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Formulation and Evaluation of Herbal Anti-Dandruff Shampoo

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Abstract

Dandruff is a common scalp disorder characterized by flaking, itching, and irritation, often associated with fungal growth and excessive sebum production. The increasing concern over the adverse effects of synthetic hair care products has led to a growing demand for safer, plant-based alternatives. The present study focuses on the formulation and evaluation of a herbal anti-dandruff shampoo using selected medicinal plant extracts known for their antifungal, antimicrobial, and soothing properties. Herbal ingredients such as neem (*Azadirachta indica*), aloe vera (*Aloe barbadensis*), tulsi (*Ocimum sanctum*), and hibiscus (*Hibiscus rosa-sinensis*) were incorporated along with suitable excipients to develop an effective and stable formulation.

The shampoo was prepared using mild surfactants and evaluated for physicochemical parameters including appearance, pH, viscosity, foamability, foam stability, detergency, wetting time, surface tension, and conditioning performance. Stability studies were conducted under different storage conditions to assess formulation integrity over time. The results indicated that the formulated shampoo exhibited acceptable viscosity, good foaming ability, efficient cleansing action, and a pH compatible with scalp conditions. The formulation also showed no signs of irritation and remained stable without phase separation.

The presence of bioactive phytoconstituents contributed to antifungal activity and scalp nourishment, suggesting its potential effectiveness in controlling dandruff. In conclusion, the developed herbal anti-dandruff shampoo is safe, effective, and offers a promising natural alternative to conventional synthetic shampoos. Further clinical studies are recommended to validate its long-term efficacy and commercial applicability.

Introduction

Hair care plays a vital role in maintaining the overall health and appearance of an individual. Among various hair problems, dandruff is one of the most common scalp disorders that affects people of all ages. It is primarily caused by the excessive shedding of dead skin cells from the scalp due to fungal infection, mainly Malassezia furfur, poor hygiene, or imbalance in sebum secretion. Continuous dandruff leads to itching, irritation, and even hair fall if not treated properly.

To overcome this problem, antidandruff shampoos are widely used as they help remove flakes, control fungal growth, and maintain scalp cleanliness. However, most commercial shampoos are chemical-based, containing synthetic surfactants, preservatives, and fragrances that may cause side effects such as scalp irritation, dryness, and hair damage on prolonged use. Therefore, there is an increasing demand for herbal formulations that are safe, effective, and environmentally friendly.

Herbal Antidandruff Shampoo

A herbal antidandruff shampoo is a cosmetic preparation that contains plant- based ingredients with antifungal, antibacterial, cleansing, and conditioning properties. It is formulated using natural extracts like Neem, Tulsi, Aloe vera, Shikakai, Lemon, and Rose extract, which not only cleanse the scalp but also nourish hair roots, promote growth, and prevent dandruff recurrence.

Advantages of Herbal Antidandruff Shampoo

- Natural and safe – Free from harsh chemicals like sulfates and parabens.
- Biodegradable and eco-friendly – Do not pollute the environment.
- Mild and non-irritant – Gentle on scalp and suitable for long-term use.
- Multifunctional action – Provide antifungal, antibacterial, and hair- conditioning effects.
- Cost-effective and easily available – Herbs are commonly accessible and economical.

Disadvantages

- Short shelf life – Absence of strong preservatives reduces product stability.
- Batch-to-batch variation – Herbal extracts may vary in potency depending on source and season.
- Less foam formation – Due to natural surfactants, the lathering is lower than synthetic shampoos.
- Longer treatment duration – Results may appear slowly compared to chemical products.
- Be stable, safe, and easy to rinse off.

Concept of Herbal Anti-Dandruff Shampoo

The concept of a herbal anti-dandruff shampoo is based on the idea of using natural plant-derived ingredients to cleanse the scalp, remove dandruff, and maintain the overall health of hair without causing adverse effects. Unlike synthetic shampoos that contain harsh chemicals, herbal shampoos use ingredients obtained from medicinal plants, which are rich in bioactive compounds like alkaloids, flavonoids, glycosides, saponins, and essential oils.

In ancient systems of medicine, especially Ayurveda, herbs such as Neem, Tulsi, Aloe vera, Shikakai, and Lemon have been used for centuries to treat scalp disorders. The herbal concept focuses not only on removing visible dandruff flakes but also on treating the root cause which may be fungal infection (Malassezia furfur), excess sebum production, or poor scalp hygiene.

The formulation concept involves combining various herbal extracts that possess antifungal, antibacterial, anti-inflammatory, and cleansing properties. For example:

- Neem acts as a natural antifungal and antimicrobial agent.
- Tulsi purifies the scalp and reduces inflammation.
- Aloe vera provides hydration and soothes irritation.
- Lemon juice maintains the scalp pH and reduces oiliness.
- Shikakai acts as a natural surfactant, cleansing hair gently and improving texture.

