A Comprehensive Review on Anti-Dandruff Herbal Shampoo Using Amla, Reetha, and Shikakai

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Abstract—**This review article provides a comprehensive overview of the formulation and therapeutic potential of herbal anti-dandruff shampoos incorporating three traditional Ayurvedic botanicals Amla (Emblica officinalis), Reetha (Sapindus mukorossi), and Shikakai (Acacia concinna). These herbs are widely recognized for their cleansing, conditioning, and antimicrobial properties, making them suitable natural alternatives to synthetic shampoo ingredients. The review discusses the phytochemical constituents responsible for their biological activities, including tannins, saponins, flavonoids, and essential nutrients that contribute to scalp health and hair strength. Mechanisms of action related to dandruff control such as antifungal activity against Malassezia species, scalp exfoliation, sebum regulation, and reduction of inflammation are examined in detail. Additionally, the article evaluates formulation approaches, stability considerations, and comparative efficacy with commercial anti-dandruff agents. Safety, sustainability, and consumer acceptability of herbal shampoo formulations are also explored. Overall, this review highlights the potential of Amla, Reetha, and Shikakai as effective, eco-friendly, and non-toxic ingredients for developing herbal shampoos targeted at dandruff management, supporting their integration into modern cosmetic and therapeutic applications.**

Index Terms—**Herbal Shampoo, Anti-dandruff, Amla, Reetha, Shikakai, Malassezia; Ayurvedic botanicals; Phytochemicals; Scalp health; Natural hair care.**

I. INTRODUCTION

Dandruff is one of the most prevalent scalp disorders worldwide, characterized by excessive flaking, scalp itching, and inflammation associated primarily with the overproliferation of Malassezia species, altered sebum production, and disturbed epidermal turnover. While not medically severe, dandruff significantly affects self-esteem, social interactions, and overall quality of life, making its management an important dermatological concern. Conventional anti-dandruff formulations typically incorporate synthetic antifungal agents such as zinc pyrithione, ketoconazole, and selenium sulfide, which, although effective, are associated with several drawbacks. These may include scalp irritation, hair dryness, resistance development, and concerns regarding long-term safety, especially with repeated use. Moreover, the presence of harsh surfactants and preservatives in many commercial shampoos often compromises the scalp barrier function, further aggravating sensitivity and dryness. Human hair is an essential component. It is a fundamental aspect of human attractiveness. Sebum generation, apocrine sweat, pheromones production, thermoregulation, and protection from environmental aggressors are just a few of the many roles that human hair plays [1]. Hair care products which come under cosmetic; A cosmetic is a product used to cleanse, beautify, increase attractiveness, or change one's look. It derives from the Greek term "Kosmeticos," which refers to the preparation employed for this purpose and applied to the human body or any portion of it.

In recent years, there has been a paradigm shift toward natural, plant-based, and sustainable cosmetic formulations. Consumers are increasingly seeking products that align with holistic well-being, leading to heightened interest in herbal remedies traditionally used in Ayurveda and other ancient medicinal systems. Herbal ingredients are favored due to their biodegradability, low toxicity, and multifunctional properties, addressing not only dandruff but overall scalp nourishment and hair conditioning. As a result, botanical extracts have emerged as promising alternatives to synthetic chemicals, offering broad-spectrum antimicrobial activity, antioxidant protection, and improved scalp physiology. Among

the wide variety of natural botanicals explored in hair care, Amla, Reetha, and Shikakai have gained particular prominence due to their historical relevance, abundant phytochemicals, and demonstrated efficacy in traditional hair-cleansing practices. Their gentle yet effective nature offers a balanced approach to cleansing and dandruff mitigation, creating a strong foundation for modern herbal shampoo formulations.

Importance of Herbal Ingredients in Modern Hair-Care Formulations

Herbal-based cosmetic formulations have become central to modern personal care, driven by the increasing preference for safer, eco-friendly, and holistic alternatives to synthetic products. Herbal ingredients possess naturally occurring bioactive compounds such as tannins, saponins, alkaloids, phenolic acids, and flavonoids, which contribute significantly to scalp cleansing, antimicrobial activity, and hair nourishment. Unlike synthetic agents, these compounds often exhibit synergistic effects, enhancing therapeutic efficacy while minimizing adverse reactions. This has strengthened the position of herbal shampoos in addressing dermatological conditions like dandruff, which benefit from multi-mechanistic intervention involving antifungal, anti-inflammatory, antioxidant, and keratolytic activities.

