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Herbal Shampoo: Formulation and Evaluation Study

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ABSTRACT

The present study focuses on the formulation and evaluation of a herbal shampoo as a potential alternative to synthetic hair care products associated with adverse effects. The formulation was developed to achieve effective cleansing, moisturizing, and strengthening properties while minimizing the use of harsh chemicals. Optimization of surfactants, thickeners, and herbal extracts was carried out to attain desired viscosity and stability. Herbal ingredients such as Neem (*Azadirachta indica*), Shikakai (*Acacia concinna*), and Reetha (*Sapindus mukorossi*) were selected based on their well-established therapeutic properties. These ingredients function as natural surfactants and possess antimicrobial and anti-dandruff activities. Additionally, they are rich in bioactive constituents including alkaloids, flavonoids, saponins, and polyphenols, which contribute to improved scalp health and hair nourishment. The prepared formulation was evaluated for organoleptic characteristics, physicochemical parameters, and performance tests such as pH, viscosity, foam stability, surface tension, dirt dispersion, and wetting time. The results demonstrated satisfactory performance, stability, and safety for scalp application. The study concludes that the developed herbal shampoo offers an effective, safe, and environmentally sustainable alternative for modern hair care needs.

Keywords: Herbal shampoo, Neem, Shikakai,Reetha, Antidandruff.

I. INTRODUCTION

Shampoo is a liquid or cream preparation of soap or detergent used for washing hair. It is a hair care product generally available in viscous liquid form and is designed to cleanse the hair and scalp effectively. The primary purpose of shampoo is to remove dirt, excess oil (sebum), dandruff, environmental pollutants, and residues of hairstyling products without eliminating excessive natural oil that keeps the hair soft and manageable. Shampooing is most common method of maintaining hair hygiene [1].

Hair is an important protective appendage of the body derived from the ectoderm of the skin and is considered an accessory structure of the integumentary system along with sebaceous glands, sweat glands [2]. Sebaceous glands produce sebum, which helps maintain the natural shine and smoothness of hair. Proper cleansing is necessary to prevent the accumulation of impurities on the scalp. Hair care products are formulated to clean, nourish, and improve the overall appearance of hair [3]. However, modern shampoos are multifunctional and provide additional benefit such as conditioning, smoothness, and improved manageability, leaving hair shiny and easy to comb. Many synthetic shampoos are present in the current market, both medicated and non-medicated; however, herbal shampoo popularized due to natural origin which is safer, increases consumer demand and free from side effects [4].

In synthetic shampoos, surfactants are added mainly for their cleansing and foaming properties, but the continuous use of these surfactants may lead to adverse effects such as eye irritation, scalp irritation, hair loss, and dryness of hair [5]. As an alternative to synthetic shampoos, formulations containing natural herbal ingredients can be used. However, formulating cosmetic products using only natural substances is very difficult [6].

A number of medicinal plants with beneficial effects on hair have been traditionally used worldwide and are incorporated into shampoo formulations [7]. Ingredients like reetha, shikakai, neem. These medicinal plants may be used in the form of extracts, powders, crude forms, or their derivatives [8].

Developing a shampoo containing only one natural substance that is safe and mild, while also providing good foaming, detergency, and solid content comparable to synthetic shampoos, is quite

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challenging. Therefore, an attempt has been made to develop a herbal-based shampoo using conventional techniques and commonly used plant materials for hair cleansing [9].

Ideal Characteristics of Herbal Shampoo

1. It should remove loose corneal cells from the hair, excess sebum or other fatty substances, and dust or debris thoroughly and effectively.
2. It should generate a sufficient amount of foam to meet the user's psychological needs.
3. When you rinse it with water, it ought to come off with ease.
4. The hair should be left with minimal fly away, soft, glossy, and manageable texture.
5. It ought to give the hair a pleasing fragrance.
6. It shouldn't irritate the skin or eyes or have any negative consequences.
7. The hand shouldn't get rough and chapped as a result. [10]

Functions of Shampoo

1. It should effectively and completely remove dirt or soil.
2. It should effectively wash the hair.
3. It should produce a good amount of foam to satisfy the user.
4. It should be readily removed by rinsing with water.
5. It should impart a pleasant fragrance to the hair.
6. It should not have any side effects or causes irritation to the skin and eye.

Classification of Shampoo

1. Based on Appearance
   - Powder shampoo
   - Liquid shampoo or lotion shampoo
   - Gel shampoo or Solid shampoo
   - Cream shampoo
   - Oil shampoo
   - Miscellaneous anti dandruff shampoo or medicated shampoo
2. Based on Use or Function
   - Conditioning shampoo
   - Antidandruff shampoo
   - Therapeutic shampoo
   - Baby shampoo
   - Balancing shampoo
   - Clarifying shampoo
3. Based on origin
   - Herbal shampoo
   - Egg shampoo [11]

Anatomy of Hair

Hair is composed of 95% keratin, a fibrous, helicoidal protein (formed like a helix) found in the skin and all of its attachments (body hair, nails, and so on). The hair structure consists of 3 different parts:

Medulla: It is the innermost layer of the hair shaft, composed of amorphous, soft, and greasy substances.