The idea behind herbal shampoo formulation is to create a synergistic effect, where multiple herbs work together to deliver maximum benefits. The concept also emphasizes biodegradability, safety, and sustainability, making herbal shampoos more environmentally friendly and gentle on the scalp compared to synthetic counterparts.
Thus, the core concept of herbal anti-dandruff shampoo lies in developing a natural, mild, and effective hair care product that not only cleanses but also heals, nourishes, and rejuvenates the scalp using the power of nature.

Need of Herbal Anti-Dandruff Shampoo

The need for herbal anti-dandruff shampoo arises due to the growing concerns associated with chemical-based hair care products and the increasing awareness about the advantages of herbal formulations. In recent years, the excessive use of synthetic shampoos containing surfactants like Sodium Lauryl Sulfate (SLS), parabens, and silicones has led to scalp irritation, dryness, and allergic reactions in many individuals. Moreover, these ingredients are not biodegradable and contribute to environmental pollution.

Dandruff, being a chronic and recurring scalp problem, requires long-term management. The prolonged use of synthetic antifungal shampoos often leads to resistance and side effects, making it necessary to look for safer alternatives. Herbal formulations provide that safe and effective option. They are gentle, non- toxic, and suitable for all hair types, including sensitive scalps.

Furthermore, environmental stress, changing lifestyles, poor diet, and pollution have made hair care a significant health concern. Herbal shampoos, enriched with natural antioxidants, vitamins, and minerals, not only remove dandruff but also nourish the scalp, strengthen hair follicles, and prevent damage caused by oxidative stress.

Another major reason for the growing need for herbal anti-dandruff shampoos is the increasing demand for eco-friendly and sustainable cosmetic products. Consumers are now more inclined towards natural and cruelty-free formulations. Herbal shampoos fulfill this need as they are derived from renewable plant sources and are biodegradable in nature.

In the pharmaceutical and cosmetic industries, there is also a rising interest in merging traditional herbal knowledge with modern scientific research to produce standardized, high-quality products. The need for herbal anti-dandruff shampoos fits perfectly within this modern trend of developing safe, effective, and sustainable formulations for hair and scalp care.Therefore, the need for herbal anti-dandruff shampoo is not only due to the rising incidence of dandruff but also due to the growing preference for natural, chemical-free, and environmentally friendly products that promote holistic scalp health and well-being.

ANATOMY OF HAIRS

Hair is one of the most distinctive features of mammals and serves various biological and cosmetic functions. It not only enhances personal appearance but also plays an important role in thermal regulation, protection, and sensory perception. Understanding the anatomy of hair is essential before formulating any hair care product such as shampoo, conditioner, or oil, because the structure of hair directly influences its strength, texture, and response to external agents.
The human hair is a keratinized filamentous structure that grows from the epidermis but originates deep within the dermal layer of the skin. Each hair strand is composed primarily of the protein keratin, along with small amounts of lipids, water, and pigments such as melanin. Hair growth and health depend on the proper functioning of the hair follicle, sebaceous glands, and scalp skin.

A. *Structure of Hair*

The hair consists of two main parts:

(a) *Hair Shaft*

The hair shaft is the visible part of the hair that extends above the surface of the skin. It is a non-living structure composed of keratinized cells. The shaft is cylindrical in shape and made up of three concentric layers:

- Cuticle:
  The outermost layer of the hair shaft. It is made up of thin, flat, overlapping cells arranged like the scales on a fish or the tiles on a roof. The cuticle protects the inner layers of the hair and provides smoothness and shine. A healthy cuticle is essential for maintaining hair luster and resistance to damage. When the cuticle is damaged due to heat, chemicals, or pollution, hair becomes rough, dull, and prone to breakage.
- Cortex:
  The middle and thickest layer, composed of elongated keratinized cells that give the hair its strength, elasticity, and texture. The cortex also contains melanin pigments, which determine the natural color of hair. The arrangement of keratin fibrils within the cortex influences the type of hair — straight, wavy, or curly.
- Medulla:
  The innermost layer of the hair shaft, consisting of loosely arranged cells and air spaces. It may be absent in fine or light-colored hair but is usually present in thick or coarse hair.

Figure 1 Hair Anatomy

(b) *Hair Root*

The hair root lies below the skin surface and anchors the hair within the scalp. It is enclosed within a small tubular structure called the hair follicle. The root plays a vital role in the growth and nourishment of the hair strand. The hair root and follicle are located within the dermis and are surrounded by blood vessels, nerves, and sebaceous glands.

Structure of Hair Follicle

The hair follicle is a dynamic, tunnel-like structure that extends from the epidermis into the dermis. It is responsible for the production and growth of hair. The follicle consists of the following parts:

Hair Bulb:

The bulb is the expanded base of the hair follicle and is the most vital part for hair growth. It contains matrix cells, which are actively dividing cells responsible for producing the hair shaft and the inner root sheath. These cells receive nourishment from blood vessels located in the dermal papilla, a small cone-shaped projection at the base of the bulb. Dermal Papilla:

The dermal papilla provides essential nutrients and oxygen to the growing hair through a network of capillaries. It also contains receptors for hormones and growth factors that regulate the hair growth cycle.

