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DEVELOPMENT AND EVALUATION OF HERBAL ANTI-DANDRUFF FORMULATION

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ABSTRACT

Dandruff is a common scalp disorder characterized by excessive flaking, itching, dryness and irritation of the scalp. The present study focuses on the formulation and evaluation of herbal anti-dandruff shampoo containing Neem, Tulsi, Aloe Vera, Reetha, Shikakai, Fenugreek and Peppermint oils. These natural ingredients were chosen because of their traditionally reported cleansing, antimicrobial, antifungal, soothing, moisturizing and scalp-conditioning properties. Neem (*Azadirachta indica*) and basil (*Ocimum sanctum*) have antimicrobial and antifungal properties, while aloe vera helps soothe and moisturize the scalp. Reetha (*Sapindus mukorossi*) and shikakai (*Acacia concinna*) act as natural cleansing agents, while fenugreek (*Trigonella foenum-graecum*) can help condition the scalp and reduce dryness. Peppermint oil provides a refreshing feeling and may contribute to scalp cleansing and antimicrobial activity. Herbal extracts and peppermint oil will be incorporated into a suitable shampoo base and evaluated for various physicochemical and performance parameters including color, odor, appearance, pH, viscosity, foamability, foam stability, wetting ability, dirt dispersion, solid content, spreadability, cleansing ability, skin/scalp irritation and consistency. The antifungal or anti-dandruff activity of the formulation can also be tested using appropriate microbial testing method. The developed formulation is expected to provide effective cleansing and scalp care while offering a plant-based alternative to traditional anti-dandruff shampoos.

INTRODUCTION

Dandruff, also known as pityriasis capitis or lobular dermatitis, is one of the most common chronic and recurrent scalp conditions globally. It is marked by irregular shedding of skin cells on the scalp, resulting in flaking of white or yellow scales. This condition is often accompanied by itching and redness, especially in more severe cases. Nearly half of the world's population experiences dandruff at some point in their lives, making it a major concern for appearance and skin health. Although dandruff is not contagious or life-threatening, it can have a significant impact on a person's social and emotional well-being.

Affected people often suffer from low self-esteem, social discomfort and a reduced quality of life. The recurring and long-lasting nature of the condition may require continued or repeated treatment, increasing the individual's challenges.

Dandruff can generally be divided into two main types depending on how active the oil glands on the scalp are:

Dry dandruff, also called pityriasis sicca: This type produces small, dry, white, and flaky particles that are not oily. It is more common in people with dry scalp. These layers fall easily on the clothes and shoulders.

Oily dandruff, known as pityriasis steatoides: This type forms large, yellow, and sticky flakes that stick to the scalp and hair. It is often associated with sebaceous dermatitis and increased oil production.

METHODOLOGY

Herbal Ingredients (Active Pharmaceutical Ingredients)

The following herbal medicines and plant extracts were used as active ingredients in the formulation:

Herbal Ingredients Used – Materials and Their Roles

S. No.	Herbal Ingredient	Botanical Name	Family	Part Used	Role in Formulation
1	Neem	<i>Azadirachta indica</i>	Meliaceae	Leaves (dried powder/extract)	Antifungal agent – inhibits <i>Malassezia</i>
2	Aloe Vera Gel	<i>Aloe barbadensis Miller</i>	Asphodelaceae	Leaf gel	Moisturizer, soother, viscosity enhancer
3	Tulsi Extract	<i>Ocimum sanctum L.</i>	Lamiaceae	Leaves (extract)	Antimicrobial, anti-inflammatory
4	Reetha Extract	<i>Sapindus mukorossi</i>	Sapindaceae	Fruit pericarp	Natural surfactant (foaming base)

5	Shikakai Extract	<i>Acacia concinna</i>	Fabaceae	Pods/fruit	Natural surfactant, hair conditioner
6	Fenugreek Extract	<i>Trigonella foenum-graecum</i>	Fabaceae	Seeds	Nourishing, conditioning, thickener
7	Peppermint Oil	<i>Mentha piperita</i>	Lamiaceae	Leaves (steam-distilled oil)	Fragrance, cooling, penetration enhancer

Chemicals and Reagents Used

S. No.	Chemical / Reagent	Grade	Manufacturer / Source
1	Xanthan Gum	Pharmaceutical Grade	Loba Chemie Pvt. Ltd., Mumbai
2	Glycerin (Glycerol)	IP Grade	Loba Chemie Pvt. Ltd., Mumbai
3	Citric Acid (Anhydrous)	AR Grade	Merck Specialities Pvt. Ltd.
4	Methyl Paraben	IP Grade	Loba Chemie Pvt. Ltd., Mumbai
5	Distilled Water	Purified (IP)	Prepared in-house
6	Ethanol (95%)	AR Grade	Merck Specialities Pvt. Ltd.

SHAMPOO PREPARATION

Step 1: Preparing Herbal Extract (Maceration Method)

Dried neem leaves and basil leaves were obtained from verified herbal suppliers. A specific amount of each plant material was placed in a clean, wide-mouthed glass container. Distilled water, in a ratio of 1:5 (drug to solvent), was added to the container, and the mixture was left to solidify at room temperature ($25 \pm 2^\circ\text{C}$) for 24–48 hours, stirring every 6 hours.

After solidifying, the mixture was filtered using several layers of muslin cloth to remove solid residues.

The resulting filtrate was then concentrated using a water bath set at 60°C until a semi-solid extract of the desired consistency was obtained. The same approach was adopted for reetha (fruit pericarp), shikakai (pod), and fenugreek (seed). The concentrated extract was placed in amber colored vials and stored at 4°C until ready for use.

