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Research Paper

Development and Evaluation of an Innovative Herbal Hair Conditioner

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ABSTRACT

The rising demand for safer, eco-friendly alternatives to synthetic hair care products has propelled the exploration of herbal formulations rooted in traditional medicine. This study aimed to develop and evaluate an innovative herbal hair conditioner using ten carefully selected botanicals known for their therapeutic benefits-Amla, Shikakai, Henna, Hibiscus, Aloe vera, Fenugreek, Reetha, Jatamansi, Coconut oil, and Rose water. Four distinct formulations (F1, F2, F3, and F4) were prepared by varying key ingredient concentrations while maintaining a consistent base. These were then assessed through comprehensive physicochemical and organoleptic evaluations, including pH balance, viscosity, cleansing efficiency, moisturizing time, dirt dispersion, wetting ability, and product stability. Among all formulations, F2 (Aloe vera and Hibiscus-rich) demonstrated superior moisturizing and wetting properties, while all variants exhibited a pH within the hair-friendly range of 4.5-5.5. The formulations remained stable over six weeks without signs of separation or degradation. Sensory evaluations confirmed their consumer appeal, with smooth texture, pleasant herbal aroma, and consistent color. The research confirms that herbal conditioners can effectively compete with, and potentially replace, synthetic counterparts by offering holistic benefits without harmful chemicals. These findings highlight the potential of traditional herbs to produce sustainable, effective, and safe cosmetic products that align with consumer health and environmental concerns when combined with modern formulation techniques.

INTRODUCTION

Hair plays a vital role in protection and thermoregulation and aesthetics, social perception, and personal identity. Healthy, well-maintained

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hair is often associated with good hygiene, vitality, and confidence[1]. However, factors such as environmental pollution, chemical-laden hair care products, stress, hormonal imbalances, and poor nutrition can compromise hair health, leading to conditions such as dryness, brittleness, hair fall, dandruff, and scalp irritation[2]. Hair conditioners are essential cosmetic products formulated to improve hair texture, softness, manageability, and moisture retention after shampooing. Conventional conditioners, while effective, often contain synthetic ingredients such as silicones, parabens, and quaternary ammonium compounds[3]. Long-term use of these chemicals may result in scalp sensitivity, product buildup, and adverse environmental impact. As a result, there is a growing global interest in herbal and natural alternatives that are safe, eco-friendly, and rooted in traditional systems of medicine[4]. Traditional botanicals, widely used in Ayurveda, Unani, and other indigenous systems, offer a rich source of bioactive compounds that promote scalp and hair health. Herbs such as Amla *(Phyllanthus emblica)*, Shikakai *(Acacia concinna)*, Henna *(Lawsonia inermis)*, Hibiscus flower *(Hibiscus rosa-sinensis)*, Aloe vera *(Aloe barbadensis)*, Fenugreek seeds *(Trigonella foenum-graecum)*, Reetha *(Sapindus mukorossi)*, Jatamansi root *(Nardostachys jatamansi)*, Coconut oil *(Cocos nucifera)*, and Rose water *(Rosa centifolia)* are well-documented for their conditioning, nourishing, and restorative effects on hair[5,6]. Despite their therapeutic potential, herbal formulations often lack scientific validation and standardized methods of preparation and evaluation[7,8]. This research aims to bridge this gap by formulating a novel herbal hair conditioner using selected traditional botanicals and integrating it with modern cosmetic formulation techniques. The objective is to develop a scientifically validated, effective, and consumer-friendly herbal hair conditioner, followed by its evaluation based on physicochemical parameters, sensory attributes, and performance testing. By combining the wisdom of traditional herbal medicine with advancements in cosmetic technology, this research aspires to contribute toward safer, sustainable, and efficacious personal care products.

Aim and Objectives:

This research aims to develop and evaluate a novel herbal hair conditioner that synergistically combines traditional plant-based ingredients with contemporary cosmetic formulation techniques. The primary objective is to harness the therapeutic properties of selected botanicals, such as Amla, Shikakai, Henna, Hibiscus flower, Aloe vera, Fenugreek seeds, Reetha, Jatamansi root, Coconut oil, and Rose water to create a formulation that is both effective and safe for hair care applications. The research focuses on formulating a stable product and assessing its physicochemical properties, including pH, viscosity, and spreadability, as well as its conditioning efficacy and user acceptability. Additionally, the study emphasizes the importance of integrating ethnobotanical knowledge with modern cosmetic science to promote the use of traditional herbs in contemporary hair care solutions.

MATERIALS AND METHODS:

Selection of Herbal Ingredients:

Based on traditional knowledge and literature review, the following herbs were selected for their well-known benefits in hair care (Table 1)[9-13].

Table No. 1: The table below illustrates herbal ingredients and their benefits.