Furthermore, herbal formulations align with rising global concerns about environmental sustainability and green chemistry. Botanicals such as Amla, Reetha, and Shikakai are renewable, biodegradable, and culturally familiar ingredients that can be sourced with minimal ecological impact. Their incorporation into personal care products reduces dependency on synthetic surfactants and preservatives, many of which are linked to water pollution and ecotoxicity. In addition, herbal extracts are known for their gentle cleansing action, helping maintain the natural pH and microbiome balance of the scalp an essential factor in preventing dandruff recurrence.

The cosmetic industry has also embraced herbal ingredients due to increasing regulatory pressure to minimize the use of harmful chemicals and allergens. As consumers demand clean-label, organic, and chemical-free hair-care products, herbal shampoos have become a mainstream choice. This shift has encouraged extensive research into standardizing herbal extracts, optimizing formulations, and validating their pharmacological properties through scientific studies. Consequently, the integration of powerful botanicals like Amla, Reetha, and Shikakai into shampoo formulations represents a promising step forward in creating safe, effective, and sustainable anti-dandruff solutions that resonate with both traditional wisdom and modern scientific expectations.

II. LITERATURE REVIEW

1. A Review on Herbal Shampoo

This review covers the broad scope of herbal shampoos: their definition, benefits, and comparisons with synthetic shampoos. The authors emphasize how herbal shampoos cleanse, condition, and improve overall hair/scalp health while minimizing side effects like irritation because they are "non-toxic" and derived from natural sources. They also discuss common evaluation parameters (pH, foaming, stability) and note that natural ingredients (plant extracts) can effectively replace harsher synthetic detergents. While not focused solely on anti-dandruff herbs, this review provides the general framework (formulation challenges, evaluation criteria) that is applicable when designing an herbal shampoo with Amla, Reetha, and Shikakai.

2. A Review on Herbs Used in Anti-Dandruff Shampoo and Its Evaluation Parameters

This is perhaps the most directly relevant review for your topic. The authors examine the causes of dandruff (especially Pityrosporum / Malassezia), drawbacks of synthetic anti-dandruff shampoos (zinc pyrithione, ketoconazole, etc.), and then present various herbs used in anti-dandruff formulations. They review evaluation parameters specific to anti-dandruff shampoos: antimicrobial assays (zone of inhibition), pH, toxicity, and stability. They also list many herbs with antifungal or antibacterial properties (though they do not limit themselves to Amla, Reetha, Shikakai): this provides a valuable herbal “menu” for reference.

3. A Comprehensive Review on Herbal Shampoos

This recent review gives a holistic overview of herbal shampoos, including consumer trends, therapeutic efficacy, and environmental/sustainability aspects. Significantly, it names Amla, Reetha, and Shikakai as key herbs and discusses their cleansing, conditioning, and hair-strengthening properties. The authors also compare herbal shampoos favorably versus synthetic

ones in terms of scalp health and reduced chemical-induced side effects. This is probably the closest "review article" to your exact topic, because it explicitly mentions your three herbs and their roles in hair care.

III. ANTI-DANDRUFF HERBAL SHAMPOO FORMULATION

1. Amla:

Biological Source: Phyllanthus emblica

Synonyms: Amlaki, Emblic Myrobalan

Amla (Emblica officinalis), Reetha (Sapindus mukorossi), and Shikakai (Acacia concinna) have been widely used in Ayurvedic hair-care systems for centuries, each offering unique benefits attributable to their rich phytochemical profiles. Amla, known for its high vitamin C and antioxidant content, plays a crucial role in reducing oxidative stress on the scalp, promoting hair growth, and enhancing follicular strength. It also possesses antimicrobial and anti-inflammatory properties, making it effective in alleviating dandruff-related irritation and restoring scalp health.

2. Reetha:

Biological Source: Sapindus mukorossi

Synonyms: Soapnut, Arishtak

Reetha, often referred to as "soapnut," is a natural source of saponins, which act as mild yet effective surfactants. These saponins provide cleansing action without stripping the scalp of its natural oils, helping maintain moisture balance while removing dirt, sebum, and dandruff flakes. Its inherent antifungal activity further supports dandruff management by suppressing the growth of Malassezia species. Additionally, Reetha contributes to foam stabilization, an important cosmetic property in shampoo formulations.

Fig. 2: Reetha (Sapindus mukorossi)

3. Shikakai:

Biological Source: Acacia concinna Synonyms: Soap pod, Fruit for Hair

Shikakai, known as the "fruit for the hair," is prized for its gentle cleansing ability, natural conditioning effects, and scalp-soothing activity. Rich in tannins, saponins, and polyphenols, Shikakai helps strengthen hair shafts, reduce breakage, and alleviate scalp dryness factors often associated with persistent dandruff. Its mildly acidic nature supports the maintenance of an optimal scalp pH, which discourages microbial overgrowth and enhances cuticle smoothness.

