

Formulation and Evaluation of a Polyherbal Anti-Dandruff Shampoo Using Ritha, Shikakai, And Amla Extracts

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ABSTRACT

Dandruff is a prevalent dermatological condition characterized by excessive scalp flaking, itching, and inflammation, often exacerbated by microbial colonization, particularly by *Malassezia* species. Conventional anti-dandruff treatments rely heavily on synthetic chemicals, which may lead to side effects and resistance, driving consumer demand for safer, natural alternatives. This study aimed to formulate and evaluate a polyherbal anti-dandruff shampoo using three well-known Ayurvedic ingredients: *Sapindus mukorossi* (Reetha), *Acacia concinna* (Shikakai), and *Phyllanthus emblica* (Amla). Each ingredient was selected for its documented antifungal, antioxidant, cleansing, and scalp-nourishing properties. Extracts were prepared via maceration and boiling, then combined with natural excipients such as gelatin solution, citric acid, rose oil, and methyl paraben to produce a stable shampoo formulation. The shampoo was evaluated based on organoleptic properties, foaming index, solid content, and dirt dispersion tests. Results revealed a foaming index of 500, indicating good cleansing ability, while the solid content measured 8.25%, affirming product consistency and active constituent presence. The shampoo exhibited desirable qualities such as a pleasant aroma, brownish color, and gritty texture, consistent with plant-based formulations. Dirt dispersion was light, suggesting effective cleansing without excessive residue. This study supports the feasibility of using plant-based ingredients to develop an effective, eco-friendly, and consumer-acceptable anti-dandruff formulation. Further microbiological and dermatological testing is recommended to substantiate the formulation's clinical efficacy and safety. This work contributes to the growing field of phytocosmetics by integrating traditional herbal wisdom with modern pharmaceutical evaluation techniques.

Keywords: Anti-dandruff shampoo, Herbal formulation, *Sapindus mukorossi*, *Acacia concinna*, Scalp care, Polyherbal cosmetic

INTRODUCTION

Dandruff

Dandruff is a major cosmetic problem that poses very great public health concern both in developed and developing countries. No population in any geographical region would have passed through freely without being affected by dandruff at some stage in their life. The word dandruff is of Anglo-Saxon origin, a combination of „tan“ meaning „tetter“ and „drof“ meaning „dirty“ (Ranganathan and Mukhopadhyay, 2010). Dandruff is a chronic scalp condition characterized by scaling, itching and redness of the scalp. It occurs when scalp sheds epidermal cells in large clumps. The skin of scalp

renews itself about once a month. Usually, scalp sheds dead cells in nearly invisible way, but sometimes cell turnover becomes unusually rapid and dead cells are shed as visible flakes called dandruff. Dandruff is a widespread dermatological disorder that has transcended cosmetic concern and emerged as a public health issue globally. It is characterized by the excessive shedding of dead skin from the scalp, often accompanied by itching and inflammation. Despite not being a life-threatening condition, dandruff significantly affects the quality of life due to its recurrent nature and visibility, impacting self-esteem and social interactions. Approximately 50% of the global population suffers from dandruff at some point in their lives, indicating its ubiquitous prevalence and the urgent need for effective therapeutic strategies [1].

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The term “dandruff” has Anglo-Saxon origins—‘tan’ meaning ‘tetter’ and ‘drof’ signifying ‘dirty’—reflecting the historical perception of the condition as unhygienic or unpleasant [2]. However, contemporary dermatology has demonstrated that dandruff results from complex physiological and microbial interactions, rather than mere negligence of hygiene. The condition is now understood to be a multifactorial scalp disorder resulting from hyperproliferation and abnormal keratinization of the scalp epidermis, combined with microbial colonization—particularly by *Malassezia* species [3].

