



Formulation and Evaluation of Herbal Anti-dandruff Shampoo

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(Received: 16 March 2025

Revised: 20 April 2025

Accepted: 01 May 2025)

KEYWORDS

Herbal shampoo,
Natural Ingredients,
Anti-dandruff
Shampoo, Evaluation,
Physicochemical
properties,
Chamomile flower
extract.

ABSTRACT:

Hair can be taken care of with various cosmetic products such as hair oil, hair shampoo, hair gel, hair serum, hair cream, etc. Shampooing is the most common hair care method. Herbal shampoo was prepared by adding extracts of *Matricaria recutita*, *Ocimum sanctum* and *Aloe barbadensis* Miller. A small amount of tea tree oil was added as a preservative and as a pH adjuster. A more radical approach to popularizing herbal shampoos would be to change consumers expectations of shampoo by emphasizing safety and efficacy. You can come across this herbal shampoo which is less damaging to the hair giving good results as it contains natural ingredients. The composition of a shampoo containing one or more herbs can be characterized by various methods. The main goal of this shampoo was to remove the harmful synthetic ingredients from the anti-dandruff formula and replace them with a safe natural ingredient.

Introduction:

Plants consist of many chemical constituents within which carry out various biological functions necessary for resistance or treatment of numerous diseases or disorders. Dandruff is a skin condition caused due to fungus *Malassezia* fungi, which affects the scalp, makes it itchy and greasy (1). Dandruff is a common scalp disorder affecting almost half of the population. Keratinocytes play a key role in the expression and generation of immunological reactions during dandruff formation (2). The severity of dandruff worsens in winter. Various specialized shampoos were used to treat dandruff namely synthetic and herbal preparations. The herbal shampoo is a type of cosmetic preparation that uses herbs that is natural ingredients from the plant (3). Any hair cleansing solution, made from the extracts of Ayurvedic herbs and flowers, can be termed as a 'herbal shampoo'. It can also be defined as a hair care product in form of viscous liquid used to remove dirt, oil from the hair and make them clean (4). The shampoo has abundant abilities like lubrication, conditioning, hair growth, reduction of hair loss, maintaining hair color, medication. It also has vital roles like anti-dandruff property, cleansing action, also acts as a keratolytic agent. The main aim of shampoo preparation is to clean dirt and dandruff, also used to make hairs soft and silky (5). The purpose of the present investigation is to avoid the use of synthetic or chemical preparations that are available in the market. Several herbal ingredients with

antidandruff properties were used, which makes hair soft and lustrous, promote hair growth(6). Importantly these preparations are cost effective, not much expensive (7). Various plants used for the formulation such as neem, tulsi, reetha, bhringraj, shikakai, hibiscus.

1. Advantages of herbal shampoos:

- It is pure and it involves organic ingredients.
- Free from side effects.
- There is no use of synthetic additives.
- No use of petroleum-based ingredients.
- It is skin friendly.

2. Demerits of synthetic shampoos:

- The artificial additives used in synthetic shampoos can cause significant irritation to sensitive people.
- It leads to toxicity in the nervous system and even cancer.
- The active ingredients used in synthetic shampoos can cause headache, nausea, dizziness, and sometimes it causes vomiting.
- It causes more harmful effects.

3. Ideal Characteristics of Shampoo :

- Should effectively wash hair.
- Should produce a good amount of foam.
- The shampoo should be easily removed by rinsing with water.



- Should leave the hair non-dry, soft, and lustrous with good, manageability.
- Should impart a pleasant fragrance to the hair.
- Should not make the hand rough and chapped.
- Should not have any side effects or irritate skin obeyed

4. Problems related to hairs:

- Dandruff
- Dry hair
- Split ends
- Oily ends
- Frizzy hair
- Limp hair
- Hair loss
- Heat damage
- Colour damage
- Grey hair

5. Dandruff :

A fungus known as *Malassezia restricta* and *M. globosa* is thought to be the source of dandruff, which is the excessive shedding of dead skin cells from the scalp. One type of yeast that causes skin and scalp infections is *Malassezia*, which was originally known as *Pityrosporum* (Shuster, 1984). Noticable to the naked eye, the replacement of scalp cells happens gradually. This is a monthly process of change. The disruption on the scalp that we refer to as dandruff will occur if this process picks up speed. The perfect environment for *Malassezia* growth is one that is warm and humid, crowded, and devoid of personal hygiene (Rippon, 1982). A fifth of the population suffers from dandruff, which primarily affects men over women between the ages of 20 and 30 after puberty .

