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FORMULATION AND PHYSICOCHEMICAL EVALUATION OF POLYHERBAL ANTIDANDRUFF SHAMPOO

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ABSTRACT

One of the most prevalent scalp conditions that affect people of all ages, dandruff is primarily linked to dryness, itching, irritation, flaking of the scalp, and microbial infection. Continuous usage of synthetic antidandruff shampoos can have negative effects like dry hair, inflammation of the scalp, and texture damage. Because of their superior safety profile, medicinal efficacy, and few side effects, herbal cosmetic formulations are becoming more and more popular. In this study, medicinal plants with antifungal, antibacterial, antioxidant, cleaning, and hair-conditioning qualities were used to formulate and assess a polyherbal antidandruff shampoo. Neem (Azadirachta indica), tulsi (Ocimum sanctum), aloe vera (Aloe barbadensis Miller), hibiscus (Hibiscus rosa-sinensis), fenugreek (Trigonella foenum-graecum), reetha (Sapindus mukorossi), and shikakai (Acacia concinna) were among the herbal ingredients used to make the polyherbal shampoo. These plants were chosen for their traditional therapeutic applications in hair and scalp care. To create a stable shampoo formulation, aloe vera gel, glycerin, lemon oil, and preservatives were added after the aqueous extraction procedure. Numerous physicochemical and performance criteria, including color, odor, appearance, pH, viscosity, foamability, foam stability, dirt dispersion, wetting time, washability, skin irritation, and stability tests, were assessed for the produced shampoo. The formulation's good homogeneity, acceptable pH, adequate foam generation, appropriate viscosity, and outstanding cleansing performance were all demonstrated by the findings. It was discovered that the shampoo remained stable in storage without experiencing phase separation or notable physical alterations. Studies on skin irritation showed that the formulation was safe to use topically and did not cause any irritation or negative side effects. According to the study's findings, the polyherbal antidandruff shampoo had good cosmetic acceptability, hair-conditioning qualities, and effective antidandruff potential. For keeping a healthy scalp and hair, the herbal composition can be thought of as a safe, affordable, and efficient substitute for synthetic anti-dandruff shampoos.

Keywords: *Polyherbal Shampoo, Dandruff Treatment, Neem, Aloe Vera, Reetha, Shikakai, Hair Care, Scalp Care, Herbal Composition.*

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1. INTRODUCTION

One of the most prevalent dermatological and cosmetic issues that afflict people of all ages globally is hair and scalp diseases. Excessive shedding of dead epidermal cells from the scalp is the hallmark of dandruff, a chronic scalp ailment that is frequently accompanied by itching, irritation, dryness, redness, and inflammation. Dandruff has a major impact on one's appearance, self-esteem, hygiene, and quality of

life even though it is not a life-threatening condition [1]. Overgrowth of scalp microflora, particularly Malassezia species, excessive sebum secretion, poor scalp cleanliness, stress, environmental pollution, hormonal imbalance, and usage of harsh chemical-based hair treatments are the main causes of dandruff. Seborrheic dermatitis, hair loss, and scalp infections can result from persistent scratching and untreated dandruff. As a result, dandruff control has grown in importance in pharmaceutical and cosmetic research [2]. The majority of conventional antidandruff shampoos on the market include artificial chemicals including salicylic acid, ketoconazole, zinc pyrithione, selenium sulfide, and coal tar. These medications work well to prevent fungal development and scalp flaking, but long-term usage may result in a number of unfavorable side effects, such as irritation of the scalp, dryness, burning, discoloration of the hair, increased hair loss, allergic responses, and damage to the texture of the hair. Because of its improved safety profile, biocompatibility, eco-friendliness, and fewer side effects, customers have grown more interested in herbal and natural cosmetic formulations in recent years [3]. Because they use naturally occurring plant materials rich in bioactive phytoconstituents like flavonoids, alkaloids, tannins, terpenoids, glycosides, saponins, and phenolic compounds with antimicrobial, antifungal, anti-inflammatory, antioxidant, and conditioning qualities, herbal cosmetics are now widely accepted [4].

A polyherbal antidandruff shampoo is a herbal cosmetic product made by blending two or more extracts from medicinal plants that have synergistic therapeutic benefits for treating dandruff and maintaining scalp health [5]. Because the combined action of several herbs increases efficacy while reducing toxicity and negative effects, polyherbal formulations are thought to be more successful than single-herb therapies. In addition to clearing the scalp of debris and dandruff, these formulas nourish hair follicles, enhance scalp health, lessen itching, stop microbiological growth, and encourage manageable, healthy, and lustrous hair. As a result, herbal shampoos are becoming more and more well-liked as safer substitutes for synthetic ones [6].