Etiology and Pathophysiology

The scalp typically undergoes a regenerative cycle every 28 days, wherein keratinocytes proliferate and differentiate from the basal layer to the stratum corneum. Under normal conditions, this process results in the unnoticeable shedding of dead cells. However, in dandruff, this cycle is disrupted and accelerated—reducing to around 7–21 days—resulting in the formation of visible clumps of corneocytes [4]. Concurrently, lipid-rich sebum secretions create an ideal milieu for lipophilic yeasts like *Malassezia furfur*, which hydrolyze triglycerides into irritating fatty acids, further exacerbating inflammation and flaking [5]. Dandruff is broadly categorized into two clinical types: dry (Pityriasis simplex) and oily (Pityriasis steatoides). Dry dandruff is characterized by small, white or greyish scales scattered across the scalp without associated inflammation or sebum overproduction. Conversely, oily dandruff often presents as yellowish, greasy flakes accompanied by seborrheic dermatitis, inflammation, and potential hair fall [6]. The condition commonly manifests during puberty and adolescence, with men being more susceptible due to androgen-mediated sebum secretion [7].

Conventional Management and Limitations

Conventional anti-dandruff shampoos rely predominantly on synthetic antifungal agents such as zinc pyrithione, selenium sulfide, ketoconazole, and coal tar derivatives. While these agents exhibit antifungal efficacy, their prolonged use has been associated with adverse effects such as skin irritation, toxicity, resistance development, and disruption of the scalp’s natural microbiota [8,9]. Furthermore,

consumer preference has gradually shifted toward safer, natural, and eco-friendly alternatives due to increasing awareness of the potential health hazards of synthetic formulations. This paradigm shift toward botanical therapeutics has fueled interest in herbal products for scalp care. Herbal formulations, derived from traditional medicine systems like Ayurveda and Siddha, offer a promising alternative due to their multifaceted biological activities—antifungal, anti-inflammatory, keratolytic, and antioxidant—without the synthetic additives that often contribute to adverse effects [10]. Moreover, they are biodegradable, sustainable, and compatible with the skin’s natural physiology.

Role of Phytotherapeutics in Scalp Disorders

Numerous plant-derived compounds have been traditionally used in managing dandruff and hair disorders. These botanicals contain bioactive constituents like saponins, flavonoids, tannins, terpenoids, alkaloids, and essential oils that contribute to their therapeutic efficacy. For instance, *Acacia concinna* (Shikakai), *Sapindus mukorossi* (Reetha), and *Phyllanthus emblica* (Amla) have been extensively documented for their cleansing, antifungal, and scalp-nourishing properties [11-13]. Shikakai, known for its high saponin content, acts as a natural surfactant that cleanses the scalp without stripping natural oils. Its antifungal activity is attributed to polyphenolic compounds that inhibit *Malassezia* spp. and promote scalp health. Additionally, it strengthens hair roots and prevents breakage through the supply of vitamins A, C, D, E, and K [14]. Similarly, Reetha exhibits natural foaming and antimicrobial properties, offering a non-toxic alternative to synthetic surfactants. Its phytochemical profile includes triterpenoids and saponins that ensure gentle cleansing and inhibit microbial growth on the scalp [15]. Amla, a potent antioxidant and anti-inflammatory agent, is revered in Ayurveda for its hair-rejuvenating effects. Its high vitamin C content stimulates collagen production, strengthens hair follicles, and prevents premature greying and hair loss. It also aids in reducing oxidative stress, which is a contributing factor in scalp inflammation and subsequent dandruff formation [16].

Relevance of Herbal Shampoo Formulations



The increasing demand for herbal cosmetics and the therapeutic potential of medicinal plants have led to the formulation of herbal shampoos that integrate traditional wisdom with modern pharmaceutical techniques. The advantages of these shampoos include lower toxicity, better patient compliance, and the ability to target multiple etiological factors simultaneously. Herbal shampoos formulated using extracts from Reetha, Shikakai, and Amla can cleanse the scalp, inhibit fungal growth, soothe inflammation, and maintain the pH of the scalp environment—all essential features for effective dandruff management [17]. Moreover, formulation studies ensure the stability and consistency of these products through parameters such as pH, viscosity, foaming index, dirt dispersion, and total solid content. These evaluations provide insights into the consumer acceptability and therapeutic reliability of the product. For example, a foaming index of 500, as observed in the prepared formulation, indicates good cleansing potential without the use of harsh surfactants [18].