Symptoms:

1. Erythema, which is red patches on the skin of the scalp, and sometimes on the face
2. Eyebrow dandruff
3. Hair loss
4. Dry flakes on the skin of the face.

6. Causes of dandruff :

Naturally found on the scalp and other areas of the skin, *Pityrosporum ovale* (*P. ovale*) is one of the fungi that can cause dandruff. This fungus usually doesn't damage people. The fungus *P. Ovale* will multiply on the scalp due to

increased oil production brought on by hormonal fluctuations, stress, and weather changes. Dandruff is caused by the fungus growing faster than usual, which also causes skin cells on the scalp to itch and hair follicles to fall out. It is currently thought that the precise process of dandruff development is caused by the production of lipases, an enzyme. These enzymes are used by the fungus *Malassezia* to convert sebum into oleic acid. When oleic acid reaches the epidermis, it increases skin cell turnover in those who are vulnerable. This ultimately results in redness, irritation, and dandruff flakes.

- Dry skin.
- Irritated, oily skin.
- Not shampooing often enough
- Other skin conditions:
 1. Eczema
 2. Psoriasis
- Seborrheic dermatitis *Malassezia*-yeast like fungus
- Sensitivity to hair products (contact dermatitis)

7. Classification of dandruff:

Depending upon the symptoms dandruff categorize into three types -

● Dry skin dandruff:

It is also called as pityriasis simplex characterize by excessive formulation of minute scales which accumulate on scalp area. In this type of dandruff there is no excessive hair loss and no inflammation . The scales are first found in middle of scalp and then spread of frontal, parietal and occipital area.



Fig: Dry skin dandruff

● Oily skin dandruff:

Oil related dandruff happen when there is an accumulation of sebum oil on scalp. Inflammation of varied intensity developed on scalp along with oily scales of dirty yellow



colour and hair fall occurs. The most common site affected by this dandruff is scalp, behind ears, over breast and armpits.



Fig: Oily skin dandruff

● Fungal dandruff:

Fungal dandruff is a natural component found on skin and scalp. This fungus survives on excessive oil.



Fig: Fungal dandruff

Drug profile:

The plant materials required for the study were obtained from and around Malkapur, Maharashtra.

1. *Matricaria recutita*:

- Common name: German chamomile, Wild chamomile
- Biological name: *Matricaria recutita*
- Family: Asteraceae
- Part used: Dried flower heads
- Uses: Chamomile flowers are used to make tea, promote relaxation and sleep, anxiety relief, support the immunity system, reduce the risk of gastrointestinal disease, promote hair shine and softness, reduce dandruff, treat frizz and split ends.



Fig: Chamomile flower

2. *Ocimum sanctum*:

- Common name: Holy basil, Tulsi
- Biological name: *Ocimum sanctum*
- Family: Lamiaceae
- Part used: Leaves
- Uses: Boosting immunity, aiding in respiratory health, reducing stress, manage blood sugar levels, reduce the growth of harmful bacteria in mouth, promoting hair growth, reduces hair fall, preventing scalp infection.



