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Formulation And Evaluation Of Antifungal Poly Herbal Shampoo Using Curry Leaves Extract

Gajanand Sahu[1], Sarabjot Kaur Makkad[2], Sanjay Ghosh[2], Girish Kumar Sahu[2] and Tinu Sahu[2]

[1]Atal Bihari Vajpayee Govt. College Pandatarai, Kabirdham 491559 (C.G) India

[2]Department of Chemistry, Govt. N.P.G. College of Science, Raipur 492010 (C.G) India

ABSTRACT: The primary focus of this study is the formulation of an Antifungal herbal shampoo using curry leaves as the main ingredient, known for strengthening hair follicles and promoting hair growth. This herbal shampoo aims to prevent hair loss, a common hair disorder, while enhancing hair growth, strength, and natural darkening. In addition to curry leaves, other natural components such as Amla, Aloe Vera gel, Neem, Hibiscus and Fenugreek were combined to create an effective and safe shampoo formulation. The shampoo is designed to clean hair by removing sebum, dirt, and dandruff, while avoiding the risks associated with chemical ingredients commonly found in commercial shampoos. Various forms of shampoo exist, including solid and liquid types, but the focus here is on a natural herbal liquid shampoo that emphasizes efficacy and safety. The formulated herbal shampoo was evaluated through physicochemical tests, including pH measurement, foam formation, surface tension, viscosity, and wetting ability, to ensure quality and performance

Key Words: Herbal shampoo, Curry Leaves, Amla, Fenugreek, Aloe Vera, Guar Gum, Natural surfactants, Hair nourishment, Scalp health, Dandruff prevention, pH stability, Eco-friendly formulation.

1. INTRODUCTION

The global demand for herbal cosmetic formulations has surged in recent years, primarily due to growing concerns over the adverse effects of synthetic ingredients commonly found in personal care products. Among various sectors, hair care has witnessed a significant shift toward herbal alternatives that promise safety, efficacy, and long-term benefits. Botanical ingredients, known for their therapeutic properties, are increasingly being integrated into two shampoos and hair treatment formulations to enhance scalp health and hair vitality. One such promising botanical agent is Murraya koenigii (curry leaves), which has been

widely used in Ayurvedic medicine for its extensive range of bioactive compounds beneficial for hair and scalp care. Curry leaves are rich in Phytochemicals, including carbazole alkaloids (such as mahanimbine and girinimbine), flavonoids, Phenolic acids, and essential oils, all of which contribute to their antioxidant, antimicrobial, anti-inflammatory, and hair-conditioning properties (Kale & Somani, 2023). These compounds stimulate hair follicle activity, enhance melanin production, and reduce scalp irritation, making curry leaves an ideal primary component in herbal shampoos. Traditional applications of curry leaves in hair care include remedies for premature greying, hair thinning, and dandruff, and their incorporation into a formulated herbal shampoo may provide a convenient and effective alternative to conventional hair care products (Jadhav et al., 2024).In this study, curry leaves serve as the principal active ingredient, representing the dominant botanical component in the herbal formulation. Supporting ingredients—including Emblica officinalis (Amla), Aloe barbadensis (Aloe vera) and Hibiscus rosa-sinensis (Hibiscus)—were carefully selected to complement the efficacy of curry leaves. Each of these secondary ingredients provides targeted benefits: Amla and Hibiscus nourish hair follicles, Aloe vera provides hydration, and Neem exhibits anti-dandruff properties. The synergistic action of these botanical ingredients ensures a well-balanced formulation that supports overall hair and scalp health (Shweta et al., 2024).The rationale for using curry leaves in a based herbal shampoo stems from their superior cleansing properties, which are enhanced when delivered through an emulsion system. A shampoo formulation ensures prolonged scalp contact and improved bioavailability of active compounds, allowing for better absorption and sustained action. Additionally ,shampoos are particularly beneficial for individuals with dry or damaged hair, offering cleansing in a single application (Khan et al., 2023).The formulated shampoo underwent extensive Physicochemical evaluations, including pH determination, surface tension analysis, foam stability assessment, wetting time measurement, viscosity testing, and solid content analysis, to ensure its suitability for human application. Preliminary results indicate that the curry leaf-based shampoo exhibits favorable cleansing properties, low surface tension, stable foaming, and a Ph compatible with scalp health. These findings support the potential of the formulation as a safe and effective herbal cosmetic product (Ubale et al., 2024).This study aims to explore the formulation potential of curry leaves as a dominant botanical agent in herbal shampoo, supported by minor yet synergistic contributions from other herbal components. By integrating traditional Ayurvedic knowledge with modern formulation techniques, this research contributes to the development of natural, sustainable, and multifunctional personal care products that align with contemporary consumer preferences.