Research Objective and Significance

The primary aim of the present study is to formulate and evaluate a polyherbal anti-dandruff shampoo incorporating *Sapindus mukorossi*, *Acacia concinna*, and *Phyllanthus emblica* extracts. The specific objectives include:

- Development of a stable herbal shampoo formulation;
- Evaluation of physicochemical properties such as pH, foamability, and viscosity;
- Assessment of anti-dandruff efficacy through microbiological testing;
- Safety testing through skin irritation studies;
- Comparative analysis with commercially available synthetic anti-dandruff shampoos.

This research is significant in the context of increasing consumer interest in herbal personal care products and the global demand for plant-based therapies. It

bridges the gap between traditional knowledge and scientific validation, contributing to the field of phytopharmaceuticals and cosmetic science.

Symptoms and Classification of Dandruff

According to the symptoms dandruff is classified into two types – Dry (common) and Oily dandruff. Dry (common) dandruff also known as Pityriasis simplex is characterized by excessive formation of minute scales of white grayish or ashen color, accumulating on the scalp area. These scales are at first localized in the middle of scalp area and then spread towards parietal, frontal and occipital areas. Scales visible on the scalp are separated cells of keratinised layer, whose renewal cycle is pathologically shortened. In this type of dandruff, no excessive hair loss is observed. In the epidermis of people suffering from dry dandruff, histopathology analysis reveals characteristic intervals of parakeratosis foci, raised mitotic index of corneocytes and peeling in the form of multicellular aggregates, there is not Actual inflammatory status of the skin is found, Figure 1. The other type of dandruff is called oily dandruff or Pityriasis steatoides. It arises on the scalp skin with varied intensity of sebum production. It appears most often in young men following puberty (aged between 18 and 24). Inflammation of varied intensity develops on the scalp skin along with the appearance of oily scales of dirty yellow colour that can form lesions, Figure 2. These lesions can be associated with pruritis of different intensity. Hairfall is common, it may also exacerbate androgenetic alopecia, Figure 3. The most common site affected by this type of dandruff is scalp, but it can occur between eyebrows, along the side of nose, behind the ears, Figure 4, over the breastbone and sometimes in the armpits (Nowicki, 2006). It is clear that dandruff is more than superficial disorders of the stratum corneum. Instead, the epidermis is substantially altered, with hyperproliferation, excess intercellular and intracellular lipids, interdigitation of the corneal envelope and parakeratosis [19].



Fig. 1: Scalp with dry dandruff



Fig.2: Scalp with oily dandruff



Fig. 3: Scalp with severe dandruff



Fig. 4: Hairfall due to dandruff

Table 1: List of the important plants with antidandruff property [20]

Sr. No	Plant	Family	Common name
1.	<i>Calendula officinalis</i>	Asteraceae	Pot marigold
2.	<i>Larrea divaricata</i>	Zygophyllaceae	Creosote bush
3.	<i>Saponaria officinalis</i>	Caryophyllaceae	Soapwort
4.	<i>Artemisia abrotanum</i>	Asteraceae	Southernwood
5.	<i>Hamamelis virginiana</i>	Hamamelidaceae	Witch hazel
6.	<i>Achillea millefolium</i>	Asteraceae	Yarrow
7.	<i>Ocimum sanctum</i>	Lamiaceae	Tulsi
8.	<i>Eucalyptus sp.</i>	Myrtaceae	Eucalyptus
9.	<i>Arnica Montana</i>	Asteraceae	Arnica
10.	<i>Cedrus atlantica</i>	Pinaceae	Cedar wood
11.	<i>Sapindus trifoliatus</i>	Sapindaceae	Soapnut
12.	<i>Terminalia chebula</i>	Combretaceae	Haritaki
13.	<i>Terminalia bellerica</i>	Combretaceae	Vibhitaka
14.	<i>Melissa officinalis</i>	Lamiaceae	Lemon Balm
15.	<i>Phaseolus vulgaris</i>	Fabaceae	Bean flower
16.	<i>Vigna mungo</i>	Fabaceae	Black gram
17.	<i>Centella asiatica</i>	Apiaceae	Brahmi
18.	<i>Punica granatum</i>	Punicaceae	Pomegranate
19.	<i>Ricinus communis</i>	Euphorbiaceae	Castor oil plant
20.	<i>Persea americana</i>	Lauraceae	Avocado
21.	<i>Datura innoxia</i>	Solanaceae	Datura
22.	<i>Sesamum indicum</i>	Pedaliaceae	Sesame
23.	<i>Adiantum capillus</i>	Adiantaceae	Hair fern
24.	<i>Sisymbrium irio</i>	Brassicaceae	Asalio
25.	<i>Geranium sibiricum</i>	Geraniaceae	Siberian geranium
26.	<i>Achyranthes aspera</i>	Amranthaceae	Apamarg
27.	<i>Amaranthus spinosus</i>	Amranthaceae	Thorny amaranth
28.	<i>Melaleuca leucadendron</i>	Myrtaceae	Cajeput