Fig: Tulsi leaves

3. *Aloe barbadensis* Miller:

- Common name: Aloe vera, medicinal aloe, first aid plant
- Botanical name: *Aloe barbadensis* Miller
- Family: Asphodelaceae (Liliaceae)
- Part used: leaves



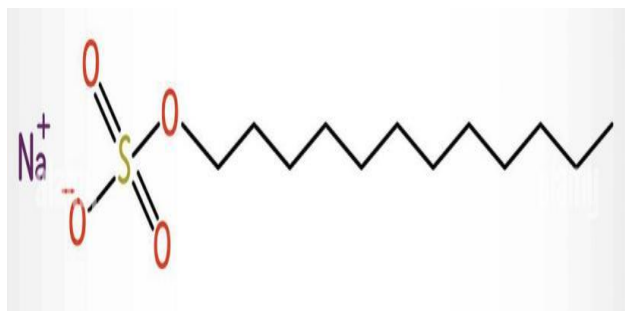
- Uses: Soothing burns and minor skin irritation, promoting wound healing, moisturizing and hydrating, promote healthy growth , soothe the scalp, reduces dandruff.



Fig: Aloe vera

4.Sodium lauryl sulphate:

- Common name: Sodium lauryl alcohol sulfate
- Chemical formula: $\text{CH}_3(\text{CH}_2)_{11}\text{OSO}_3\text{Na}$
- IUPAC name : Sodium dodecyl sulfate
- Structure:



Structure of SLS

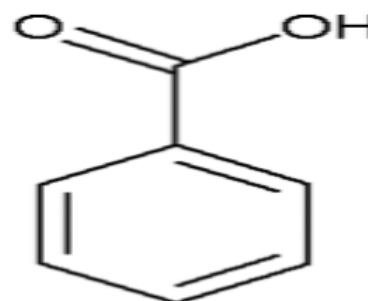
- Boiling point: 216°C
- Melting point: $204\text{-}207^\circ\text{C}$
- Solubility: Highly soluble in water
- Mode of action: Sodium lauryl sulfate (SLS) acts as a surfactant, lowering surface tension and acting as a detergent by solubilizing the viral envelope and/or denaturing envelope and capsid proteins, thus inhibiting viral infectivity.
- Uses: SLS is used in various products, including shampoos, soaps, toothpastes, and household cleaners.
- Toxicity profile: Oral (LD50): Acute: 1288 mg/kg [Rat]



Fig:Sodium lauryl sulphate

5. Benzoic acid:

- Common name: Carboxybenzene , dracyclic acid
- Chemical formula: $\text{C}_7\text{H}_5\text{COOH}$
- IUPAC name: Benzenecarboxylic acid
- Structure:



Benzoic acid structure

- Boiling point : 250°C
- Melting point: $121\text{-}123^\circ\text{C}$
- Solubility: More soluble in hot water
- Toxicity profile: Benzoic acid, while a food preservative and generally considered safe, can cause skin and eye irritation, and prolonged or repeated exposure can lead to skin drying and cracking.
- Uses: Preservative in processed foods to prevent the growth of bacteria, fungi, and yeast. Used as an expectorant, antiseptic, and local anesthetic. Used in the production of various ointments that treat fungal infections in the skin . Used in the manufacturing process of phenol. Used in the synthesis of salts and esters.



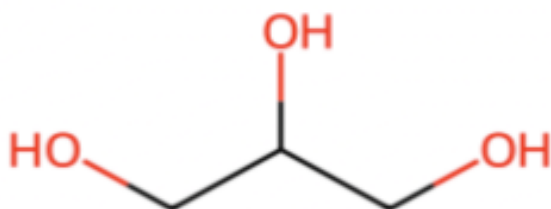
Fig:Benzoic acid



Fig: Glycerin

6. Propanetriol:

- Common name: Glycerin , glycerine
- Chemical formula: C₃H₈O₃
- IUPAC name: Propane-1,2,3-triol
- Structure:



Glycerin structure

- Boiling point: 290°C
- Melting point: 17.8 °C
- Solubility: Highly soluble in water. Insoluble in chloroform, ether
- Mode of action: When administered rectally, glycerin exerts a hygroscopic and/or local irritant action, drawing water from the tissues into the feces and reflexively stimulating evacuation. Glycerin decreases intraocular pressure by creating an osmotic gradient between the blood and intraocular fluid, causing fluid to move out of the aqueous and vitreous humors into the bloodstream.
- Toxicity profile: Glycerin, while generally considered low in toxicity, can cause adverse effects with high doses, including gastrointestinal issues and, in severe cases, dehydration, seizures, and even coma.
- Uses: Act as humectant, In food and beverage use as sweetener for low sugar food, preservative to improve shelf life, Use in cosmetic to moisturizer for anti aging treatment, wound care.