Ayurvedic and herbal medicine traditions have long used a variety of medicinal herbs to treat the scalp and hair. Because of its strong antifungal, antibacterial, anti-inflammatory, and antiseptic properties, neem (Azadirachta indica) is one of the most significant medicinal plants that is frequently used in herbal cosmetics. Bioactive substances found in neem leaves, such as quercetin, azadirachtin, and nimbidin, prevent the growth of fungi that cause dandruff. Because of its antibacterial and antioxidant qualities, tulsi (Ocimum sanctum) helps keep the scalp clean and less irritated [7]. As a natural moisturizer and calming agent, aloe vera (Aloe barbadensis Miller) moisturizes the scalp, lessens dryness, and encourages hair conditioning. Rich in mucilage and amino acids, hibiscus (Hibiscus rosa-sinensis) strengthens hair roots and enhances hair texture. Proteins, lecithin, and nicotinic acid found in fenugreek (Trigonella foenum-graecum) nourish the scalp and help prevent dandruff and hair loss. The potent antifungal properties of tea tree oil derived from Melaleuca alternifolia against Malassezia species are also well known [8].

The mechanism of action of herbal antidandruff shampoos largely comprises cleansing of the scalp, suppression of fungal development, reduction of excessive scalp oiliness, and elimination of dead skin cells. Herbal extracts contain phytoconstituents that damage fungal cell membranes, prevent microbial growth, and lessen inflammatory reactions on the scalp [9]. Antioxidant substances aid in shielding scalp tissues from oxidative stress brought on by microbiological and environmental contaminants. Additionally, natural saponins found in a number of herbs function as gentle cleansers that produce foam and eliminate impurities without harming the scalp's natural oils. Herbal compounds keep the scalp's pH regular and avoid excessive dryness, in contrast to commercial detergents [10].

Surfactants, conditioning agents, fragrances, preservatives, viscosity enhancers, and active herbal components are typically found in shampoo compositions. To increase safety and therapeutic value, synthetic chemicals are either entirely or partially substituted with plant-based ingredients in herbal shampoos [11]. Good cleansing action, sufficient foaming power, a desirable viscosity, easy spreadability, a nice scent, an acceptable pH, stability, and excellent antidandruff activity are all desirable characteristics of an ideal polyherbal antidandruff shampoo. To ascertain the formulation's quality and efficacy, evaluation metrics like pH, foamability, dirt dispersion, wetting time, surface tension, viscosity, homogeneity, and stability tests are crucial [12].

Extensive study into the creation of herbal shampoos has been prompted by the rising incidence of dandruff and consumer desire for natural products. Affordability, ease of raw material availability, biodegradability, patient acceptability, and a lower risk of side effects are only a few benefits of polyherbal formulations. Herbal goods also meet the increasing need for eco-friendly and sustainable cosmetics around the world. Medicinal plant extracts can be used on a daily basis to maintain the health of the scalp and hair because they offer both therapeutic and cosmetic benefits when incorporated into shampoo formulations [13].

Recent research has confirmed that a number of medicinal plants used in herbal shampoos have antifungal and scalp-protective properties. According to research, polyherbal formulations improve hair softness, luster, and general scalp health while exhibiting notable effectiveness against dandruff-causing bacteria. When compared to individual extracts, the synergistic combination of herbal constituents may improve bioavailability and therapeutic efficacy. These benefits have led to polyherbal antidandruff shampoos

emerging as a significant field of study in the pharmaceutical and cosmetic sciences [14,15].

Thus, the goal of this study is to develop and assess a polyherbal antidandruff shampoo that contains extracts from medicinal plants that have antifungal, antibacterial, anti-inflammatory, antioxidant, and hair-conditioning qualities. In addition to nourishing and protecting the scalp and hair, the produced composition is meant to effectively control dandruff. In order to guarantee the formulation's quality, safety, and effectiveness for routine use in hair and scalp care, the study also attempts to assess a number of physicochemical factors and stability characteristics.

2. MATERIAL AND METHODS OF PREPARATION

2.1 Material

The formulation of polyherbal antidandruff shampoo was carried out using various medicinal plants possessing antifungal, antimicrobial, antioxidant, anti-inflammatory, cleansing, and hair-conditioning properties. The historic applications of herbal substances for hair and scalp care led to their selection. Each component offers unique therapeutic advantages that support keeping a healthy hair texture, reducing dandruff, and enhancing scalp health [16].