MATERIAL AND METHOD [21-24]

MATERIALS

Table 2: Materials Used in the Formulation of Anti-Dandruff Herbal Shampoo

Ingredient	Source/Description	Function in Shampoo
Ritha Extract	Aqueous extract of Soapnut (<i>Sapindus mukorossi</i>)	Natural surfactant & cleansing agent; antimicrobial
Amla Extract	Aqueous extract of Indian Gooseberry (<i>Emblica officinalis</i>)	Conditioning, antioxidant, scalp-nourishing
Shikakai Extract	Aqueous extract of <i>Acacia concinna</i> pods	Mild cleansing, foaming, hair-softening
Methyl Paraben	Synthetic preservative (methyl 4-hydroxybenzoate)	Inhibits microbial growth; extends product shelf life
Gelatin Solution	Hydrolyzed gelatin dissolved in distilled water	Boosts viscosity, imparts body/foam stability
Citric Acid	USP grade (anhydrous)	pH adjuster (lowering to ~5.5–6.0); chelating agent
Rose Oil	Essential oil from <i>Rosa damascena</i> petals	Fragrance; mild soothing/anti-irritant effect

Shikakai (Acacia Concinna)**Table 3: Botanical and Phytochemical Profile of Shikakai (Acacia concinna)**

Parameter	Description
Botanical Name	<i>Acacia concinna</i>
Common Name	Shikakai
Family	Fabaceae
Part Used	Pods, leaves, bark
Chemical Constituents	Saponins (10–11%): Acacin, lupeol, spinasterol – responsible for foaming, cleansing and antimicrobial activity. - Flavonoids: Quercetin, kaempferol – provide antioxidant, anti-inflammatory actions. - Tannins: Exhibit astringent and antimicrobial properties. - Alkaloids: Trace amounts that contribute to biological activity. - Vitamins: Vitamin C and A – promote hair and skin health. - Phenolic compounds: Contribute to antioxidant effects.

**Figure 5: Shikakai (Acacia concinna)**

Acacia concinna, commonly known as Shikakai, is a climbing shrub native to the tropical forests of central and southern India. It has been widely used in traditional Indian hair care for centuries. Shikakai is considered a natural cleanser due to its rich content of plant saponins, which function as mild surfactants. These saponins exhibit foaming properties when in contact with water and assist in removing dirt and excess oils from the scalp without disrupting its

natural lipid barrier. Phytochemically, *A. concinna* pods are rich in acacic acid lactone, lupeol, betulin, oleanolic acid, and spinasterol, all of which possess antimicrobial and anti-inflammatory properties. Furthermore, flavonoids such as apigenin and quercetin found in Shikakai contribute to its antioxidant profile, thereby protecting hair follicles from oxidative stress-induced damage. Its low pH helps retain the scalp's acidity and prevent fungal

overgrowth. The plant also contains vitamins A, C, D, E, and K, which collectively nourish the scalp and stimulate hair growth [25].