Fig. 3: Shikakai (Acacia concinna)

When used together, Amla, Reetha, and Shikakai provide a synergistic effect, combining cleansing, conditioning, antifungal, and anti-inflammatory actions. This synergy makes them ideal candidates for formulating effective, natural, and consumer-friendly anti-dandruff shampoos. Their integration into modern cosmetic science bridges the gap between traditional Ayurvedic knowledge and evidence-based

dermatological care, highlighting their relevance in current hair-care research and product development.

Herbal Approach to Anti-Dandruff Therapy:
Herbal ingredients contain a wide range of phytochemicals such as alkaloids, flavonoids, tannins, glycosides, and saponins that exhibit antimicrobial, anti-inflammatory, and antioxidant actions. They also improve air quality by nourishing hair roots, preventing hair fall, and maintaining scalp pH. The use of Amla, Reetha, and Shikakai in combination helps create a balanced shampoo with cleansing and therapeutic properties.

Sr.no	Plant Name	Scientific Name	Major Phytochemicals	Pharmacological Roles in Shampoo
1.	Amla	Phyllanthus emblica	Vitamin c, Gaallic acid, Ellagic acid, Emblicanins A&B, Polphenols, Flavonoids	Antioxidant, anti-inflammatory, strengthens hair follicles, reduces scalp irritation
2.	Reetha	Sapindus mukorossi	Saponins, Sugars, Fatty acids	Natural surfactant, cleansing agent, romoves excess sebum, antimicrobial
3.	Shikakai	Acacia concinna	Saponins, Tannins, Vitamins A, D, E, K, Nicotinic acid	Mild cleanser, natural conditioner, maintains scalp pH, anti-dandruff, anti-itch activity.

Table No.1: Phytochemical Constituents of Amla, Reetha and Shikakai

Sr.no	Parameter	Amla	Reetha	Shikakai
1.	Antifungal Action	Inhibits Malassezia through polyphenols	Saponins disrupt fungal membranes	Tannins inhibit fungal colonization
2.	Anti-inflammatory Action	Reduces scalp Inflammation	Mild soothing effect	Calms itching &irritation
3.	Cleansing Activity	Minimal Cleansing	Primary natural Surfactant	Mild cleansing,prevents dryness
4.	Conditioning Effect	Strengthens hair roots	Mild conditioning	Excellent natural conditioner
5.	Sebrum Control	Regulates scalp oil	Removes excess sebum	Maintains Scalp balance

Table 2: Mechanism of Anti-Dandruff Action of Key Ingredients

IV. METHODOLOGY

Data Collection and Organization:
All extracted data were categorized into the following thematic groups:

1. Phytochemical composition of the herbs
2. Pharmacological activities relevant to dandruff management
3. Traditional Ayurvedic uses and ethnobotanical significance
4. Extraction methods and formulation techniques
5. Evaluation parameters of herbal shampoos (foamability, pH, viscosity, antifungal activity)
6. Comparative advantages over synthetic shampoos

Information was systematically tabulated and cross-verified to identify overlaps, complementary findings, and research gaps.

Data Analysis and Synthesis:
A qualitative synthesis approach was used due to the diversity in study designs. Findings from various sources were compared to determine:

- The synergistic potential of Amla, Reetha, and Shikakai.
- Their mechanisms of action against Malassezia and dandruff-associated conditions.
- Their formulation advantages such as mild surfactant properties (Reetha), conditioning effects (Shikakai), and antioxidant benefits (Amla).

- Their safety, stability, and environmental sustainability in cosmetic applications.

Patterns were identified and analyzed to build a cohesive understanding of the herbs' suitability for anti-dandruff shampoo formulations.

Method of Preparation:

After studying and analysing several articles based on the formulation of Herbal Anti-dandruff shampoo, we have highlighted the most used below method of preparation;

1. Extracts of Amla, Reetha, and Shikakai are prepared via decoction or ethanolic extraction.
2. Reetha extract is used as the main surfactant base.
3. Other extracts are incorporated with constant stirring.
4. Thickener is added to adjust viscosity.
5. pH is adjusted to 5–6.
6. The final formulation is filtered, packed, and labeled.