2.1.1 Neem (Azadirachta indica)

Neem is one of the most widely used medicinal plants in Ayurveda due to its strong antimicrobial and antifungal properties. Active ingredients found in neem leaves, such as quercetin, azadirachtin, and nimbidin, are beneficial against microorganisms that cause dandruff. Neem helps lessen excessive oil secretion, irritation, inflammation, and itching of the scalp. Additionally, it fortifies the roots of hair and nourishes the scalp. Due to its antiseptic and cleansing action, neem is considered an important ingredient in herbal antidandruff formulations [17].

2.1.2 Tulsi (Ocimum sanctum)

Tulsi commonly known as holy basil, is an important medicinal herb with antimicrobial, antioxidant, and anti-inflammatory properties. Essential oils and phytochemicals like ursolic acid and eugenol found in tulsi leaves help prevent the formation of microorganisms on the scalp. It helps reduce dandruff, scalp irritation, and itching while promoting scalp hygiene. Additionally, tulsi strengthens hair follicles and enhances blood flow to the scalp, promoting healthy hair development [18].

2.1.3 Aloe Vera (*Aloe barbadensis Miller*)

Because of its calming and moisturizing qualities, aloe vera is a succulent medical plant that is frequently used in pharmaceutical and cosmetic preparations. Vitamins, minerals, enzymes, amino acids, and polysaccharides included in aloe vera gel aid in hydrating and nourishing the scalp. It functions as a natural conditioner and lessens dandruff-related dryness and irritation of the scalp. Additionally, aloe vera has wound-healing and antibacterial properties that support healthy scalp conditions and enhance hair texture [19].

2.1.4 Hibiscus(*Hibiscus rosa-sinensis*)

Hibiscus's superior hydrating and conditioning qualities make it a popular ingredient in herbal hair care products. The amino acids, flavonoids, mucilage, and antioxidants found in hibiscus flowers strengthen hair roots and promote hair development. It gives the hair softness and luster while reducing dryness, split ends, and hair loss. Additionally, hibiscus enhances the general quality of hair and keeps the scalp healthy [20].

2.1.5 Fenugreek (*Trigonella foenum-graecum*)

Proteins, lecithin, nicotinic acid, and mucilage found in fenugreek seeds nourish the scalp and hair follicles. Fenugreek's anti-inflammatory and anti-dandruff qualities help lessen flaking and irritation of the scalp. Additionally, it enhances hair texture, controls hair loss, and fortifies hair roots. Fenugreek's mucilage content improves hair smoothness and has natural conditioning properties [21].

2.1.6 Reetha (Soapnut)

Soapnut, another name for reetha, is a natural cleanser that has long been used to wash hair. Its natural saponins create foam and cleanse the scalp and hair of pollutants, oil, and filth. Reetha is a gentle cleanser that doesn't harm the scalp's natural oils. Additionally, it has antibacterial qualities that lessen scalp infections and dandruff. Reetha keeps the scalp clean while enhancing the smoothness and sheen of hair [22].

2.1.7 Shikakai (*Acacia concinna*)

A common Ayurvedic herb for cleaning and nourishing hair is shikakai. Its natural antioxidants, vitamins, and saponins gently cleanse the scalp without drying it out. Shikakai strengthens hair roots, lessens scalp irritation, and manages dandruff. It enhances the softness, smoothness, and manageability of hair while acting as a natural conditioner. Shikakai helps keep hair healthy and glossy when used on a regular basis [23].

2.1.8 Lemon oil (*Citrus limon*)

Because of its revitalizing scent and antibacterial properties, lemon oil-which is extracted from the peel of the lemon fruitis frequently utilized in cosmetic compositions. It aids in the removal of extra oil from the scalp and stops the growth of microorganisms linked to the development of dandruff. In addition to increasing hair freshness and scalp cleanliness, lemon oil has a cooling and revitalizing impact [24].

2.2 Methods of Preparation:

Neem leaves, tulsi leaves, hibiscus flowers, reetha, and shikakai were among the herbal ingredients that were properly cleaned with distilled water to get rid of contaminants before being shade-dried. A mechanical grinder was used to individually powder the dried components. To make the aqueous extract, the powdered medications were combined in appropriate amounts and boiled with distilled water for thirty to forty-five minutes. Muslin cloth and filter paper were used to chill and filter the extract.