Cuticle: A thin protective outer layer that contains nutrients that promote hair development. It is highly keratinized, with cells structured like scales placed one on top of the other, measuring approximately 60 micrometers long and 6 micrometers wide.

Cortex: The major component of the hair, containing long keratin chains that provide elasticity, suppleness, and resistance to the hair. The cortex's cells are linked together by a lipid and protein-rich intercellular cement. [12].

Growth cycle of hair

Hair growth cycle consists of four phases:

Anagen (growth phase): It is the growing phase. This phase lasts for several years.

Catagen (transitional phase): During this phase the hair follicle shrinks and hair growth slows.

Telogen (resting phase): It is the resting phase where hair growth stops and new hair begins the growth phase, pushing the old hair out.

Exogen phase: last phase of hair growth cycle where hair strand completely detaches from the scalp and sheds off. [13]

Hair problem:

Hair loss: Hair loss is caused by a variety of circumstances, Including stress, hormonal imbalance, and the use of the improper products. Prevention can be achieved by eating protein-rich foods, switching to mild shampoos, massaging with heated oil, staying hydrated, and exercising regularly.

Dandruff: Dandruff is the scaly particles that stick to the hair's root and are caused by a bad diet, a dry scalp, an infection, excess sebum, or sensitivity to particular products.

Split ends: When the oil from the scalp does not reach the ends of the hair, causing it to dry and split over time. Another cause is heat, which exacerbates the ends. Applying a little oil to the ends might help prevent split ends.

Oily scalp: Oily scalp can be caused by a variety of factors, including a bad diet, heredity, or hormonal fluctuations, but the most common culprit is frequent washing. Lactic acid is an ingredient that helps to regulate oil production. Inflammatory skin

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disorder that affects the scalp and can cause hair loss[14].

Advantages of Herbal Shampoo

1. Easy to manufacture and cheap in cost.
2. Easily available and found in large variety and quantity.
3. They did not provoke allergic reaction and do not have negative side effects.
4. Easily incorporate in skin and hair.

Plant profile

1. Reetha

Synonym: Indian soapberry, Washnut

Biological source:*Sapindus mukorossi*, **family:**Sapindanceae

Chemical constituents: Triterpenoidsaponins, sapindoside A & B, sugar, tannins

Uses:

- Cleanser insecticide.
- For treating migraine headaches.
- To remove skin impurities like pimples or eczema.

2. Shikakai

Synonyms: Soap Pod, Saptala (Sanskrit)

Biological Source: It is derived from the dried fruit pods, leaves, and bark of *Acacia concinna*.

Family: Leguminosae (Fabaceae).

Chemical Constituents: Saponins, spinasterol, lactonenatural sugars, hexacosanol, oxalic acid, tartaric acid, citric acid, ascorbic acid, alkaloids, and nicotine

Use:

- Act as natural hair cleanser, astringent.
- Act as natural detangle hairs.

3. Neem

Synonyms: Azadirachta indica, MargosaNimtree

Biological Source: It consists of almost all aerial parts (leaves, bark, seeds, flowers) of the plant *Azadirachta indica* Linn.

Family: Mellaceae.

Chemical Constituents: Azadirachtin, nimbin, quercetin, salannins

Uses:

- To treat dandruff.
- Reduce scalp itchiness/inflammation.
- Promote hair growth due to its antifungal and antibacterial properties. [15].

The present study aims to formulate and evaluate a herbal shampoo. The objective of the study is to develop a formulation that provides efficient cleansing, good foaming ability, and desirable viscosity while maintaining the natural integrity of hair and scalp. It also focuses on incorporating herbal extracts such as reetha, shikakai, and neem, which are known for their cleansing, conditioning, and antimicrobial properties. Furthermore, the study seeks to evaluate various physicochemical parameters including pH, viscosity, foam stability, surface tension, and overall stability of the prepared formulations. Another objective is to assess the performance, safety, and user acceptability of the herbal shampoo, ensuring it minimizes side effects commonly associated with synthetic products and promotes healthy, strong, and shiny hair.

II. MATERIAL AND METHOD

Plant materials such as reetha (*Sapindus mukorossi*), shikakai (*Acacia concinna*), and neem (*Azadirachta indica*)were procured from the local market of Talegaon, District-Wardha (India). These materials were thoroughly washed with distilled water to remove impurities and then shade-dried to preserve their active constituents. The dried materials were further subjected to pulverization, followed by extraction processes such as maceration to obtain the required extracts.