Step 2: Preparing the Gel Base

Xanthan gum (1% w/v) was slowly dispersed in a measured amount of distilled water in a clean glass beaker. Continuous mechanical stirring was carried out using a magnetic stirrer at 500 rpm. Xanthan gum can stick if added too quickly, so it was added to the water while slowly stirring. Continue stirring until the glue is completely hydrated and forms a clear, smooth and sticky gel. The mixture was allowed to swell and hydrate for an additional 30

minutes without stirring before proceeding to the next step.

Step 3: Adding the Surfactant Base

Reetha and Shikakai extracts, which act as natural surfactants and provide a foaming base equal to 20% v/v in the formula, were added dropwise to the xanthan gum gel base slowly and at low speed with constant stirring.

Vigorous stirring was avoided to prevent excessive foaming during preparation. Stirring was kept at a gentle and consistent rate to ensure that the surfactant extract was mixed evenly into the base.

Step 4: Adding Herbal Active Ingredients

Based on the batch composition, measured amounts of Neem extract and Tulsi extract were added one after the other to the formulation, with gentle mixing after each addition.

Then aloe vera gel was slowly added and mixed evenly. Glycerine was also added at this stage as a humectant. Each ingredient was mixed thoroughly before adding the next ingredient to ensure complete and uniform integration throughout the formulation.

Step 5: Adding the Oil Phase (Peppermint Oil)

Before the peppermint oil was added to the aqueous formulation, it was dissolved in a small amount of glycerin, which served as a miscibility agent.

This was necessary because peppermint oil is hydrophobic and does not mix easily with water. The glycerine-oil mixture was added to the main formulation with continuous stirring to ensure a good and uniform dispersion of the oil without phase separation.

Step 6: pH Adjustment and Conservation

The pH of each batch was checked using a calibrated digital pH meter (Systronix 335).

If necessary, the pH was adjusted to a target range of 5.5–6.5 using citric acid solution for acidification or sodium hydroxide solution for alkalization, which was suitable for application to the scalp. Methyl paraben (0.2% w/v) was dissolved in a small amount of warm distilled water and added as a preservative to prevent microbial growth during storage. The final volume was made up to the required batch size (20 mL per batch) with distilled water (Q.S.) and mixed well.

EVALUATION PARAMETER

Physical Evaluation (Organoleptic Properties)

The colour, odor and physical appearance (texture, clarity, consistency) of each batch were examined using visual inspection and sensory evaluation.

The appearance was checked for lumps, roughness or separation of layers.

Foam height test

The ability of each formulation to produce foam was evaluated using the graduated cylinder method.

A 0.5 mL sample of each shampoo was placed in a clean graduated glass cylinder (250 mL capacity), and the volume was brought up to 50 mL with distilled water. The cylinder was sealed and shaken 10 times using standardized up

Viscosity measurement

The apparent viscosity of each formulation was measured using a Brookfield viscometer (DV-II+ Pro) with a suitable spindle (S62) at a speed of 20 rpm and a temperature of $25 \pm 2^\circ\text{C}$. Three readings were taken for each sample, and the average viscosity was calculated and reported in centipoise (CP). Viscosity is an important factor for shampoo formulation as it affects how easily the product can be poured, dispensed and applied.

Homogeneity test

Each shampoo formulation was checked visually and by touch for uniformity.

A thin layer of each sample was spread on a glass slide and examined under a $10\times$ magnifying lens for any dispersed particles, clusters or separation of components. A homogeneous product must have consistent distribution of all ingredients without visible separation.

Spread ability Test

Spreadability was assessed by applying a small amount (~ 0.5 mL) of each formulation to the back of the hand and spreading it manually with a finger.

Ease of spreading, area covered and any residue left behind were noted. Formulations were graded as 'good', 'moderate' or 'poor' depending on how easily they spread.

RESULT AND DISSCUSSION

Physical Evaluation (Organoleptic Properties)

The organoleptic properties of the shampoo are briefly presented. Physical assessment is an

important first step in evaluating any cosmetic formulation, as it provides quick information about how the product looks and feels, its overall quality and any early indications that it may not be stable.

The pH level in all three herbal batches was found to be within the safe range of 5.5 to 6.5, which is suitable for scalp use. The natural pH of the scalp is slightly acidic, around 4.5 to 5.5, and products with a pH between 5.5 and 6.5 are considered safe because they closely match the scalp's natural acid mantle while remaining stable in formulation.

The pH of the commercial shampoo was 5.5, which is slightly lower and closer to the natural pH of the scalp.

Significant differences in viscosity were observed between the three batches, which was directly related to the amount of reetha extract used. Batch B1, which contained 4 mL of reetha extract (low concentration), had the lowest viscosity at 39.3 cP, making it too thin for real-world use. Batch B2, containing 8 ml reetha and 2 ml shikakai, had medium viscosity 145.2 CP. The viscosity of batch B3 with 3 mL reetha and 2 mL shikakai was 284.3 cP, which was close to the texture of a regular shampoo gel.

When examined visually and under the microscope the herbal batches appeared to have a consistent texture, with no visible separation of layers, insoluble particles or roughness. This shows that the preparation process, especially the method of adding ingredients step by step and stirring continuously, did a good job of mixing all the components evenly into the product.

The shampoo applies easily to the skin, without pulling, tangling or leaving any residue. commercial shampoo.

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