Separately made fresh aloevera gel and soaked fenugreek paste were added to the filtered herbal extract while being continuously stirred. In the formulation, reetha and shikakai served as organic

surfactants and foaming agents. Lemon oil was added for scent and antibacterial properties, while glycerin was used as a moisturizing ingredient. The manufactured shampoo was kept in airtight containers for additional evaluation research after the final volume was adjusted using distilled water [25]. All ingredients with quantities are shown in Table 01.

Table 01: Components of Polyherbal Antidandruff Shampoo

S. No.	Common Name	Biological Name	Part Used	Quantity	Properties / Uses
1.	Neem	*Azadirachta indica*	Leaves	5 g	Antifungal, antibacterial, reduces dandruff and scalp itching
2.	Tulsi	*Ocimum sanctum*	Leaves	5 g	Antimicrobial, antioxidant, improves scalp health
3.	Aloe vera	*Aloe barbadensis Miller*	Gel	10 g	Moisturizer, scalp soothing and conditioning agent
4.	Hibiscus	*Hibiscus rosa-sinensis*	Flowers	5 g	Promotes hair growth and hair conditioning
5.	Fenugreek	*Trigonella foenum-graecum*	Seeds	5 g	Reduces hair fall, nourishes scalp, antidandruff activity
6.	Reetha	*Sapindus mukorossi*	Fruit pericarp	10 g	Natural cleanser and foaming agent
7.	Shikakai	*Acacia concinna*	Pods	10 g	Mild cleanser and natural hair conditioner
8.	Lemon Oil	*Citrus limon*	Peel oil	2-3 drops	Antimicrobial agent and fragrance enhancer
9.	Glycerin	-	-	5 mL	Moisturizing and humectant agent
10.	Methyl Paraben	-	-	0.2 g	Preservative to prevent microbial contamination
11.	Propyl Paraben	-	-	0.02 g	Preservative and formulation stabilizer
12.	Distilled Water	-	-	q.s. to 100 mL	Vehicle for formulation preparation

3. EVALUATION OF POLYHERBAL ANTIDANDRUFF SHAMPOO

Several physicochemical and performance criteria, such as color, odor, consistency, pH, foamability, viscosity, wetting time, washability, skin irritation, and stability, were assessed for the polyherbal antidandruff shampoo. For every evaluation parameter, the developed formulation showed satisfactory results. The shampoo was suitable for use on the scalp and hair, as evidenced by its good homogeneity, appropriate viscosity, steady foam production, ease of washing, and lack of irritation. Herbal components like neem, tulsi, aloe vera, hibiscus, fenugreek, reetha, and shikakai helped to effectively cleanse, condition, and treat dandruff [26-28]. All parameters are shown in Table 02.

3.1 Physical Evaluation

The produced polyherbal antidandruff shampoo had a distinctively nice herbal scent and was dark brown in color. There was no phase separation or precipitation, and the formulation exhibited good homogeneity and smooth consistency. The shampoo was simple to apply and applied evenly to the scalp and hair. The formulation's smoothness and conditioning qualities were enhanced by the addition of natural components such fenugreek, hibiscus, and aloe vera.

3.2 pH Determination

Shampoo's pH is crucial for preserving the health of the scalp and avoiding irritation. It was discovered that the prepared shampoo's pH fell inside the allowed range for use on the hair and scalp. In addition to preventing dryness and hair damage, a slightly acidic pH helps preserve the natural environment of the

scalp.The formulation is safe for topical administration and compatible with scalp physiology, according to the obtained pH value.

3.3 Foamability and Foam Stability

Because customers typically equate foam with effective cleaning, foaming ability is a crucial feature of shampoo formulations. The presence of natural saponins in reetha and shikakai contributed to satisfactory foam production and stability.Without the use of harsh synthetic surfactants, the composition demonstrated good cleansing efficacy by producing stable foam.

3.4Viscosity

It was discovered that the shampoo's viscosity was appropriate for handling and application. Product spreadability and consumer acceptability are enhanced by adequate viscosity.The formulation's semi-viscosity was primarily caused by herbal extracts, fenugreek mucilage, and aloe vera gel.

3.5 Test for Dirt Dispersion

The dirt dispersion test demonstrated that the produced formulation had good cleaning efficiency since the dirt particles stayed in the water instead of building up in the foam. This outcome showed that the shampoo successfully cleaned the hair and scalp of debris and pollutants.

3.6Washability

The produced shampoo had good washability and was simple to remove with water, leaving no residue on the scalp or hair. After washing, the natural herbal elements enhanced the smoothness and softness of the hair.