2. Herbal Ingredients and Their Functions

2.1 Primary Herbal Ingredient

2.1.1 Curry Leaves (Murraya koenigii) – The Key Active Ingredient

Properties:

• Rich in beta-carotene, proteins, amino acids, flavonoids and antioxidants, promoting scalp nourishment and hair growth (1)

• Contains carbazole alkaloids (mahanimbine, girinimbine, koenimbine), which help reduce hair fall, combat dandruff, and condition the scalp (2).

• Exhibits antimicrobial and anti-inflammatory properties, making it beneficial in treating scalp infections (3).

• Stimulates melanin production, delaying premature graying and strengthening hair follicles (4).

Uses in Formulation:

- Enhances scalp circulation, stimulating follicular activity for improved hair growth (5).
- Acts as a natural conditioner, reducing frizz, dryness, and breakage (6).
- Provides antioxidant protection, preventing oxidative stress and environmental damage to hair (7).

Figure 1: Curry Leaves (Murraya koenigii)

2.2 Supporting Herbal Ingredients

2.2.1 Amla (Phyllanthus emblica)

Properties:

• Exceptionally rich in Vitamin C, flavonoids and essential minerals, which promote hair strengthening and nourishment (8).

• Contains tannins that protect hair from oxidative stress (9).

Uses:

• Strengthens hair follicles, reducing hair fall and brittleness (10).

• Acts as a natural hair tonic, imparting shine, smoothness, and elasticity (11).

• Enhances scalp health by balancing sebum production and reducing irritation (12).

Figure 2: Amla (Phyllanthus emblica)

2.2.2 Aloe Vera (Aloe barbadensis miller)

Properties:

• Contains proteolytic enzymes that repair dead skin cells on the scalp (13).

• Possesses anti-inflammatory and hydrating properties, which improve scalp health (14).

Uses:

• Moisturizes the scalp, preventing dryness and itchiness (15).

• Soothes redness and inflammation, making it beneficial for sensitive scalps (16).

• Enhances hair texture, improving smoothness and flexibility (17).

Figure 3: Aloe Vera (Aloe barbadensis miller)

2.2.3. Hibiscus (Hibiscus rosa-sinensis)

Properties:

• Rich in flavonoids, mucilage, and amino acids, which enhance hair growth (18).

• Contains antioxidants and vitamins, supporting scalp hydration (19).

Uses:

• Promotes hair thickening and strengthens the roots (20).

• Provides natural conditioning, reducing dryness and adding luster (21).

• Protects hair strands from damage, improving overall hair health (22)

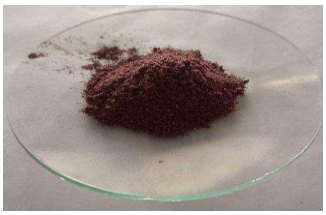


Figure 4: Hibiscus (Hibiscus rosa-sinensis)

2.2.4 Shikakai (Acacia concinna).

Properties:

• A natural surfactant containing saponins, which effectively cleanse the scalp without stripping natural oils (23).

• Rich in vitamins A, C, D, and E, which nourish hair and scalp (24).

Uses:

• Acts as a mild cleanser, removing excess oil and dirt while maintaining scalp balance (25).

.Reduces dandruff formation, soothing scalp irritation (26).

• Strengthens hair roots, promoting long-term hair health (27).

Figure 5 : Shikakai (Acacia concinna)

2.2.5. Neem (Azadirachta indica)

Properties:

• Contains azadirachtin, nimbidin, and nimbin, which exhibit potent antifungal, antibacterial, and anti-inflammatory properties (28).