Inner and Outer Root Sheath:

The hair follicle is surrounded by two sheaths-
Inner Root Sheath (IRS): Made up of three layers (Henle's layer, Huxley's layer, and cuticle of the IRS), it helps in shaping the hair shaft and guiding it upward.
Outer Root Sheath (ORS): A continuation of the basal layer of the epidermis, it provides structural support and protection to the follicle.
Objectives

- To formulate a natural, mild, and effective shampoo
  The first and foremost objective is to prepare a shampoo using herbal ingredients that can effectively cleanse the scalp and remove dandruff flakes without damaging the hair or altering its natural oil balance. The formulation should be free from harsh surfactants, parabens, or synthetic fragrances.
- To utilize medicinally valuable herbs with antifungal and antibacterial properties
  The herbal shampoo should contain plant extracts such as Neem (Azadirachta indica), Tulsi (Ocimum sanctum), Aloe vera, Shikakai (Acacia concinna), Lemon juice, and Lavender oil, which are known for their potent antimicrobial and scalp-soothing effects. These herbs help in eliminating the dandruff-causing fungi (Malassezia furfur) and prevent recurrence.
- To maintain the natural pH and moisture of the scalp
  Maintaining scalp pH (around 5.5) is essential to prevent microbial growth and irritation. The herbal ingredients selected should help restore the scalp's natural acid mantle and maintain adequate moisture levels, avoiding dryness or excessive oiliness.
- To provide nourishment and strength to the hair
  Herbal ingredients such as Aloe vera and Shikakai not only help in cleansing but also supply essential nutrients like amino acids, vitamins, and minerals that strengthen hair follicles, reduce hair fall, and promote healthy growth. The objective is to achieve therapeutic action along with cosmetic enhancement.
- To ensure safety and suitability for long-term use
  The shampoo should be non-toxic, hypoallergenic, and safe for regular application on all hair types. The objective is to minimize side effects like scalp irritation, hair roughness, or loss of natural shine that are commonly associated with chemical-based shampoos.
- To evaluate the formulation scientifically
  The formulated herbal shampoo should undergo various evaluation tests, such as pH determination, foaming ability, dirt dispersion, viscosity, solid content, and stability studies, to ensure its effectiveness and quality. These tests help confirm that the product meets standard pharmaceutical and cosmetic parameters.
- To promote eco-friendly and sustainable product development
  One of the broader objectives is to encourage the use of renewable natural resources in cosmetic formulations. Herbal shampoos are biodegradable and environmentally safe, contributing to green chemistry and sustainable development.
- To bridge traditional knowledge with modern scientific validation
  Herbal medicine has been an integral part of ancient healthcare systems like Ayurveda. The objective of this study is to integrate this traditional wisdom with modern formulation techniques to develop a standardized, scientifically validated herbal anti-dandruff shampoo

Literature Review

Dandruff is a common scalp disorder characterized by flaking, itching, and irritation of the scalp, mainly caused by the overgrowth of the fungus Malassezia furfur. Conventional anti-dandruff shampoos contain synthetic antifungal agents such as zinc pyrithione, ketoconazole, or selenium sulfide, which though effective, often cause dryness, irritation, and damage to the scalp and hair on prolonged use. Therefore, in recent years, the use of herbal-based shampoos has gained popularity due to their mildness, safety, biodegradability, and therapeutic efficiency.

Several studies between 2022 and 2025 have reported the successful formulation and evaluation of herbal anti-dandruff shampoos using natural ingredients such as Neem, Tulsi, Aloe vera, Lemon, and Shikakai. These herbs possess potent antifungal, antimicrobial, antioxidant, and cleansing properties, making them suitable alternatives to synthetic ingredients.

In 2025, Maricharla Rakesh formulated and evaluated a herbal Neem anti- dandruff shampoo using Neem (Azadirachta indica), Tulsi (Ocimum sanctum), and Aloe vera extracts. The results showed good physical stability, pH 5.4 ± 0.1, and strong antifungal activity against Malassezia furfur. The study confirmed that herbal shampoos are safe for regular use and maintain scalp pH without irritation.

Shaikh et al. (2025) prepared a polyherbal shampoo containing Reetha, Shikakai, Neem, and Lemon extracts. The formulation exhibited good foaming ability, stable viscosity, and significant antifungal properties. They concluded that saponins present in Shikakai act as natural surfactants, effectively replacing chemical detergents while maintaining mild cleansing and scalp protection.

Aghara (2025) highlighted that polyherbal combinations show synergistic effects where Neem and Tulsi act as antifungal agents, Aloe vera provides conditioning, and Lemon juice maintains scalp pH. The author suggested that such formulations can offer long-lasting dandruff control without chemical irritation. Similarly, Sanghavi (2025) reported that the use of Aloe vera and Neem together improved scalp hydration and reduced flaking within two weeks of use.

