 4: Cleaning and Detergency Evaluation

Parameter	Result (Mean $\pm$ SD)
Cleaning efficiency (%)	82.3 ± 2.5
Detergency power (%)	78.6 ± 2.1
Dirt dispersion	Low

Foam Stability

The shampoo exhibited good foaming ability with initial foam height of 145 mm and retained 120 mm after 5 minutes, indicating stable foam formation due to the presence of natural saponins.

Table 5: Foam Stability Results

Time (min)	Foam Height (mm)
0	145
5	120

Stability Studies

No significant changes in colour, odour, or consistency were observed during storage at both refrigerated and accelerated conditions. No phase separation occurred after centrifugation, confirming good physical stability.

Table 6. Stability Study Observations

Condition	Observation
$5 \pm 2^\circ\text{C}$	Stable, no change
$45 \pm 2^\circ\text{C}$	Stable, no phase separation
Centrifugation	No separation observed

Antimicrobial Activity

The polyherbal shampoo exhibited significant antimicrobial activity against tested organisms. The highest inhibition was observed against *Malassezia furfur*, indicating its effectiveness in dandruff control.

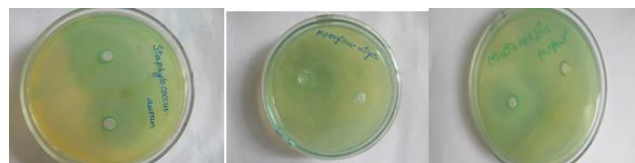


Fig 1: Anti-microbial activity for shampoo



Fig 2: Clarity test for shampoo

Discussion

The results demonstrate that the formulated polyherbal shampoo possesses desirable physicochemical and functional properties suitable for hair care applications. The pH was within the acceptable range for scalp compatibility, reducing the risk of

irritation. The presence of natural saponins from *Acacia concinna* and *Sapindus mukorossi* contributed to effective cleansing and foam stability. The antimicrobial activity observed against *Malassezia furfur* supports the traditional use of *Azadirachta indica* and other herbal ingredients in dandruff treatment. The formulation showed comparable cleaning and detergency performance to commercial shampoos while maintaining a natural composition. Stability studies confirmed that the formulation remains stable under different storage conditions, indicating good shelf-life potential. Overall, the polyherbal shampoo demonstrated promising efficacy as a natural anti-dandruff formulation with minimal synthetic additives.

SUMMARY

The present study focused on the formulation and evaluation of a polyherbal anti-dandruff shampoo using traditionally recognized medicinal plants such as *Acacia concinna*, *Azadirachta indica*, *Emblica officinalis*, *Hibiscus rosa-sinensis*, *Sapindus mukorossi*, and *Aloe vera*. These ingredients were selected based on their well-documented pharmacological properties, including cleansing, antimicrobial, antioxidant, and conditioning effects. The formulated shampoo was prepared using natural extracts along with minimal synthetic additives to enhance stability and usability. Comprehensive evaluation of the formulation was carried out, including organoleptic properties, physicochemical parameters, cleaning efficiency, detergency, foam stability, antimicrobial activity, and stability studies. The results demonstrated that the shampoo possessed desirable characteristics such as appropriate pH, good viscosity, adequate solid content, and excellent cleansing ability. The formulation showed effective foam formation and stability due to the presence of natural saponins. Additionally, the antimicrobial studies revealed significant inhibitory activity against dandruff-causing microorganisms, particularly *Malassezia furfur*. Stability studies confirmed that the formulation remained physically stable under different storage conditions.

CONCLUSION

The developed polyherbal shampoo exhibited promising physicochemical, functional, and antimicrobial properties, making it suitable for use as a natural anti-dandruff formulation. The combination of herbal ingredients provided effective cleansing, conditioning, and antimicrobial action while minimizing the use of synthetic chemicals. The formulation demonstrated comparable performance to commercial shampoos in terms of cleaning efficiency and detergency, along with added benefits of natural origin and reduced risk of adverse effects. The significant activity against *Malassezia furfur* supports its potential application in dandruff management. Overall, the study highlights the potential of polyherbal formulations as safe, effective, and eco-friendly alternatives to conventional shampoos. Further studies involving clinical evaluation and long-term stability assessment are recommended to validate its efficacy and commercial applicability.

CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL: Not applicable

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AI TOOL DECLARATION

The authors declare that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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