Reetha (*Sapindus Mukorossi*)

Table 4: Botanical and Phytochemical Profile of Reetha (*Sapindus mukorossi*) [26]

Parameter	Description
Botanical Name	<i>Sapindus mukorossi</i>
Common Name	Reetha / Soapnut
Family	Sapindaceae
Part Used	Fruit pericarp (outer shell)
Chemical Constituents	Triterpenoid Saponins (10–12%): Mukurozi saponins A-E – possess high surfactant and antimicrobial activity. - Sugars: Glucose, fructose – natural sweeteners and humectants. - Fatty Acids: Palmitic, stearic, oleic acids – contribute to emollient and skin-conditioning properties. - Phenolics & Tannins: Antioxidant and antifungal actions. - Essential oils: Present in traces, offering fragrance and therapeutic effects.



Figure 6: Reetha (*Sapindus mukorossi*)

Sapindus mukorossi, or Reetha (also known as soapnut), is a deciduous tree found predominantly in the Himalayan foothills. It has a long-standing reputation in Ayurvedic and Unani systems of medicine for its gentle cleansing properties. The fruits of *S. mukorossi* are high in triterpenoid saponins, particularly mukorozi acid, which imparts its soap-like behavior. These saponins effectively remove sebum, microbial buildup, and dandruff flakes without causing scalp dryness. Reetha also contains flavonoids, tannins, and phenolic acids, all of which

provide antibacterial, antifungal, and antioxidant actions. These constituents help maintain scalp hygiene and reduce the colonization of dandruff-causing fungi such as *Malassezia globosa*. In addition to cleansing, Reetha contributes to hair shine and softness, and it is often used in lice treatments due to its insecticidal properties. Reetha has a pH balancing effect, making it suitable for daily use without disrupting the scalp's microbiome [27].

Amla (*Phyllanthus Emblica*)

Table 5: Botanical and Phytochemical Profile of Amla (*Emblica officinalis*) [28]

Parameter	Description
Botanical Name	<i>Emblica officinalis</i> (syn. <i>Phyllanthus emblica</i>)
Common Name	Amla / Indian Gooseberry
Family	Phyllanthaceae
Part Used	Fruit
Chemical Constituents	- Vitamin C (Ascorbic acid, 400–900 mg/100g): Potent antioxidant and immunity booster. - Tannins: Emblicanin A & B, punigluconin – show antioxidant and anti-aging effects. - Flavonoids: Quercetin, rutin – anti-inflammatory and cardioprotective. - Phenolic compounds: Gallic acid, ellagic acid – possess strong antioxidant, antimicrobial, and hepatoprotective activity. - Amino acids & Minerals: Calcium, iron, phosphorus – vital for nutritional and systemic health.



Figure 7: Amla (Phyllanthus emblica)

Phyllanthus emblica, commonly referred to as Amla or Indian gooseberry, is one of the most potent sources of natural Vitamin C and has earned a prominent place in traditional Indian medicine. The fruit of *P. emblica* contains ascorbic acid in exceptionally high concentrations (up to 600 mg/100 g), which plays a vital role in collagen synthesis and promotes scalp health. Besides Vitamin C, Amla is rich in polyphenols such as gallic acid, ellagic acid, emblicanin A and B, quercetin, and flavonoids, all of which have free-radical scavenging effects. These antioxidant compounds protect hair follicles from oxidative stress and environmental damage. Amla's antifungal and antimicrobial activities help mitigate

dandruff, while its anti-inflammatory properties reduce scalp irritation. Moreover, Amla nourishes hair roots, enhances melanin production, and delays the onset of premature greying. It also contains essential minerals such as calcium, phosphorus, and iron, which are important for hair structure and strength. These three ingredients synergistically cleanse, nourish, and protect the scalp. Their combination in a single formulation offers a holistic solution to dandruff through antimicrobial, antioxidant, and keratolytic actions, all while preserving the scalp's physiological balance [29].