Excipients including hydroxyl propyl methyl cellulose (HPMC) as a thickening agent, sodium lauryl sulfate (SLS) as a surfactant, and sodium benzoate as a preservative were used in the formulation. Ethanol (purity ≥99%) was utilized for extraction purposes. All the ingredients were of analytical grade and procured from standard chemical suppliers. Double-distilled water prepared in the laboratory was used throughout the formulation process to maintain purity and consistency of the herbal shampoo.

Extraction of plant material

- Reetha shells, shikakai pods, and neem leaves were collected and washed thoroughly with distilled water to remove impurities.
- The materials were shade dried and coarsely powdered using a grinder.
- A mixture of distilled water and ethanol (70:30) was prepared to enhance extraction of both water-soluble and alcohol-soluble constituents.
- The powdered material was soaked in the hydroalcoholic solvent in a closed container.
- The mixture was kept for 48 hours with occasional stirring to ensure proper extraction.
- After maceration, the mixture was filtered using muslin cloth or filter paper to remove solid residues.
- The filtrate was subjected to mild heating (40-60°C) to evaporate excess solvent and obtain a concentrated extract.

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- The extract was cooled and stored in an airtight container for further use in shampoo formulation.

Formulation Process

Table1: Formulation of herbal shampoo batches by *trial and error* method

Batches	F1	F2	F3	F4	F5
Ingredients (g)					
HPMC	1.5	1.5	1.5	1.5	1.5
SLS	2.0	3.0	2.0	2.0	1.0
Reetha extract	6.0	6.0	8.0	6.0	7.0
Shikakai extract	6.0	6.0	8.0	6.0	7.0
Neem extract	3.0	3.0	4.0	5.0	3.0
Glycerin	3.0	3.0	3.0	3.0	4.0
Sodium benzoate	0.3	0.3	0.3	0.3	0.3
Citric acid (q.s.)	q.s.	q.s.	q.s.	q.s.	q.s.
Distilled water	q.s. to 100g	q.s. to 100g	q.s. to 100g	q.s. to 100g	q.s. to 100g

Method of Preparation for Herbal Shampoo (F1-F5)

All five formulations (F1-F5) were prepared using the same method, with variations only in the composition as specified in the formulation table.

Accurately weighed quantity of hydroxypropyl methylcellulose (HPMC, 1.5 g) was dispersed in approximately 50 g of hot distilled water (70-80°C) with continuous stirring. The dispersion was allowed to hydrate and cool to room temperature to form a clear and uniform gel base.

Separately, the required quantity of sodium lauryl sulfate (SLS) was dissolved in a small amount of lukewarm distilled water. This SLS solution was then slowly incorporated into the HPMC gel with gentle stirring to minimize foam formation.

Subsequently, the specified quantities of reetha extract, shikakai extract, and neem extract were added sequentially to the base with continuous mild stirring to ensure uniform distribution.

Glycerin was then incorporated as a humectant and mixed thoroughly. The preservative, sodium benzoate, was pre-dissolved in a small quantity of warm water and added to the formulation at a temperature below 40°C with gentle stirring.

The pH of the formulation was adjusted to 5.5-6.0 using citric acid solution (q.s.). Finally, the volume was made up to 100 g using distilled water and mixed uniformly.

Evolution Parameters

1. Physical appearance

The physical appearance of a shampoo should be enticing, its color, odor, and transparency can all be assessed.

2. pH Determination

A shampoo's performance, stability, and suitability for the hair and scalp are all impacted by its pH. A shampoo's Ideal pH range is normally between 4.5 and 6.5.

3. Viscosity determination

Once rheological factor that influences a shampoo's thickness and flow characteristics is viscosity. It also impacts how well the shampoo cleans and how the user feels about it.

4. Foaming ability and foam stability

Cylinder shake method was used for determining foaming ability. 50ml of the 1% herbal shampoo solution was put into a 250ml graduated cylinder and the cylinder was covered with hands and shaken for 10 minutes. The total volume of the foam content after 1min shaking was recorded. Immediately after shaking the volume of the foam at 1min intervals for 10 minutes were recorded. The foam volume remains same throughout the period of about 5min showing that the generated foam by the shampoo has good stability and the prepared shampoo exhibits higher foam property which may be due to the presence of soapnut. 1ml shampoo is dissolved with 2ml water and shaken vigorously for 10 minutes produced 0.4ml foam.

5. Dirt dispersion

Two drops of shampoo were added in a large test tube contain 10 ml of distilled water. 1 drop of India ink was added; the test tube was stoppered and

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shakes it ten times. The amount of ink in the foam was estimated as None, Light, Moderate, or Heavy.