Materials and Methods :

● Material:

Herbal ingredients, as shown in Table 1, such as chamomile flower, Tulsi , Aloe vera are recognized for their effective anti-dandruff properties and are therefore utilized in shampoo formulations. Additional ingredients used in herbal shampoo formulation include tea tree oil, lavender oil, glycerine, sodium lauryl sulfate (SLS), benzoic acid. Each of these components enhances the shampoo's overall effectiveness and performance.

Table1 :Formulation table of herbal anti-dandruff shampoo

S r. No	Ingre dient	Qua ntity (ml)	Categ ory
1.	Chamomile Extract	15	Anti-dandruff agent
2.	Tulsi Extract	7	Anti-microbial and anti-fungal agent
3.	Aloe vera Extract	7	Soothing and anti-inflammatory agent
4.	Sodium lauryl sulphate	6	Foaming agent, surfactant
5.	Benzoic acid	2	Preservative
6.	Glycerin	2	Moisturizer, Thickner
7.	Tea tree oil	2	Perfume, anti-bacterial
8.	Lavender oil	2	Perfume



9.	Purified water	q.s	Vehicle , solvent
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● Method:

1. Preparation of plant Extract:

All the ingredients, as detailed in Table 1, were carefully measured and combined with 100ml of water in a stainless-steel vessel. The mixture was then heated gradually, allowing the water volume to reduce by one-third. This process concentrated the mixture, enhancing the potency of the herbal components. Following the reduction, the mixture was thoroughly filtered to obtain a clear and purified extract. This clear extract, rich in the active herbal constituents, was subsequently used as the herbal component in the formulation.

The Extract was prepared by simple maceration. Taken Chamomile flowers and Tulsi leaves they were dried pulverized in air. Make the heat assembly and boiled the Chamomile flowers and Tulsi leaves in 100ml of purified water separately and filter it with filter paper. And extract the Aloe vera jelly from Aloe vera leaves. The total extract was combined and filtered. Stored in a container for further use.



Fig : Chamomile flower extract

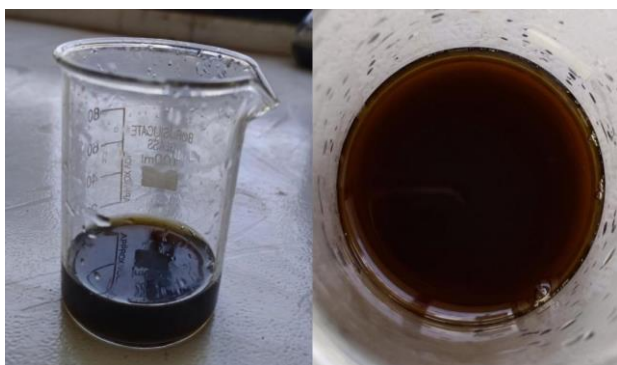


Fig : Tulsi leaves extract



Fig : Aloe vera extract

2. Formulation of herbal anti-dandruff shampoo:

The formulation of the herbal shampoo was carried out according to the formula provided in Table 1. To begin, water was added to a clean stainless-steel vessel. Following this, 6 ml of Sodium Lauryl Sulfate (SLS) was introduced into the vessel and gently mixed with the water. After ensuring the SLS was fully dissolved, 2 ml of benzoic acid was added to the mixture and stirred until it was completely integrated. Next, 7 ml of Aloe vera extract was incorporated and allowed to dissolve fully into the solution. Subsequently, 15ml of the Chamomile extract and 7 ml of tulsi extract (previously prepared herbal extract) was added along with 2 ml of glycerin, ensuring thorough and even distribution throughout the mixture. To improve the formulation, 2 ml of Tea tree oil was added for its antimicrobial properties, and anti-dandruff agent. Additionally, a few drops of essential oil were incorporated to provide a pleasant fragrance that is Lavender oil used. The entire mixture was then stirred continuously until all the ingredients were well combined. Finally, the consistency of the shampoo was adjusted with additional water if necessary to achieve the desired texture and flow.