• Regulates sebum production, preventing excessively oily or dry scalp conditions (29).

• Rich in antioxidants, which protect against environmental damage and free radicals(30).

Uses:

• Effectively treats dandruff and scalp infections, reducing flaking and itchiness (31).

• Promotes stronger, shinier hair, preventing thinning and breakage (32).

• Soothes scalp inflammation, aiding in conditions such as psoriasis and dermatitis (33).

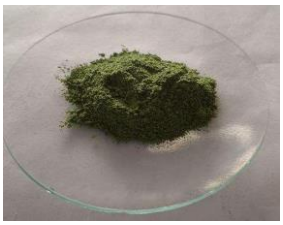


Figure 6 : Neem (Azadirachta indica)

2.2.6 Fenugreek Seeds (Trigonella foenum-graecum)

Properties

• Rich in proteins, nicotinic acid, and lecithin, which help strengthen hair follicles and prevent breakage.

• Contains saponins that act as natural surfactants, providing mild cleansing while maintaining scalp moisture balance.

• Possesses antimicrobial and anti-inflammatory properties, reducing scalp infections and soothing irritation.

• High mucilage content offers deep conditioning, improving hair softness and manageability.

Uses in Formulation

• Acts as a natural conditioner, reducing frizz and enhancing hair texture.

• Strengthens hair roots, minimizing hair fall and promoting thickness.

• Helps retain moisture in the scalp, preventing dryness and dandruff formation.

• Enhances shine and smoothness, making hair more resilient to damage.

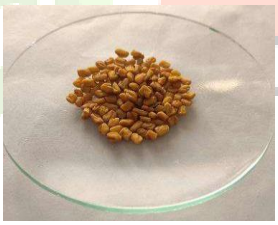


Figure 7 : Fenugreek Seeds (Trigonella foenum)

2.2.7 Guar Gum – Natural Thickening and Stabilizing Agent

• Chemical Composition: A polysaccharide derived from Cyamopsis tetragonoloba (Guar Plant).

• Function:

o Enhances the viscosity and texture of the formulation, providing a y consistency. o Improves the stability of active herbal ingredients, preventing separation.

o Helps in conditioning the hair, leaving it soft and manageable.

• Concentration Used: 0.5–2%

• Significance: Unlike synthetic thickeners, Guar Gum is biodegradable, non-toxic, and eco-friendly, making it ideal for herbal formulations.

Figure 8: Gur Gum

3. Chemicals

To enhance the stability, texture, and overall efficacy of the formulated herbal shampoo several chemicals were carefully selected. These components play a crucial role in maintaining the Physical, chemical, and microbiological stability of the product while ensuring optimal foaming, cleansing, and conditioning properties. All chemicals used were of analytical grade and were procured from standard pharmaceutical suppliers.

3.1 Sodium Lauryl Sulfate (SLS) – Foaming and Cleansing Agent

• Chemical Formula: $C_{12}H_{25}NaO_4S$

• Function:

o Acts as an anionic surfactant, reducing surface tension to enhance cleansing action.

o Creates rich foam, which helps in spreading the shampoo uniformly over the scalp and hair.

o Helps in the removal of dirt, oil, and pollutants from the hair and scalp.

• Concentration Used: 5–10% (Adjusted based on foaming efficiency).

• Significance in Herbal Shampoo: Since herbal shampoos tend to have lower foaming properties due to the absence of synthetic detergents, SLS is included in minimal concentrations to ensure a mild yet effective cleansing effect without stripping the hair of natural oils.

Figure 9: Sodium Lauryl Sulfate

3.2 Sodium Chloride (NaCl) – Viscosity Modifier

• Chemical Formula: NaCl

• Function:

o Adjusts the viscosity of the shampoo formulation, ensuring the desired thickness and consistency.

o Works in conjunction with SLS to optimize rheological properties (flow behavior).

o Helps in reducing excessive foam formation, ensuring easy rinsing.