During 2024, researchers focused on improving the physicochemical properties and stability of herbal shampoos. Kaushik and Sharma (2024) developed a polyherbal shampoo using Aloe vera and Lemon extracts. The product maintained a pH of 5.2 and viscosity around 1400 cP, indicating compatibility with scalp conditions. The study concluded that Aloe vera acts as a moisturizing and soothing agent while Lemon juice works as a mild antiseptic and natural preservative.

Tessema (2024) reported an experimental dataset showing that herbal leaf extracts such as Neem and Moringa significantly inhibited fungal growth and maintained product stability for over 60 days. Anitha and Subramanian (2024) also confirmed that phytochemicals like flavonoids, terpenoids, and phenolic compounds present in Neem and Tulsi are mainly responsible for antifungal and anti-inflammatory actions.

In 2023, comparative studies were carried out between herbal and synthetic formulations. Basu and Singh (2023) observed that herbal shampoos containing Neem, Tulsi, and Lemon extracts provided comparable cleansing and dandruff control efficacy to commercial chemical shampoos but without causing scalp irritation. Dubey and Sharma (2023) highlighted the role of Shikakai as a natural surfactant and cleansing agent due to its saponin content, which helps remove excess oil and dirt while maintaining the natural oils of the scalp.

Jha and Kaur (2023) discussed the antifungal effect of Neem and Tulsi extracts in herbal formulations, showing that herbal shampoos are both mild and therapeutically effective. Similarly, Mohan and Sharma (2023) prepared a Neem-Shikakai-Lemon shampoo that displayed good foam stability, natural color, and smooth texture, concluding that such combinations can effectively control dandruff with minimal side effects.

Earlier, in 2022, several studies contributed to the standardization of herbal formulations. Anand and Soni (2022) developed a Neem and Tulsi-based shampoo that showed strong antifungal activity and pH balance similar to the scalp's natural level. Kumar and Meena (2022) formulated a Neem and Aloe vera shampoo that provided conditioning and cleansing effects while remaining stable for 30 days. Kaur and Malik (2022) reported that natural surfactants like Shikakai and Reetha could completely replace synthetic detergents in herbal shampoos, producing stable foam and a mild cleansing effect.

Overall, the studies conducted between 2022 and 2025 emphasize that herbal anti-dandruff shampoos formulated with natural extracts such as Neem, Tulsi, Aloe vera, Lemon, and Shikakai are safe, effective, and eco-friendly alternatives to synthetic ones. These ingredients act synergistically to provide antifungal, cleansing, moisturizing, and pH-balancing effects, making them suitable for continuous scalp and hair care.

Materials Used

The herbal anti-dandruff shampoo is formulated using completely natural ingredients, each possessing specific therapeutic and cosmetic functions. The formulation aims to provide antifungal, cleansing, soothing, and refreshing effects
without any synthetic chemicals. Below are the detailed descriptions of each ingredient used in the preparation:

1. *Neem (Azadirachta indica)*

Fig. 2 : Neem Leaves

Family: Meliaceae
Part used: Leaves and bark extract
Major constituents: Azadirachtin, Nimbidin, Quercetin, and Nimbin

Role in formulation:

Neem is a well-known medicinal plant used for centuries in Ayurveda for its strong antifungal, antibacterial, and anti-inflammatory properties. In dandruff, the main causative organism is Malassezia furfur, which overgrows on the scalp. Neem extract effectively inhibits this fungus, reducing flakiness, itching, and scalp infection. It also purifies the scalp and improves scalp hygiene.
Moreover, it soothes scalp irritation and prevents recurrence of dandruff when used regularly.

2. *Tulsi (Ocimum sanctum / Holy Basil)*

Fig. 3 : Tulsi leaves

Family: Lamiaceae Part used: Leaves
Major constituents: Eugenol, Ursolic acid, Linalool, and Flavonoids

Role in formulation:
Tulsi possesses excellent antimicrobial, antiseptic, and antioxidant properties. It purifies the scalp by killing dandruff-causing microbes and helps maintain scalp cleanliness. Tulsi extract improves blood circulation to the scalp and strengthens the hair roots.
It also helps in soothing scalp inflammation and reduces itching caused by fungal infection or dryness. The pleasant herbal aroma of Tulsi further enhances the freshness of the shampoo.

3. *Aloe Vera Gel (Aloe barbadensis Miller)*

Fig. 4 : Aloe vera

Family: Liliaceae
Part used: Fresh leaf gel
Major constituents: Polysaccharides, Glycoproteins, Amino acids, Vitamins A, C, and E

Role in formulation:

Aloe vera acts as a natural moisturizer and conditioner. It hydrates the scalp, relieves irritation, and heals micro-inflammations caused by dandruff or scratching. The gel contains natural enzymes that remove dead cells and help regenerate healthy scalp tissue.