3. Evaluation of herbal anti-dandruff shampoo:

1. Visual assessment:

The prepared formulation was assessed for colour, clarity, odour, and consistency.

2. Determination of pH:

A 10% v/v shampoo solution was prepared by diluting the shampoo with distilled water. The pH of this solution was then measured at room temperature using a calibrated pH



meter to ensure it fell within the desired range for optimal performance and safety.

3. Dirt dispersion test :

The test tube containing 10ml of distilled water is added to it. Later two drops of shampoo formulation are introduced to the test tube. Afterwards one drop of India ink is added to the test tube. The test tube is then stopper with the cork and shaken for 10 times. The results had been written from amount of ink dispersed such as None, Light, Moderate, or Heavy.

4. Foaming ability and foam stability:

The foaming capability and foam stability test is carried out by using cylinder shake method. In this technique 50 ml of the 1% shampoo solution was taken in a 100 ml measuring cylinder and covered the cylinder with hand. The cylinder is then shaken for 10times. The volume of the foam appeared due to shaking is measured after every oneminute consecutively for four minutes.

5. Determination of solid content:

About 4g of shampoo solution was placed in an evaporating dish. The liquid portion of the shampoo was evaporated by placing the dish on hotplate. The remaining solid content in the dish was calculated after complete drying. It was determined by using the formula: % of solid content = $C-A/B-A \times 100$

Where,

A= weight of empty evaporating dish

B= weight of evaporating dish with shampoo solution

C= weight of evaporating dish after evaporation of shampoo

6. Wetting time:

To test the efficacy of shampoo, wetting ability of a surfactant needs to be calculated which depends on the concentration of surfactant. The formulated shampoo is evaluated for wetting time using filter paper. The maximum wetting time shows that the shampoo contains a less amount of detergents.

7. Surface tension measurement:

Dilute the shampoo using distilled water to fix 10% as concentration. Measurements were carried out using stalagmometer .

8. Viscosity Evaluations:

The viscosity of the shampoos was determined using a Brookfield viscometer, with measurements taken at room temperature. This process involved carefully calibrating the viscometer and then using it to assess the thickness or resistance to flow of the shampoo samples. The viscosity readings provided essential information on the consistency and texture of the shampoo.

9. Skin irritation test: The prepared herbal shampoo was applied to the skin and left on for a duration of 5 minutes. After this period, the shampoo was thoroughly rinsed off. Following the rinse, the skin was closely observed for any signs of irritation or inflammation. This observation period was critical in assessing the potential for adverse reactions or sensitivity caused by the herbal shampoo, ensuring its safety for use on the skin.

10. Stability Study:

The stability of the formulation was examined over a period of four weeks by storing it at a temperature range of 25-30°C. During this time, the formulation was regularly inspected for changes in appearance and physical stability. These evaluations, conducted throughout the month, ensured that any alterations or issues with the formulation's integrity or consistency were noted and assessed.

Result and discussion :

Today's consumers seek shampoos with multifunctional benefits. Many ingredients used in these shampoos are known to meet such demands. Consequently, formulating shampoos with safer, natural, and naturally derived ingredients has become increasingly desirable. The results of all evaluation parameters are presented in Table 2.