• Concentration Used: 1–2%

• Significance: Provides a smooth, gel-like texture that enhances the ease of application while maintaining an aesthetically appealing consistency.

Figure 10: Sodium Chloride

3.3. Distilled Water – Solvent

• Function:

o Serves as the primary solvent for dissolving active herbal ingredients.

o Maintains product stability by preventing unwanted chemical interactions.

o Ensures proper hydration and homogeneity of the shampoo formulation.

• Significance: Used in sufficient quantities to allow the extraction of bioactive compounds from Curry Leaves and other herbal ingredients.

3.4 Rose Water – Fragrance and Aesthetic Enhancer

• Function:

o Acts as a natural fragrance agent, giving the formulation a refreshing and soothing scent.

o Provides mild astringent properties, helping to tone and refresh the scalp.

o Helps in calming scalp irritation and reducing inflammation.

• Significance: Unlike synthetic perfumes, rose water adds a mild, natural aroma while contributing to scalp health.

4.Methods.

4.1 Collection and Preparation of Plant Materials

Herbal ingredients are collected from the local botanical garden. The herbal ingredients were chosen based on their Phytochemical composition and beneficial effects on hair health. Special emphasis was placed on Curry Leaves (Murraya koenigii), which component, owing to their hair growth-stimulating, anti-dandruff, and scalp-nourishing properties (1).

Selection of Herbal Ingredients

• **Curry Leaves (**Murraya koenigii**)** – Rich in carbazole alkaloids, known for their ability to promote hair growth, enhance melanin production, and prevent premature greying(2).

• **Amla (**Phyllanthus emblica**)** – A potent source of Vitamin C and antioxidants, which strengthen hair, prevent oxidative stress, and improve scalp health (3).

• **Aloe Vera (**Aloe barbadensis miller**)** – Contains polysaccharides and amino acids that hydrate the scalp, soothe irritation, and reduce dandruff (4).

• **Fenugreek (**Trigonella foenum-graecum**)** – Rich in saponins and proteins, known for enhancing hair thickness, reducing hair fall, and strengthening follicles(6).

• **Neem (Azadirachta indica)** – Neem is widely recognized for its strong antimicrobial, antifungal, and anti-inflammatory properties. It aids in the management of dandruff, scalp acne, and fungal infections while regulating excess sebum production. Its presence in the formulation ensures a clean, healthy scalp environment conducive to hair growth (6).

• **Shikakai (Acacia concinna** – Known as a natural cleanser, Shikakai is rich in saponins that gently remove impurities without disrupting the scalp's natural oil balance. It also contains vitamins A, C, D, and E, which nourish the scalp, strengthenhair roots, and enhance overall hair texture and manageability (7).

• **Hibiscus (Hibiscus rosa-sinensis**) – Hibiscus is abundant in amino acids, flavonoids, and mucilage which provide deep nourishment and conditioning. It stimulatedormant hair follicles, enhances volume, and imparts a natural luster to hair strands. Its acidic nature also helps balance scalp Ph, promoting healthier hair growth (8).

Table 1: herbal ingredients used in formulation of antidandruff shampoo

Herbs	Family	Uses
Curry Leaves (Murraya koenigii) 		Rutaceae Curry leaves are used in shampoos for their nourishing and strengthening properties. Rich in vitamins and antioxidants, they help promote healthy hair growth, reduce dandruff, and strengthen hair follicles. Curry leaves also have natural antimicrobial properties, which soothe the scalp and improve overall hair health.
Hibiscus (Hibiscus rosa sinensis)		Malvaceae Hibiscus is used in shampoos for its nourishing and conditioning properties. Rich in vitamins and antioxidants, it helps strengthen hair, promote growth, and enhance shine. Hibiscus