Additionally, Aloe vera adds smoothness, shine, and softness to hair strands, making them easier to manage. It balances scalp pH and prevents excessive dryness that may result from cleansing action.

Shikakai (Acacia concinna)

Fig. 5 : Shikakai

Family: Fabaceae Part used: Pods

Major constituents: Saponins, Flavonoids, and Tannins

Role in formulation:

Shikakai is a natural surfactant (cleansing agent) that replaces synthetic detergents. The saponins present in Shikakai produce mild foam that gently removes excess oil, dirt, and dandruff flakes from the scalp.

Unlike chemical surfactants (like SLS), Shikakai does not strip away natural oils, thus maintaining scalp moisture balance. It also acts as a natural conditioner, leaving hair soft, shiny, and smooth.

It enhances the overall cleansing power of the shampoo while keeping it gentle and safe for long-term use.

4. *Lemon Juice (Citrus limon) – Fresh Extract*

Family: Rutaceae

Part used: Fresh fruit juice

Major constituents: Citric acid, Limonene, Vitamin C, and Flavonoids

Role in formulation:

Lemon juice acts as a natural astringent and pH regulator. The citric acid helps control excess sebum (oil) secretion and prevents the greasy condition that often encourages fungal growth.

Its mild acidic nature restores scalp pH to around 5.5 — the ideal level for a healthy scalp. It also helps remove dead skin cells, reduce dandruff flakes, and provide a natural shine to the hair.

Lemon's vitamin C content further strengthens hair follicles and prevents breakage or dullness.

5. *Rose (Rosa damascena)*

Family: Rosaceae

Part used: Petals (flower extract)

Major constituents: Citronellol, Geraniol, Nerol, Phenylethyl alcohol, and Flavonoids

Role in formulation:

Rose extract serves as a natural fragrance enhancer, soothing agent, and mild antimicrobial component in the herbal shampoo. It imparts a pleasant floral aroma and helps to moisturize and condition the scalp and hair. The phenolic compounds present in rose petals exhibit antioxidant and antibacterial activity, which contributes to maintaining scalp hygiene and reducing irritation. Table 1 : Role of Ingredients

Methodology

1. *Collection and Authentication of Herbal Materials*

Fresh herbal ingredients such as Neem leaves (Azadirachta indica), Tulsi leaves (Ocimum sanctum), Aloe vera leaves (Aloe barbadensis Miller), Shikakai pods (Acacia concinna), Rose petals and Lemon fruits (Citrus limon) were collected from the local herbal market.

All plant materials were identified and authenticated by a botanist.

The collected materials were washed thoroughly with distilled water to remove dust and other impurities.

2. *Drying and Preparation of Extracts*

The collected plant materials (except Aloe vera gel and Lemon juice) were shade- dried at room temperature for about 7–10 days to preserve their active constituents. After complete drying, the materials were coarsely powdered using a grinder and passed through sieve no. 40 to obtain uniform particle size.

Neem, Tulsi, and Shikakai powders were stored in airtight containers until further use.

3. *Extraction of Herbal Ingredients*

Neem, Tulsi, and Shikakai extracts were prepared by boiling 10 g of each powdered material in 100 mL of distilled water for 20–30 minutes.

The solutions were cooled, filtered through muslin cloth, and stored in separate containers.

Aloe vera gel was extracted by cutting fresh Aloe vera leaves and scooping out the inner transparent gel.

Lemon juice was collected from fresh fruits, filtered, and used immediately to maintain its vitamin C content.

Fig.6 : Shikakai Extract

Fig.7: Neem Extract

Fig.8 : Tulsi Extract

4. *Preparation of Herbal Shampoo Base*

About 50 mL of distilled water was taken in a clean beaker and slightly warmed (not exceeding 40°C).
The Shikakai extract was added slowly into the warm water with constant stirring to form the natural cleansing base.
Then, Neem extract and Tulsi extract were added gradually and mixed well to ensure uniform distribution.

5. *Incorporation of Moisturizing and pH Regulating Agents*

Aloe vera gel was added into the mixture with continuous stirring to improve viscosity, smoothness, and moisturizing effect.
After that, fresh Lemon juice was added drop by drop with gentle stirring to maintain the pH (around 5.5) and reduce excess scalp oil.

6. *Addition of Fragrance*

A few drops of Rose extract were added to impart a pleasant fragrance and mild antiseptic property.
The mixture was stirred continuously until all the ingredients blended uniformly.

7. *Volume Adjustment and Filtration*

The remaining amount of distilled water was added to make the final volume up to 100 mL.
The prepared shampoo was filtered through muslin cloth to remove any undissolved particles.
A clear, uniform, and stable herbal shampoo was obtained.