Table 2: Evaluation of Herbal Anti-dandruff Shampoo

Sr.No	Evaluation Parameter	Observation
1.	Physical Appearance	Colour-Brown Odour-Lavender like Clarity-Non-transparent Appearance-Viscous
2.	pH	6.7



3.	Dirt dispersion test	Good
4.	Foam ability	82ml ,stable foam
5.	% Solid content	27 %
6.	Wetting time	15 sec
7.	Surface tension measurement	22.3dyn/cm
8.	Viscosity (cp)	285
9.	Skin irritation test	No irritancy
10.	Stability test	Stable

1. Physical appearance/visual inspection :

A shampoo like any other cosmetic preparation should have good appealing physical appearance. The formulated and marketed shampoos were evaluated for physical characteristics such as color, odor and transparency (Table 2). Our prepared shampoo was non-transparent, brown and had good odor. No significant difference was observed in terms of odor, transparency and foaming characteristics between commercial and formulated shampoo except for color.



Fig: Physical appearance of herbal shampoo

2. pH :

Most shampoos are formulated as either neutral or slightly alkaline to minimize the damage to hair. The pH of shampoo also helps in minimizing irritation to the eyes, enhances the qualities of hair and maintain the ecological balance of the scalp (Baran and Maiban ,1998). The pH of tested commercial shampoos was found within the preferred range (between 7 and 5) (Tarun et al., 2014) and are presented in Table 3. The acid balanced values were

observed with commercial shampoos (Dove: 6.12) but the pH of formulated shampoo was found to be nearly neutral (6.7).

Table 3: Physicochemical evaluation of formulated and marketed shampoo.

Evaluation Parameter	Formulated Herbal shampoo	Dove shampoo
Physical appearance	Brown	White
Colour	Not transparent	Milkyopaque
Transparency	Good	Good
Odour	Good	Good
pH	6.7	6.12
Foam ability	82ml±3	78±3
% Solid content	27%	29%
Wetting time	15 sec	10 sec
Surface tension (dyn/cm)	22.3	19.6

3.Foam ability:

Foaming or lathering is very important to the consumer and therefore, it is considered as an important parameter in evaluation of shampoo. Herbal Essences and formulated shampoo produced the foam volume 82 mL while dove shampoo generated a foam volume of 78 mL. The foams generated by formulated shampoo were small, compact, uniform, denser and stable similar to commercial samples. All tested shampoo had the same foam volume for 5 min showing that their foam has good stability.



Fig:Foaming ability test



4 Percentage Solid content :

Good shampoos usually have 20%–30% solid content as it is easy to be applied and rinse out from the hair. If it doesn't have enough solid it will be too watery and wash away quickly, similarly too many solids will be hard to work into the hair or too hard to wash out. The percent solid contents of all the tested shampoo was found within the range of 25-27% and are expected to wash out easily (Table 3).



Fig:percentage solid content

5.Surface tension measurement :

The term indicates the amount of surfactant present in shampoo to reduce the surface tension. Lesser the surface tension stronger is the cleaning ability of the shampoo. A shampoo is considered of good quality if it decreases the surface tension of pure water from 72.28 dyn/cm to about 40 dyn/cm (Ilton et al., 2007). The reduction in surface tension is an indication of their good detergent action. The formulated shampoo reduced the surface tension to 22.3 dyn/cm. However, among all the shampoo, Dove (19.6dyn/cm) has the lowest surface tension indicating that it has the strongest cleaning ability. The commercial synthetic or semi-herbal shampoos may contain excessive detergents, which can strip the hair of up to 80% of the oil and thus damage the hair. Using a mild detergent in our shampoo, we have ensured that this does not happen.

6. Wetting time :

The wetting ability of a surfactant is dependant on its concentration and is commonly used to test its efficacy. The canvas disc method is quick, efficient and reliable test to evaluate the wetting ability of a shampoo (Manikar and Jolly, 2000). The wetting time of formulated and dove shampoo was found 15sec and 10sec. It can be concluded that dove contains the maximum concentration of

detergents because it had the least wetting time by contrast our formulated shampoo exhibited maximum wetting time so, it contains minimum concentration of detergents.

7.Dirt dispersion test :

While the main objective of a shampoo is to effectively remove dirt, soil, and sebum, accurately gauging its cleansing power through experimental detergency evaluations can be challenging. Despite these challenges, the cleansing action studies revealed that the final formulation performed well, demonstrating a strong ability to cleanse effectively. This indicates that the shampoo is proficient in achieving the desired level of cleanliness, ensuring that it meets the primary goal of maintaining hair and scalp hygiene.