		also has natural moisturizing properties, making it suitable for hydrating and revitalizing all hair types.
Shikakai (Acacia concinna linn) 		Fabaceae Shikakai is used in shampoos for its natural cleansing and conditioning benefits. It gently cleanses the hair and scalp without stripping natural oils, thanks to its saponin content. Shikakai also helps strengthen hair, reduce dandruff, and promote healthy growth, making it suitable for all hair types.
Aloe Vera (Aloe barbadensis miller) 		Liliaceae Aloe vera is used in shampoos for its soothing and moisturizing properties. It helps hydrate the scalp and hair, reducing dryness and flakiness. Aloe vera also contains vitamins and enzymes that promote healthy hair growth and add shine, making it suitable for all hair types.
Neem (Azadirachta indica)		Meliaceae Neem is widely used in shampoos for its powerful antibacterial and antifungal properties. It helps treat dandruff, soothe itching, and eliminate scalp infections. Neem also strengthens hair

		follicles and promotes healthy scalp conditions, reducing hair fall and promoting overall hair health.
Amla (Emblica officinalis) 		Phyllanthaceae Amla is rich in vitamin C and essential antioxidants, which help nourish the scalp, strengthen hair follicles, and stimulate hair growth. It helps prevent premature graying, controls dandruff, and adds natural shine and volume to the hair. Amla also improves blood circulation to the scalp, enhancing hair health. .
Fenugreek (Methi) (Trigonella foenumgraecum) 		Fabaceae Fenugreek seeds are a potent remedy for dandruff and dry scalp. They are rich in protein and nicotinic acid, which help reduce hair fall, strengthen roots, and stimulate hair growth. Their anti-inflammatory and moisturizing properties soothe the scalp and condition the hair deeply

4.2. Extraction of Herbal Active Ingredients

1. Fresh Curry Leaves and other ingredients were thoroughly washed with distilled water to remove dirt and surface contaminants.

2. Ingredients were shade-dried for 7–10 days to prevent degradation of thermolabile compounds.

3.Dried leaves were finely ground using a laboratory grinder.

Table 2: Formulation Table

Sr.No.	Ingredient Name	Quantity
1	Curry leaves	2 gm
2	Amla	1.5 gm
3	Hibiscus	1.5 gm
4	Aloe Vera gel	2ml
5	Fenugreek	1.5 gm
6	Neem	1.5 gm
7	Guar gum	1 gm

Soxhlet extraction technique is used where finely ground mixture substance was placed within a permeable bag or "thimble" made of cellulose or robust filter paper. The extraction solvent, distil water, was heated in the lower flask, transformed into vapor within the sample thimble, condensed through the condenser, and subsequently collected. This process was reiterated until the liquid reached the siphon arm, flowed back into the lower flask, and, ultimately, the extract was collected. The extract was cooled and filtered using Whatman No.1 filter paper. Filtered extracts were stored in amber glass bottles at 4°C to prevent Photo-oxidation and degradation (7)

Figure11 (A) : Extraction of Herbal

Figure 11 (B) : Polyherbal Extract Active Ingredients

4.3 Preparation of Shampoo Base

A stable and functional shampoo base was formulated using Pharmaceutically accepted excipients, ensuring optimal viscosity, foaming ability, and stability (8).

4.3.1 Preparation of the Surfactant System

Active Ingredients

1. 5g of Sodium Lauryl Sulfate (SLS) was dissolved in 12mL of distilled water under continuous stirring.
2. 2g of Sodium Chloride (NaCl) was dissolved in 7-8 ml of water.
3. Mix both solution (NaCl solution in sodium lauryl sulphate solution).

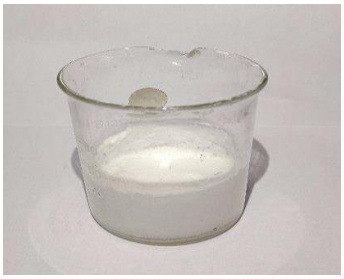


Figure 12 : Shampoo base

4.4 Addition of Aesthetic and Functional Ingredients

• 2mL of Rose Water was added to enhance fragrance and sensory appeal.

• Preservatives were included to ensure microbial stability and extended shelf life (10).