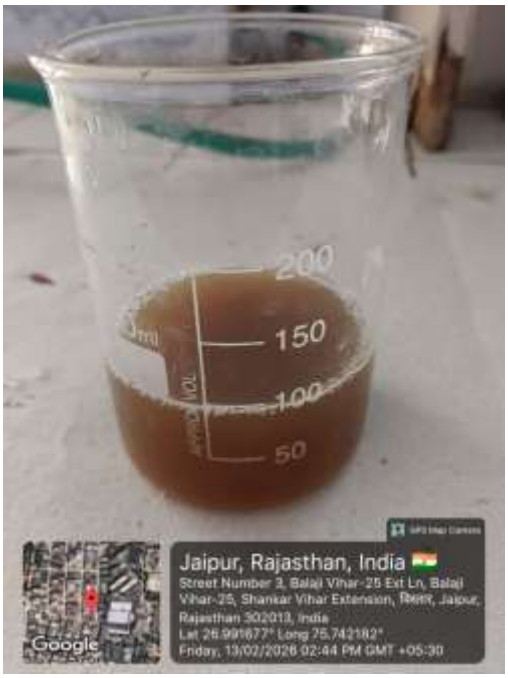

Fig.9 : Herbal Anti-Dandruff Shampoo(100ml)

8. *Storage*

The prepared herbal anti-dandruff shampoo was transferred into a clean, dry, amber-colored bottle.
It was labeled properly with the formulation name and date of preparation.
The product was stored in a cool and dry place away from direct sunlight to maintain stability and shelf life

Formulation

1. **Neem extract** – 15 mL
   Used as an antifungal and antibacterial agent. Neem (Azadirachta indica) helps to remove dandruff-causing fungi, reduces scalp infection, and keeps the scalp clean and healthy.
2. **Tulsi extract** – 7 mL
   Acts as a natural antimicrobial and scalp purifier. Tulsi (Ocimum sanctum) soothes itching, prevents infection, and refreshes the scalp.
3. **Aloe vera gel** – 7 mL
   Works as a moisturizer and conditioner. Aloe vera (Aloe barbadensis Miller) hydrates the scalp, reduces dryness, and provides smoothness and shine to the hair.
4. **Shikakai extract** – 15 mL
   Functions as a natural cleanser and mild foaming agent. Shikakai (Acacia concinna) contains saponins that gently cleanse hair without stripping natural oils.
5. **Lemon juice (fresh)** – 2 mL
   Serves as a natural pH balancer and mild preservative. Lemon (Citrus limon) controls excess oil, prevents flaking, and adds freshness to the formulation.
6. **Rose extract** – 2 mL
   Provides a natural fragrance, antioxidant, and soothing effect. Rose (Rosa damascena) adds pleasant aroma, calms irritation, and enhances the aesthetic value of the shampoo.
7. **Distilled water** – quantity sufficient (q.s.) to make 100 mL
   Used as the solvent base to dissolve and mix all herbal ingredients uniformly, giving a smooth, homogeneous final product.

All ingredients were measured accurately and mixed sequentially with continuous stirring until a uniform consistency was achieved. The formulation was filtered and stored in a clean, airtight container for further evaluation.

Evaluation Tests

After formulation, the prepared herbal anti-dandruff shampoo was evaluated for various physicochemical and performance parameters to ensure quality, safety, and effectiveness.
The following tests were carried out:

1. *Determination of Physical Appearance*

Purpose:
To observe the general physical characteristics of the prepared shampoo.

Method:
The shampoo was visually inspected in good daylight against a white background. Its color, odor, texture, and overall appearance were noted.

Significance:
A uniform color, pleasant herbal odor, and smooth texture indicate proper mixing and product acceptability.

2. *Determination of pH*

Purpose:
To check whether the shampoo is compatible with the scalp and hair.

Method:
1% solution of the shampoo was prepared using distilled water.
The pH was measured using a calibrated digital pH meter at room temperature.

Significance:
Maintaining scalp pH prevents irritation, dryness, and fungal growth. An ideal pH ensures mildness and suitability for regular use.

3. *Determination of Solid Content*

Purpose:
To determine the percentage of total solids present in the formulation.

Method:
10 mL of shampoo was taken in a pre-weighed dish and evaporated to dryness on a water bath.
The residue was weighed, and % solids were calculated.

Significance:
Helps to determine product concentration and ensure uniform consistency in each batch.

4. *Foaming Ability and Foam Stability Test*

Purpose:
To evaluate the foam producing capacity and its stability.

Method:
1% shampoo solution was prepared and shaken for 10 seconds in a graduated cylinder.
The volume of foam was measured initially and after 5 minutes.

Significance:
Moderate and stable foam indicates good cleansing action without harsh surfactants.
Excessive foam is not necessary for cleaning but affects consumer appeal.

5. *Viscosity Determination*

Purpose:
To determine the flow property and thickness of shampoo.

Method:
Viscosity was measured using a Brookfield viscometer at room temperature using spindle no. 3 at 50 rpm.

Significance:
Viscosity indicates the smoothness and spreadability of shampoo. Ideal viscosity helps in easy application and stable product texture.

6. *Skin Irritation Test (Optional for Safety)*

Purpose:
To confirm that the shampoo does not cause irritation or allergic reaction on skin.