8.Viscosity :

Since, Glycerine was incorporated into the formulation to enhance thickness, a viscosity of 285 cp indicates that the shampoo achieves an ideal balance between being too thick and too watery. This viscosity level ensures that the shampoo is easy to apply and rinse out.

9. Stability study :

This consistency suggests that the formulations are both chemically and physically stable over time, ensuring that they will retain their desired characteristics throughout their shelf life. The stability of these properties not only enhances the product's appeal but also reinforces consumer confidence in its long-term effectiveness and reliability. Additionally, the absence of any noticeable degradation in odor or color indicates that the formulation ingredients were well-chosen and effectively preserved, contributing to the overall success and marketability of the product.

Stability of formulation It was checked for selected parameters (Table 4) after the interval of one month. There was marginal increase in pH reported for the developed formulation with increase in temperature, i.e. at $45\pm 2^{\circ}\text{C}$ after one month. When % cleansing action was assessed for developed formulation after one month, it was evident that % cleansing action was dropped at negligible level. Overall stability of shampoo developed from natural ingredients was good at a temperature ranging between 4 to 42° . Stability of prepared anti-dandruff shampoo formulation was checked for particular parameters after the interval of one month. Table 3. There was slight decrease in pH reported for the developed formulation



with increase in temperature, i.e. at $45 \pm 2^\circ$ after one month. When % cleansing action was assessed for developed formulation after one month, it was evident that % cleansing action was slightly increased. Overall stability of herbal antidandruff shampoo was good at a temperature ranging between 4 to 42°C .

Table 4: Stability studies

Evaluation parameter	Before 1 month	After 1 month
Colour	Brown	No Change
Odor	Pleasant	No Change
Transparency	Thick	No Change
pH	6.7 ± 0.5	6.6 ± 0.5
Solid content	$27 \pm 2\%$	$27 \pm 2\%$
Foam volume	$82 \pm 2\text{ml}$	$83 \pm 2\text{ml}$
Surface tension	$22.3 \pm 0.5\text{dyne/cm}$	$22.3 \pm 0.5\text{dyne/cm}$
Wetting time	15sec	15.1sec

Conclusion :

The present study aimed to develop an herbal shampoo designed to reduce dandruff and promote hair growth, offering a safer alternative to conventional products that contain synthetic chemicals. In this research, a natural shampoo was formulated using an aqueous extract of various medicinal plants, including chamomile flower, tulsi leaves and aloe vera. These ingredients are well-regarded in traditional hair care for their beneficial properties.

The primary goal was to create a shampoo that excludes synthetic additives and relies predominantly on natural components. Despite this objective, achieving a completely natural formulation proved challenging. Consequently, the final shampoo contains a small percentage of Sodium Lauryl Sulfate (SLS), specifically 3.75%. While this is significantly lower than the concentrations found in many commercial shampoos, which can range from 10% to 40%, it highlights the compromise necessary to ensure product effectiveness and stability.

A comprehensive series of tests was conducted to evaluate the performance of the formulated shampoo. These assessments focused on various attributes, including foaming ability, viscosity, pH level, and conditioning performance. The results from these evaluations indicated that the shampoo met established quality control standards,

demonstrating satisfactory performance in terms of texture, stability, and effectiveness.

However, while the initial findings are promising, further scientific validation is necessary to fully confirm the shampoos overall quality and efficacy. This additional research will help ensure that the formulation not only meets the necessary safety and performance benchmarks but also stands up to long-term use and consumer expectations.

Overall, the study highlights the potential for creating a more natural alternative in the hair care market, though it also underscores the complexities involved in formulating such products. By balancing natural ingredients with minimal synthetic additives, the developed shampoo represents a step toward safer and more environmentally friendly hair care solutions. Future work will focus on refining the formulation and conducting further tests to validate its effectiveness and safety.

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