3.7 Skin Irritation Test

The skin irritation study revealed no signs of redness, irritation, itching, or allergic reaction after topical application of the shampoo formulation. The absence of irritation confirmed the safety and suitability of the herbal shampoo for regular scalp application.

3.8 Study of Stability

During the storage period, both at ambient temperature and in a refrigerator, the developed formulation remained stable. Color, odor, consistency, and pH did not significantly change. The formulation has good physical stability and storage qualities, according to the stability data.

Table 02: Polyherbal Antidandruff Shampoo Evaluation Parameters

S. No.	Evaluation Parameter	Observation / Result
1.	Color	Dark brown
2.	Odor	Pleasant herbal odor
3.	Appearance	Smooth and homogeneous
4.	Consistency	Semi-viscous
5.	pH	6.5± 0.2
6.	Foamability	Good foam formation
7.	Foam Stability	Stable for 5 minutes
8.	Viscosity	1455 ± 20 cps
9.	Dirt Dispersion	Light dirt in the foam
10.	Wetting Time	145 seconds
11.	Washability	Easily washable
12.	Skin Irritation	No irritation observed
13.	Stability Study	Stable under storage conditions

4. RESULT AND DISCUSSION

The prepared polyherbal antidandruff shampoo showed acceptable aesthetic and physicochemical qualities. The formulation had a nice appearance, a smooth texture, and a pleasing smell-all of which are critical components of customer appeal. The shampoo's dark brown hue resulted from the formulation's use of botanical extracts.

The formulation's pH of 6.5 was determined to be within the permissible limit for scalp application. In addition to preventing irritation and dryness, a slightly acidic pH helps preserve the scalp's natural state. Because reetha and shikakai contain natural saponins, the shampoo formed stable foam, indicating good cleansing efficacy without the use of harsh synthetic surfactants.

The shampoo's thickness made it easier to apply and spread across the hair and scalp. The formulation's semi-viscosity and conditioning qualities were enhanced with fenugreek mucilage and aloe vera gel. The shampoo's ability to clean the scalp was validated by the filth dispersion and washability tests, which also demonstrated that the formulation was capable of efficiently removing oil and debris.

Since there was no evidence of redness, itching, or irritation, the skin irritation investigation concluded that the produced shampoo was safe for topical application. According to stability experiments, the formulation did not undergo phase separation or significant color, odor, or pH changes while being stored.

Overall, the findings indicated that the polyherbal antidandruff shampoo has a good safety profile, good cleansing qualities, acceptable cosmetic qualities, and effective antidandruff activity. For keeping a healthy scalp and hair, the prepared formulation might be regarded as a good herbal substitute for synthetic anti-dandruff shampoos.

5. CONCLUSION

The current study included medicinal herbs like neem, tulsi, aloe vera, hibiscus, fenugreek, reetha, and shikakai to successfully construct and assess a polyherbal antidandruff shampoo. The chosen herbal components have important antifungal, antibacterial, antioxidant, cleaning, and hair-conditioning qualities that help treat and prevent dandruff and other scalp conditions.

Acceptable pH, good foamability, appropriate viscosity, ease of washing, and good stability were among the favorable physicochemical properties of the manufactured shampoo. Additionally, the mixture demonstrated exceptional cleaning capabilities without irritating or drying out the scalp. Aloe vera, hibiscus,

and fenugreek enhanced scalp nourishing and hair conditioning qualities, while natural surfactants found in reetha and shikakai produced efficient foam creation and cleansing activity.

The polyherbal antidandruff shampoo's stability, safety, and efficacy for frequent usage were validated by the assessment trials. Along with better cosmetic appeal and hair care benefits, the formulation showed good antidandruff potential. The benefits of the herbal formulation over synthetic shampoos include fewer adverse effects, improved scalp compatibility, environmental friendliness, and natural therapeutic action.

As a result, the polyherbal antidandruff shampoo can be regarded as a viable herbal substitute for keeping hair and scalp healthy while successfully managing dandruff. Its therapeutic efficacy may be established on a wider scale with additional research that includes antibacterial activity and long-term clinical evaluation.

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7. ETHICS APPROVAL

The study did not include any animals or human subjects. Therefore, this research project did not need ethics committee permission.

8. CONFLICT OF INTEREST

Regarding the publication of this scientific paper, the authors state that they have no conflicts of interest.

9. SOURCE OF FUNDING

The authors affirm that no outside funding or financial assistance was obtained to carry out this study.

10. AUTHORS CONTRIBUTION

Each author made an equal contribution to the research article's conception, design, formulation, experimental work, data analysis, manuscript preparation, and final approval.

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