Method:
A small quantity of shampoo was applied to a patch of skin on the forearm. The area was observed for 24 hours for any reaction.

Significance:
Ensures safety and mildness for human use.

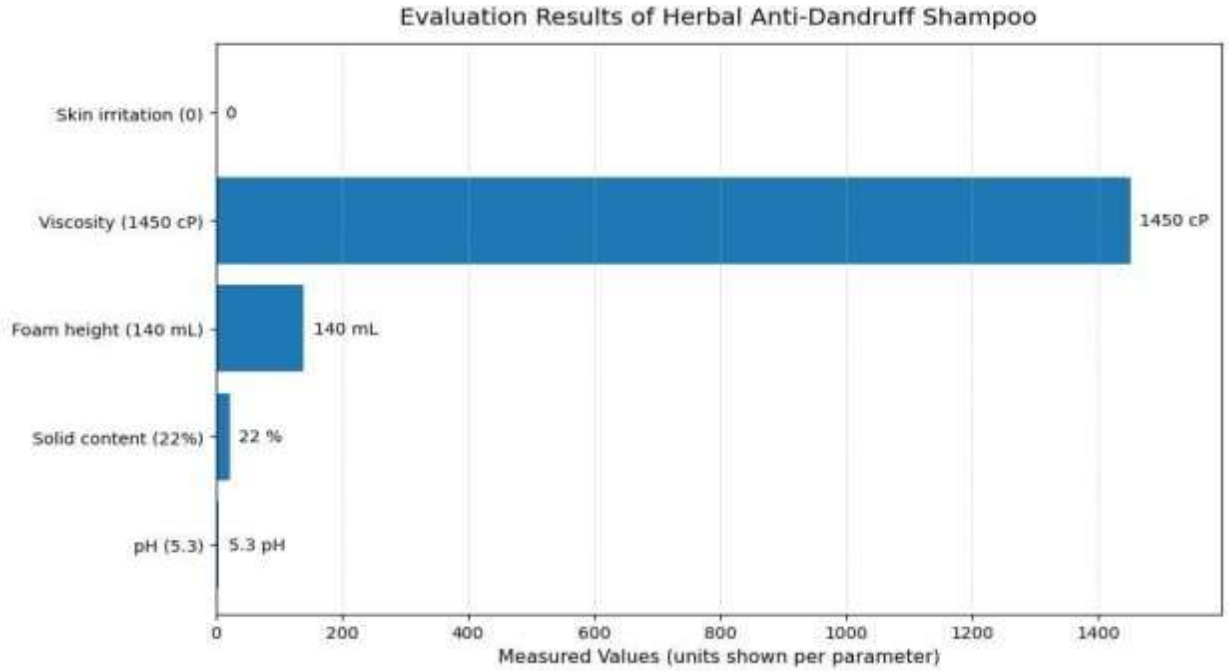

Fig. 10: Graphical representation of evaluation results

Results and Discussion

The prepared Herbal Anti-Dandruff Shampoo was evaluated for its basic physicochemical and safety parameters such as physical appearance, pH, solid content, foaming ability, viscosity, and skin irritation. These tests were conducted to determine the quality, stability, and suitability of the shampoo for human scalp application. The overall results showed that the formulation was stable, mild, and suitable for regular use.

The physical appearance of the prepared shampoo was observed to be light brownish-green in color with a smooth, uniform texture and a pleasant herbal fragrance. The color was primarily due to the natural pigments of Neem, Tulsi, and Shikakai extracts, while the aroma resulted from the blend of Tulsi and Rose Extract. The formulation appeared homogeneous, with no sign of separation, sedimentation, or suspended particles. This indicated good compatibility among the ingredients and proper mixing during preparation. The appearance of the shampoo is an important attribute because it affects consumer acceptance; the smooth texture and natural fragrance make the product appealing and easy to use. The uniform consistency also suggested that the extracts were well- dispersed in the aqueous base, ensuring equal distribution of active ingredients throughout the formulation.

The slightly acidic pH ensures that the shampoo is gentle and non-irritating to the scalp. Maintaining this pH is important because it matches the natural pH of the scalp, which helps protect the acid mantle the thin layer of sebum and sweat that defends against microbial growth. A balanced pH also helps to maintain the natural moisture of the hair, prevent frizz, and keep the cuticle layer smooth and healthy. The result indicates that the herbal ingredients, especially Lemon and Aloe vera, helped maintain an appropriate acidic pH, confirming the formulation's compatibility with human skin.

The solid content plays an important role in determining the thickness and feel of a shampoo. A value within this range ensures that the shampoo is not too watery or too thick and maintains a pleasant flow during application. Excessive solid content may make the product sticky and hard to spread, while too low solid content may result in poor cleansing efficiency. The observed solid content thus represents a well-balanced composition suitable for daily use.