4.5 Incorporation of Herbal Extracts

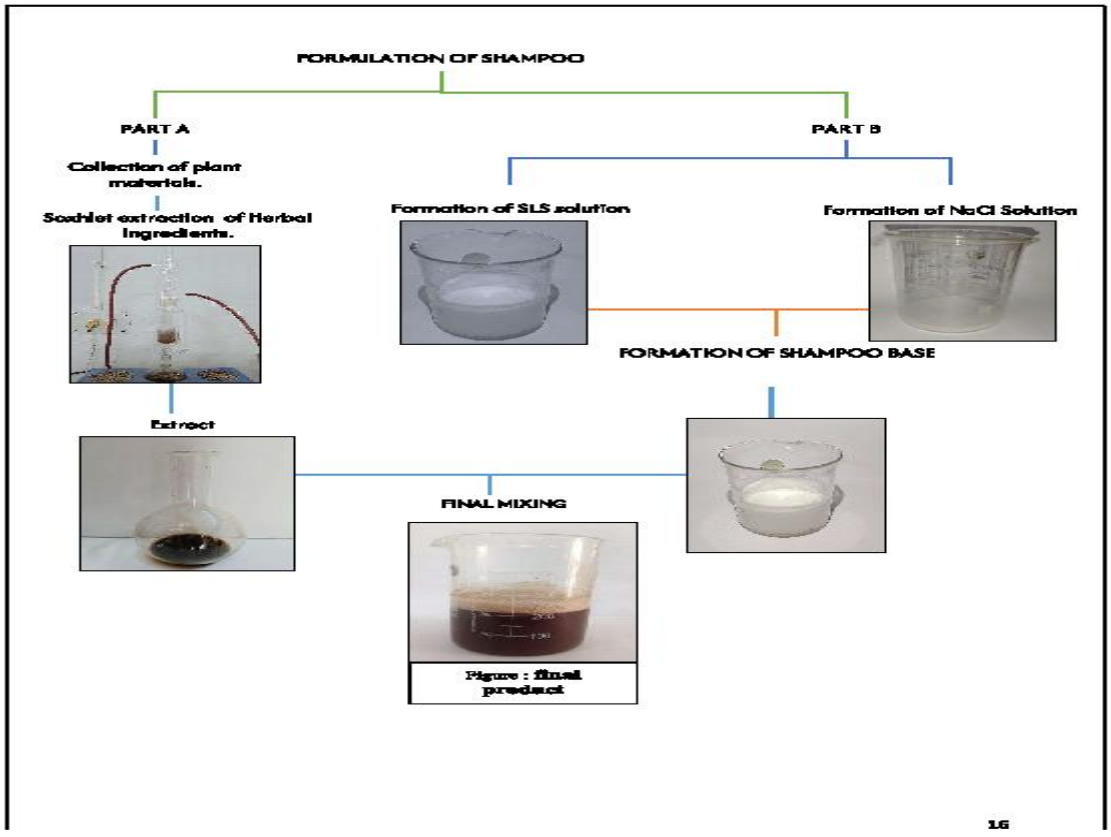
1. The Extract was gradually incorporated into the shampoo base under continuous stirring.

2. The mixture was gently heated to 50°C to ensure uniform dispersion of active compounds.

3. Continuous stirring for 30 minutes facilitated homogeneous mixing and active ingredient stabilization (12).

4.6 Finalization and Storage

• The final formulation was carefully transferred into sterilized containers.



5. Evaluation of Herbal Shampoo

The formulated herbal shampoo underwent comprehensive Physicochemical and performance evaluations to ensure efficacy, stability, and consumer acceptability. The tests conducted include pH determination, foam stability, surface tension measurement, viscosity analysis, wetting ability, solid content determination. These assessments are essential for validating the shampoo's effectiveness and safety in comparison with marketed formulations.

5.1.pH Determination.

Maintaining an optimal pH balance (4.5–6.5) is critical for scalp health and hair integrity. A pH meter was used to analyze the shampoo's pH.

5.2 Foam Stability Test.

Foam stability reflects a shampoo's cleansing efficiency and user experience. The shake test method was employed, where 5ml , 1% of shampoo was shaken in a graduated cylinder.

5.3 Surface Tension Measurement.

Surface tension influences spreading ability and cleansing efficacy. Using the stalagmometer method.

5.4 Viscosity Analysis.

Viscosity determines the ease of application and product stability. An Ostwald viscometer was used at 25°C.