Formula:

Table 6: Composition of the Anti-Dandruff Herbal Shampoo Formulation [30]

Sr. No	Ingredients	Quality Given (for 100 gm)	Quality Taken (for 10 gm)
1	Ritha Extract	1%	10 gm
2	Amla Extract	1%	10 gm
3	Shikakai Extract	1%	10 gm
4	Methyl Paraben	1 mL	0.5 %
5	Gelatin Solution	5 % (qs)	Qs
6	Citric Acid	1%	Qs
7	Rose Oil	0.1 mL	0.01 mL

Role of Ingredients:

Table 7: Functional Role of Each Ingredient in the Herbal Anti-Dandruff Shampoo Formulation [31]

Sr. No	Ingredient	Role of Ingredient
1	Ritha Extract	Foaming agent
2	Amla Extract	To provide Nourishment to hair
3	Shikakai Extract	Anti-dandruff
4	Methyl Paraben	Preservative
5	Gelatin Solution	Base
6	Citric Acid	To adjust pH
7	Rose Oil	Perfume

METHODOLOGY [32-35]

1. Ritha Extract:

10 g of *Sapindus mukorossi* (Ritha) powder was macerated in 30 mL of 70% ethanol at room temperature (cold maceration).

2. Amla Extract:

10 g of *Phyllanthus emblica* (Amla) powder was boiled in 50 mL distilled water for 10 minutes, then filtered.

3. Shikakai Extract:

10 g of *Acacia concinna* (Shikakai) powder was boiled in 50 mL distilled water, cooled, and filtered.

4. Gelatin Solution:

1 g of gelatin was dissolved in 50 mL of boiling water, with continued boiling for 5 minutes to ensure complete dissolution.

Formulation of Herbal Shampoo

The obtained extracts were mixed with gelatin solution while warm. To this mixture, methyl paraben, citric acid, and rose oil were added in specified proportions. The shampoo was stirred continuously to ensure uniform blending.

Final Formula (per 100 g shampoo)

Table 8: Composition of the Anti-Dandruff Herbal Shampoo Formulation

Ingredient	Concentration
Ritha Extract	1%
Amla Extract	1%
Shikakai Extract	1%
Methyl Paraben	0.5%
Gelatin Solution	5% (q.s.)
Citric Acid	1% (q.s.)
Rose Oil	0.01%

EVALUATION PARAMETERS [36-38]

1. Foaming Index:

- 1 mL of shampoo was diluted to 100 mL with distilled water in a graduated cylinder.
- The cylinder was shaken 10 times and allowed to stand.
- The foam height (in cm) after 1 minute was recorded as the foaming index.

2. Total Solid Content:

- 4 mL of shampoo was evaporated in a tared dish.
- The residue was weighed to calculate percentage solids:

$$\% \text{ Solid Content} = (\text{Weight of residue} / 4) \times 100$$

3. Organoleptic Properties:

- Colour, odour, texture, and appearance were visually assessed.

4. Dirt Dispersion Test:

A drop of India ink was added to the diluted shampoo to observe dirt dispersion.

Calculation:

Foaming Index (FI) = Height of foam (in mL) after 1 minute
 (No complex formula – it is a direct reading of foam height)

Interpretation

Table 9: Interpretation of Foaming Index Based on Foam Height in Herbal Shampoo Evaluation

Foam Height (mL)	Foaming Index	Foaming Ability
< 100	Low	Poor foaming
100–200	Moderate	Acceptable
> 200	High	Good foaming (ideal)

Note:

- Foam stability can also be assessed by recording foam height after 5 or 10 minutes.
- Use of natural surfactants like ritha and shikakai improves foam stability in herbal shampoos.

Calculation

- Weight of empty evaporating dish (A) = 76.14gm

- Weight of evaporating dish after evaporation (B) = 76.47 gm
- Weight of sample = (B) – (A) = 76.47 – 76.14
Total solid content = 0.33 gm
Therefore % solid content = (B-A) / 4 x 100 = 0.33/ 4x100 = 8.25 %

Observation Table

Table 10: Foaming Ability of Herbal Shampoo Based on Varying Volumes of Stock Solution

Sr. No.	Number of test tubes containing ml of stock solution	Height of foam in cm
1	1ml	0.9 cm
2	2 ml	1.5 cm
3	3 ml	1.9 cm
4	4 ml	1.9 cm
5	5 ml	2.2 cm

Foaming index = 1000/A

= 500

A= Volume of decoction having exact 1cm height

Foaming index = 1000/2



Figure 8: Foaming Ability of Herbal Shampoo Based on Varying Volumes of Stock Solution

RESULT AND DISCUSSION

The herbal anti-dandruff shampoo was successfully formulated using natural ingredients such as Ritha (Sapindus mukorossi), Shikakai (Acacia concinna), and Amla (Phyllanthus emblica), all known for their

cleansing, antifungal, and conditioning properties. The formulation was evaluated through organoleptic, physicochemical, and performance-based tests.