The foaming ability test revealed that the shampoo produced a moderate and stable foam. This moderate foam formation is expected in herbal formulations because they rely on natural surfactants like saponins from Shikakai rather than chemical agents such as sodium lauryl sulfate (SLS). Even though herbal shampoos generally generate less foam compared to synthetic ones, the cleansing power remains effective because cleaning depends more on the surfactant's emulsifying and wetting ability than on foam quantity. The stable foam observed in the formulation confirms that the natural surfactant was sufficient to clean the scalp and hair while remaining gentle and biodegradable.

The viscosity of a shampoo determines its spreadability, stability, and ease of application. A properly balanced viscosity ensures that the product spreads easily on the scalp without running off quickly and can be rinsed off without leaving residues. The obtained value indicates that the shampoo has an appropriate consistency neither too thick nor too watery making it comfortable to use. The Aloe vera gel and solid content contributed to this smooth texture, while the absence of synthetic thickeners made the formulation more natural and scalp-friendly. The uniform viscosity also suggests that all components were well blended and the formulation remained stable during storage.

The skin irritation test was performed to ensure that the shampoo is safe for external application. A small amount of the shampoo was applied to a clean patch of skin on the forearm, and the area was observed for 24 hours. No redness, itching, swelling, or burning sensation was recorded. This indicates that the formulation is mild, non-irritant, and safe for regular use. The absence of irritation can be attributed to the natural ingredients like Aloe vera, which provides soothing and cooling effects, and the controlled pH, which matches the natural acidity of the skin. The absence of harsh chemicals or synthetic surfactants further enhances its safety profile, making it suitable for sensitive skin and long-term use.

Based on all the above findings, it can be concluded that the prepared herbal anti-dandruff shampoo possesses desirable physicochemical properties. The product showed a stable and appealing physical appearance, an ideal pH compatible with the scalp, an adequate solid content ensuring consistency, moderate and stable foaming ability, suitable viscosity for easy handling, and complete safety for skin application. These parameters collectively suggest that

the shampoo formulation is well-balanced and functionally effective.
The results also demonstrate that natural ingredients such as Neem, Tulsi, Aloe vera, Shikakai, and Lemon can be successfully combined to produce a mild and eco-friendly shampoo with good cosmetic appeal. Neem and Tulsi extracts contribute antimicrobial and antifungal properties, Aloe vera adds moisturizing and healing benefits, Shikakai acts as a gentle cleanser, and Lemon juice maintains the natural acidity of the scalp. Together, these components create a formulation that not only helps control dandruff but also nourishes the scalp and strengthens the hair.
In discussion, it can be inferred that although herbal shampoos generally produce less foam and contain no synthetic thickeners, the overall performance of this formulation is satisfactory and comparable to commercial products. The product's balanced viscosity, natural fragrance, and mild action make it suitable for daily use. Additionally, since all ingredients are biodegradable and free from harsh chemicals, the formulation is environmentally safe.

Conclusion

The present research concludes that the formulated Herbal Anti-Dandruff Shampoo containing Neem, Tulsi, Aloe vera, Shikakai, Lemon, and Rose Extract is a mild, safe, and effective herbal preparation that can be used as an alternative to synthetic shampoos for the treatment and prevention of dandruff. The formulation exhibited desirable physical and chemical characteristics, and all evaluation parameters such as pH, foaming ability, viscosity, and skin compatibility were found within acceptable limits.
The results confirm that the combination of herbal ingredients acts synergistically to deliver both therapeutic and

cosmetic benefits. Neem and Tulsi extracts provide antifungal and antibacterial activity, effectively controlling dandruff and scalp irritation caused by Malassezia furfur. Aloe vera gel contributes to moisturizing and healing the scalp, reducing dryness and itchiness. Shikakai extract acts as a gentle cleanser that removes dirt and oil without damaging natural hair proteins, while Lemon juice helps in maintaining pH balance and reducing excess sebum production. Rose Extract adds a pleasant aroma and provides soothing effects that improve user comfort. Together, these natural components make the formulation holistic, effective, and user-friendly.

The study also demonstrated that herbal formulations can perform comparably to chemical shampoos in terms of cleansing and dandruff removal, but without harmful effects. The mild foaming and ideal viscosity make the product cosmetically appealing, while its balanced pH ensures scalp protection and long-term safety. The non-irritant nature of the shampoo makes it suitable for people with sensitive skin and for daily use. Moreover, the formulation is biodegradable and eco-friendly, aligning with the increasing global preference for sustainable and green cosmetic products.

In conclusion, the developed Herbal Anti-Dandruff Shampoo is a successful blend of traditional herbal knowledge and modern formulation science. It offers a natural, safe, and economical approach to scalp hygiene and dandruff management. The formulation not only fulfills therapeutic goals but also enhances hair texture and appearance, proving that herbal cosmetics can provide both health and beauty benefits. Hence, the study demonstrates that herbal formulations can serve as reliable, sustainable, and effective alternatives to synthetic hair-care products for maintaining healthy hair and a dandruff-free scalp.

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