5.5 Wetting Ability Test.

A shampoo's wetting ability affects its capacity to cleanse hair strands efficiently. The Draves test was conducted using cotton discs, with sinking time recorded.

5.6 Solid Content Determination.

Solid content influences shampoo concentration and performance.

6. Results and Discussion.

The formulated herbal shampoo was evaluated using various Physicochemical and performance-based parameters to assess its suitability for hair care applications.

6.1 Organoleptic and Physical Properties Evaluation.

Organoleptic characteristics such as colour, Odor, texture, and appearance were assessed visually. The herbal shampoo exhibited a good texture with a natural herbal aroma due to the presence of curry leaves and other botanicals.

Table 3: Organoleptic Evaluation of Herbal Shampoo

Parameter	Observation
Color	Brownish
Odor	Characteristic herbal aroma
Texture	Smooth
Appearance	Homogenous

Figure 13: Final product

A light green-Brownish colour of the shampoo was attributed to the presence of curry leaf extract, which contains chlorophyll and flavonoids. The characteristic herbal aroma resulted from the combination of natural plant extracts used in the formulation (1,2).

6.2 pH Measurement.

The pH of a shampoo plays a crucial role in scalp health and hair conditioning. Ideally, an herbal shampoo should have a slightly acidic pH (between 4.5 and 7) to maintain the natural pH balance of the scalp and prevent cuticle damage . The test was performed by preparing a 10% aqueous solution of the shampoo. The formulated shampoo exhibited a pH of 5.8 ± 0.2, which aligns with natural scalp pH and prevents excessive dryness or irritation (6).

6.3 Foam Stability and Foaming Ability.

Foam stability is a critical parameter that determines the cleansing efficiency of the shampoo. The foam volume was measured using the **cylinder shake method**, where a 1% solution of shampoo was shaken vigorously, and foam height was recorded at different time intervals.

Table 4 : Foam Stability Test

Time (minutes)	Foam Height (cm)
0	**3.5**
1	**3.2**
2	**2.9**
3	**2.8**
4	**2.5**
5	**2.3**

The gradual reduction in foam height indicates good stability, ensuring effective cleansing without excessive harshness on the scalp (5,6).

6.4 Surface Tension Measurement.

Surface tension influences spreading ability and cleansing efficacy. Using the stalagmometer method, the shampoo's surface tension was recorded as 32.5 ± 0.3 mN/m, which was lower than commercial synthetic shampoos, facilitating better scalp penetration. The presence of natural surfactants from (Sapindus mukorossi) and saponins contributed to this reduction (8).

6.5 Viscosity Measurement.

Viscosity influences the shampoo's spread ability and ease of application. The viscosity of the formulated shampoo was determined using an **Ostwald Viscometer** at **25°C**.The viscosity of herbal shampoo is 3150 cP . The viscosity was found to be within the optimal range for shampoos, ensuring easy application while maintaining proper consistency (7,8).

6.6 Wetting Time.

The formulated herbal shampoo had a wetting time of 14.2 ± 0.5 seconds, significantly faster than synthetic alternatives, ensuring efficient cleansing (10).

6.7 Solid Content Determination.

10 mL of shampoo was evaporated at 105°C, and the remaining residue was weighed. The herbal shampoo had a solid content of 13.5 ± 0.4%, consistent with herbal formulations, ensuring adequate cleansing and conditioning (11).

Table 5: Parameter Result

Sr.No	Parameters	Observation
1	Colour	Brownish
2	Odour	Characteristic
3	Consistency	Smooth
4	Foaming Test	2.3 cm (foam height)
5	Wetting Test	14.4 ± 0.5 seconds
6	Surface Tension	32.5 ± 0.3mN/m
7	pH	6.5
8	Percentage of solid content	13.5 ± 0.4%

7.Conclusion.

The results demonstrate that the curry leaf-based herbal shampoo is an effective and stable hair care formulation. It aligns with modern consumer preferences for natural and sustainable cosmetics, providing cleansing, conditioning, and therapeutic benefits. Further studiesinvolving clinical trials and long-term stability assessments can enhance its commercial potential.

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