Sr.no	Ingredient	Function
1.	Amla extract/powder	Anti-dandruff, Antioxidant, scalp protection
2.	Reetha extract/powder	Natural surfactant, cleansing agent
3.	Shikakai extract/powder	Conditioner, detangler, pH balancer
4.	Distilled water	Solvent
5.	Xanthan gum /HPMC	Thickening agent
6.	Tea tree oil/Neem oil	Added antifungal activity
7.	Sodium benzoate/potassium sorbate	Natural preservative
8.	Citric acid	PH adjustment
9.	Perfume (mild)	Aroma

Table 3: Formulation Components for Herbal Anti-Dandruff Shampoo

V. EVALUATION TEST

A number of assessment criteria are evaluated in order to guarantee the herbal shampoo's effectiveness, safety, and acceptance. Standardizing the formulation, verifying the stability of the product, and evaluating its performance all depend on these tests.

1. Organoleptic Assessment

First, the prepared shampoo is assessed for physical attributes like:

Color: It should be consistent and eye catching.

Odour: It should smell nice and herbal, not artificial or unpleasant.

Look: It should be uniform in appearance, devoid of any lumps or separation.

Texture: Depending on formulation, it might be slightly viscous or smooth and gel-like [13].

2. Measurement of pH

One important factor influencing scalp compatibility is the shampoo's pH.

Method: The pH of a 10% shampoo solution (shampoo diluted in distilled water) is measured using a digital pH meter.

The ideal range is between 4.5 and 6.5 to avoid dryness or irritation and to match the pH of the scalp naturally [14].

3. Measurement of Viscosity

The consistency and simplicity of use of the shampoo are determined by its viscosity. Method: Measured using an appropriate rotating viscometer or a Brookfield viscometer. Note: The thickness of the shampoo should be reasonable, meaning it shouldn't be too thick or runny [14].

4. Foaming Ability and Foam Stability

Foaming capacity gives an idea of cleansing efficiency.

Method: Shake test 1 gm of shampoo is mixed with 20 mL of distilled water in a graduated cylinder and shaken vigorously.

Foam Height Measurement: The height of foam is measured immediately and again after 5 minutes to check foam stability [15].

5. Dirt Dispersion Test

This test checks whether the shampoo can hold dirt in the foam and prevent it from redepositing on the hair.

Method: A drop of India ink is added to the shampoo solution. The mixture is shaken and observed.
Result Interpretation: If the ink remains in the foam, it indicates poor dirt dispersion. If the ink moves to the water layer, it signifies good cleansing efficiency [16].
6. Surface Tension Measurement
Lower surface tension enhances wetting and spreading properties of shampoo.
Method: A stalagmometer or drop-counting method is used to calculate surface tension.
Ideal Value: Should be significantly lower than pure water (72 dynes/cm), ideally around 35– 40 dynes/cm.
7. Wetting Time Test
This test determines how quickly the shampoo wets hair strands or wool threads.
Method: A 1% shampoo solution is prepared. A standard wool thread is dropped into it, and the time taken to sink is recorded.
Shorter Time = Better Wetting.
8. Solid Content Determination
This reflects the concentration of active ingredients.
Method: 4 g of shampoo is evaporated in a dish at 105°C until a constant weight is achieved.
Ideal Result: Should be between 20–30% solid content.
9. Conditioning Performance
This test evaluates the after-feel, smoothness, shine, and ease of combing post-application.
Method: A trained panel or volunteers assess hair feel after drying.
Parameters: Detangling ease, softness, non-sticky finish, and natural shine are rated.
10. Microbial Load Test
Ensures that the herbal formulation is free from microbial contamination.
Method: Total plate count method is used to identify and quantify microbial colonies.
Requirement: Should comply with pharmacopeial limits for topical products

Sr.no	Test Parameter	Description
1.	pH	Should be 5.0-6.0to maintain scalp health
2.	Viscosity	Determines flow, Consistency,spreadability
3.	Foam Height&Stability	Measures cleansing and surfactant effiency
4.	Solid Content	Indicates formulation purity and stability
5.	Surface Tension	Should be low for good cleansing action
6.	Dirt Dispersion Test	Indicates ability to remove dirt without oil spreading in foam
7.	Wetting Time	Lower value indicates good penetration ability
8.	Anti-fungal test	Activity against candida
9.	Irritation study	Ensures formulation is non- irritant
10.	Stability Study	Evaluated under different temperatures &conditions

Table 4: Evaluation Parameters for Herbal Shampoos

Sr.no	Parameter	Amla	Reetha	Shikakai
1.	Hair Strengthening	Excellent	Moderate	Good
2.	Foaming Ability	Low	High	Moderate
3.	Conditioning	Moderate	Mild	Excellent
4.	Anti-dandruff Activity	Strong	Moderate	Strong
5.	Scalp Soothing	High	Mild	High
6.	Compatibility in formulations	Very good	Very good	Very good