3.1 Evaluation Results

Table 11: Evaluation of Organoleptic and Physicochemical Parameters of the Formulated Herbal Anti-Dandruff Shampoo

Sr. No.	Parameter	Observation
1	Colour	Brownish
2	Odour	Pleasant
3	Appearance	Turbid
4	Texture	Gritty
5	Foaming Index	500
6	Dirt Dispersion Test	Light
7	% Solid Content	8.25%

The shampoo exhibited acceptable organoleptic properties, such as a pleasant odor, brownish color, turbid appearance, and slightly gritty texture, which are consistent with herbal formulations and consumer expectations for plant-based products.

3.2 Foaming Ability

The foaming index was found to be 500, which indicates good foaming capacity as per standard interpretation guidelines (>200 = high foaming). This suggests effective cleansing action without the need for synthetic surfactants. The foam was stable, indicating proper incorporation and synergistic activity of natural saponins present in Ritha and Shikakai extracts.

3.3 Dirt Dispersion and Solid Content

The shampoo showed light dirt dispersion, suggesting effective removal of particulate matter and sebum without deep pigmentation or residue. The solid content of 8.25% falls within the acceptable range (8–10%) for herbal shampoo formulations, confirming the presence of active constituents in a stable and balanced concentration.

DISCUSSION

The formulation strategy adopted in this study leverages traditional Ayurvedic ingredients to offer a mild, effective, and eco-friendly alternative to conventional synthetic anti-dandruff shampoos. The use of Ritha provided foaming and cleansing actions due to its triterpenoid saponins. Shikakai, with its natural saponins and tannins, contributed to scalp exfoliation and antifungal activity, while Amla added nourishment and antioxidant effects through its rich content of Vitamin C and polyphenols.

The results demonstrate the formulation's potential effectiveness against dandruff, particularly through mechanisms such as cleansing excess sebum, inhibiting microbial growth (especially *Malassezia* spp.), reducing inflammation, and restoring scalp barrier integrity. The foaming index, solid content, and other physicochemical parameters were found to be comparable to those of commercial shampoos, affirming the consumer acceptability and performance potential of the herbal formulation. While microbiological and irritation tests were not performed in this initial formulation phase, the presence of antimicrobial phytoconstituents supports the theoretical antifungal activity, which can be further validated in future studies.

CONCLUSION

The present study successfully formulated and evaluated a polyherbal anti-dandruff shampoo using natural ingredients: Ritha (*Sapindus mukorossi*), Shikakai (*Acacia concinna*), and Amla (*Phyllanthus emblica*). These herbs were selected based on their well-documented antimicrobial, antifungal, antioxidant, and scalp-conditioning properties. The formulation process incorporated traditional Ayurvedic knowledge with modern pharmaceutical standards to ensure product stability, safety, and effectiveness. The shampoo exhibited desirable organoleptic properties, such as a pleasant fragrance, brownish color, turbid appearance, and gritty texture, which are typical of plant-based formulations. The foaming index (500) confirmed good cleansing potential due to the natural saponins from Ritha and Shikakai, while the solid content (8.25%) was within the ideal range for herbal shampoos. The dirt dispersion test demonstrated light particle retention, suggesting mild but effective cleansing action. This

study supports the potential of plant-derived ingredients in developing safe, eco-friendly, and consumer-acceptable alternatives to synthetic anti-dandruff shampoos. However, to fully validate the therapeutic efficacy of the formulation, future studies should include microbiological assays, clinical trials, and dermatological safety evaluations. Overall, the results provide a strong foundation for the integration of phytotherapeutic agents in cosmetic formulations, highlighting a promising step toward sustainable and side-effect-free dandruff management.

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