6. Surface Tension

Measurements were carried out with a 10% shampoo dilution in distilled water at room temperature. Thoroughly clean the stalagmometer using chronic acid and purified water because surface tension is highly affected with grease or other lubricants and after cleaning determine the surface tension.

7. Wetting time test

The concentration of a surfactant determines how well it wets. A quick and accurate test to determine a shampoo's wetting ability is the canvas disc method. A longer wetting time means there are less detergents in the shampoo.

8. Stability studies

During the storage period, the formulations organoleptic qualities (color and odor) showed stability and acceptability, indicating their physical and chemical stability [16,17].

Table 2: Optimize formulation of herbal shampoo

Sr. no.	Ingredients	Quantity(g)
1	HPMC	1.5
2	SLS	2.0
3	Reetha extract	8.0
4	Shikakai extract	8.0
5	Neem extract	4.0
6	Glycerin	3.0
7	Sodium benzoate	0.3
8	Citric acid (q.s.)	q.s.
9	Distilled water	q.s. to 100g

Fig. 1: Optimized herbal shampoo

III. RESULT AND DISCUSSION

After preparation of the herbal shampoo using selected plant extracts such as reetha, shikakai, and neem, the formulated batches were evaluated for various physicochemical parameters. The percentage yield of the extracts was found to be satisfactory, indicating efficient extraction of active constituents.

Among all batches, one optimized formulation showed comparatively better results in terms of viscosity, foam stability, and overall performance. The detailed results of evaluation parameters are presented in tabulated below(table).

1. Physical Appearance

The prepared formulations (F1–F5) were visually inspected for color, clarity, odor, and consistency. All batches showed a brown to dark brown color with a characteristic herbal odour.

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Table1.3:Physical appearance

Batch	Colour	Odor	Consistency	Homogeneity
F1	Brown	Pleasant	Slightly viscous	Good
F2	Dark brown	Strong unpleasant	Highly viscous	Good
F3	Dark brown	Slight pleasant	Moderately viscous	Excellent
F4	Brown	Slight pleasant	Thin	Good
F5	Brown	Mild pleasant	Thin	Moderate

2. pH Determination
The pH of all formulations was found in the range of 4.5–6.5, which is suitable for scalp and indicates that the shampoo is mild and non-irritant.

3. Viscosity
The viscosity of F3 formulation found to be optimum than other batches, without being too thick or too thin. According to the observation table (1.4).

4. Foam Ability and Stability
The foam height and foam stability of all formulation are presented in table (1.4).It was observed that the F3 produce comparatively higher foam and showed good foaming stability than other formulation indicating effective cleansing performance.

5. Dirt Dispersion Test
According to the observation table (1.4). F3 formulation showed minimal dirt in foam, indicating good cleansing ability and efficient removal of dirt and oil.

6. Surface Tension Test
The surface tension value of all formulation are show in table (1.4) it was found that the F3 formulation show surface tension reaching the acceptable range, indicating good cleansing efficiency.

7. Wetting Time Test
According to the observation table (1.4). F3 formulation showed slightly lower wetting time compared to others, indicating better wetting ability.

Table 1.4: Evaluation of prepare formulation batches

Parameter	F1	F2	F3	F4	F5
pH	5.5	5	5.5	5	5
Viscosity	1.92	2.20	2.60	2.06	1.78
Foam height(mm)	10	20	22	15	18
Foam stability(min)	10	10	12	10	9
Dirt dispersion	Good	Moderate	Excellent	Good	Good
Surface tension	31	32	34	31	30
Wetting time(sec)	190	220	110	150	195

8. Stability Studies
All formulations were found to be stable during the study period with no significant changes in color, odor, or consistency.
As a result, it can be concluded that the F3 formulation is suitable for effective application as a herbal shampoo.

IV. SUMMARY AND CONCLUSION

The present study focused on the formulation and evaluation of a herbal shampoo using natural ingredients such as reetha, shikakai, and neem. These plant materials were selected due to their well-known cleansing, antimicrobial, and hair-nourishing properties. The extracts were prepared using the maceration process with suitable solvents like water and ethanol to obtain active constituents. A total of five different formulations (F1-F5) were prepared by varying the concentration of ingredients such as SLS and herbal extracts, while maintaining HPMC as a thickening agent and sodium benzoate as a preservative. Each

formulation was evaluated for various physicochemical parameters including pH, viscosity, foam stability, homogeneity, and cleansing ability. The evaluation results showed that F-3 batch formulation possessed acceptable characteristics, with slight variations depending on composition. Among them, one optimized formulation showed better performance in terms of foam stability, viscosity, and good cleansing action.

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CONFLICT OF INTEREST
The authors declare no conflict of interest.

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