Table 5: Comparative Benefits of Amla,Reetha, and Shikakai in Shampoo Formulations

VI. DISCUSSION AND FUTURE PROSPECTS

The findings from the reviewed literature demonstrate that Amla, Reetha, and Shikakai each possess distinct yet complementary properties that make them highly suitable for anti-dandruff shampoo formulations. Their rich phytochemical profile, including tannins, saponins, flavonoids, polyphenols, and essential nutrients, plays a crucial role in combating dandruff and maintaining scalp health. Amla, with its high

vitamin C and antioxidant content, helps reduce oxidative stress, strengthen hair follicles, and alleviate inflammation factors frequently associated with dandruff recurrence. Studies further highlight its antimicrobial potential against Malassezia, a primary causative agent of dandruff.

Reetha, known for its natural saponins, contributes significantly to the cleansing action of herbal shampoos. Unlike synthetic surfactants that strip the scalp of natural oils, Reetha cleanses effectively while preserving moisture balance. Its antifungal activity further enhances dandruff control, providing a dual benefit of gentle cleansing and microbial suppression.

Shikakai, valued for its mild cleansing and conditioning properties, supports scalp pH maintenance, reduces irritation, and prevents the excessive dryness often observed with chemical-based shampoos. Its naturally acidic nature discourages microbial overgrowth while promoting cuticle smoothing and reducing flakiness. Literature consistently supports the synergistic action of these three botanicals when used together. Their combined effects improve cleansing efficiency, scalp nourishment, antifungal activity, and hair conditioning attributes essential for an effective anti-dandruff formulation. Compared to synthetic anti-dandruff agents such as ketoconazole and zinc pyrithione, herbal formulations offer improved biocompatibility, fewer side effects, and better long-term scalp tolerance. However, challenges remain in standardizing herbal extracts, ensuring batch-to-batch consistency, enhancing stability, and scientifically validating traditional claims through controlled studies. Overall, the review underscores the promising potential of Amla, Reetha, and Shikakai as safe and effective natural alternatives in modern anti-dandruff hair care.

There is significant scope for further exploration and scientific enhancement of herbal anti-dandruff shampoo formulations containing Amla, Reetha, and Shikakai. Future research could focus on:

1. Standardization of Extracts: Developing standardized extraction techniques to ensure consistent levels of active phytochemicals such as saponins and tannins.
2. Advanced Phytochemical Profiling: Using chromatographic and spectroscopic techniques (HPLC, GC–MS) to identify specific antifungal and anti-inflammatory compounds.
3. Mechanistic Studies: Laboratory studies to elucidate the precise mechanisms by which these herbs inhibit Malassezia and regulate scalp microbiota.
4. Formulation Optimization: Incorporating modern formulation technologies such as nanoemulsions, micellar systems, or encapsulation to enhance stability and bioavailability of herbal actives.
5. Clinical Evaluations: Conducting controlled clinical trials to assess efficacy, safety, and consumer acceptance compared to commercial synthetic shampoos.
6. Sustainability and Green Chemistry: Exploring eco-friendly extraction methods and biodegradable packaging to enhance the environmental benefits of herbal products.
7. Synergistic Combinations: Evaluating combinations with other botanicals such as neem, aloe vera, and tea tree oil to enhance antifungal and soothing properties.

VII. CONCLUSION

This review highlights the significant potential of Amla, Reetha, and Shikakai as effective, natural, and sustainable ingredients for the formulation of anti-dandruff shampoos. Their combined actions including antioxidant, antifungal, anti-inflammatory, cleansing, and conditioning effects address both the symptoms and underlying causes of dandruff. The synergistic interaction of these botanicals provides a comprehensive approach to scalp care, offering advantages over synthetic chemical-based formulations that often cause irritation, dryness, or long-term scalp imbalance.

The reviewed evidence supports their traditional use in Ayurvedic hair care while also emphasizing the need for further scientific validation and formulation optimization. With increasing consumer preference for natural and eco-friendly products, herbal shampoos incorporating Amla, Reetha, and Shikakai hold great promise in the cosmetic and dermatological markets. Continued research, improved standardization, and advanced formulation technologies will further enhance their therapeutic efficacy and global acceptance. Overall, these botanicals represent a valuable foundation for developing safe, effective, and

environmentally considerate anti-dandruff hair care solutions.

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