Sr. No.	Herb	Botanical Name	Benefits
1	Amla	*Phyllanthus emblica*	Strengthens hair, promotes growth

2	Shikakai	*Acacia concinna*	Natural cleanser, adds shine
3	Heena	*Lawsonia inermis*	Antimicrobial, cooling effect, promotes growth
4	Hibiscus flower	*Hibiscus rosa-sinensis*	Condition hair, reduces frizz
5	Aloe vera	*Aloe barbadensis*	Moisturizes, soothes the scalp
6	Fenugreek seeds	*Trigonella foenum-graecum*	Antibacterial, reduces dandruff
7	Reetha	*Sapindus mukorossi*	Natural cleanser, mild foaming agent
8	Jatamansi root	*Nardostachys jatamansi*	Prevents premature greying, promotes hair growth
9	Coconut oil	*Cocos nucifera*	Deep conditioner nourishes hair
10	Rose water	*Rosa centifolia*	Natural fragrance, adds shine and smoothness
11	Glycerin	Glycerol	Hydrates hair, prevents dryness and flakiness

Procurement of Raw Materials:

All raw materials used in the formulation were procured from certified herbal suppliers to ensure authenticity and quality (Figure 1). Fresh Aloe vera gel was directly extracted from mature leaves to retain its natural properties. Cold-pressed and organic oils, such as coconut oil, were selected for their purity and efficacy. All ingredients were stored in clean, airtight containers under cool and dry conditions to maintain their stability and prevent degradation before use.

Figure 1: (a) Amla, (b) Shikakai, (c) Heena, (d) Hibiscus flower, (e) Aloe vera, (f) Fenugreek seeds, (g) Reetha, and (h) Jatamansi root.

Procedure:

Step 1: Preparation of Herbal Extracts (Tables 2 & 3)**:**

1.Soak powders (amla, shikakai, henna, hibiscus flower, fenugreek, reetha, and jatamansi) in 40 ml of distilled water and gently heat at 60-

70°C for 30 minutes with occasional stirring to extract active constituents.

2.Cool and filter the mixture using Whatman filter paper.

3.Collect the filtrate and keep it aside for use in the aqueous phase.

Step 2: Preparation of the Aqueous Phase:

1. In a clean beaker, combine: Filtered herbal extract, Aloe vera gel (10 g), Glycerine (5 ml), Rose water (10 ml), Sodium benzoate (preservative)
2. Heat this mixture to about 40-50°C and stir well to ensure uniform mixing.

Step 3: Preparation of the Oil Phase:

1. In a separate beaker, warm coconut oil (10 ml) to about 40°C to liquefy it if solid.
2. Ensure no overheating to preserve its nutritional properties.

Step 4: Emulsification:

1. Slowly add the oil phase to the aqueous phase while stirring continuously with a magnetic stirrer or homogenizer at moderate speed (~3000 rpm).
2. Stir for 15-20 minutes until a uniform, creamy emulsion is formed.
3. Allow the conditioner to cool to room temperature (Figure 2).

Step 5: Final Adjustments and Packaging:

1. Check and adjust the pH of the conditioner (ideal range: 4.5-5.5).
2. Transfer the finished product into airtight containers (Figure 3).
3. Label and store in a cool, dry place away from direct sunlight.

Table No. 2: The table below illustrates the herbal ingredients and their respective quantities used in a 100 g batch of the conditioner.

Sr. No.	Ingredient	Quantity
1	Amla (powder or extract)	5 g
2	Shikakai (powder or extract)	4 g
3	Henna (powder)	3 g
4	Hibiscus flower (powder or extract)	4 g
5	Aloe vera gel (fresh)	10 g
6	Fenugreek seed (powder)	4 g
7	Reetha (powder or extract)	3 g
8	Jatamansi root (powder or extract)	2 g
9	Coconut oil	10 ml
10	Rose water	10 ml
11	Glycerine	5 ml
12	Distilled water	40 ml
13	Sodium benzoate (preservative)	0.2 g

Table No. 3: The four different formulations (F1-F4) of hair conditioner, each standardized for a 100 g batch, with variations in key ingredient quantities while maintaining a consistent base composition.

Sr. No.	Ingredient	F1 (Balanced base formula)	F2 (Aloe & Hibiscus rich)	F3 (Protein-enriched & Fenugreek focused)	F4 (Conditioning & fragrance boost)
1	Amla (g)	5	4	4	5
2	Shikakai (g)	4	3	3.5	4
3	Henna (g)	3	2.5	2.5	3
4	Hibiscus flower (g)	4	6	3.5	4
5	Aloe vera gel (g)	10	15	8	12
6	Fenugreek seed (g)	4	3.5	6	4
7	Reetha (g)	3	3	3	2.5
8	Jatamansi root (g)	2	1.5	1.5	2

9	Coconut oil (ml)	10	10	12	8
10	Rose water (ml)	10	8	9	15
11	Glycerine (ml)	5	4	6	6
12	Distilled water (ml)	40	39	36	34
13	Sodium benzoate (g)	0.2	0.2	0.2	0.2

Figure 2: Prepared formulations of the herbal hair conditioner cooling in beakers at room temperature.

Figure 3: Transfer the finished herbal hair conditioner into airtight Amber glass containers.

Evaluation Parameters:

The prepared formulations of herbal hair conditioner were systematically evaluated using a combination of organoleptic assessments and physicochemical parameters as outlined below[14-17]:

1. pH Determination: The pH was assessed by immersing standard pH indicator strips into the hair conditioner sample. The resulting color change was compared against a calibrated pH scale to determine the hydrogen ion concentration.

- Acceptable pH range for hair strands: 3.6-5.5
- Recommended pH range for conditioners: 3.0-7.0.

2. Dirt Dispersion Test: Two drops of the conditioner were added to a test tube containing 10 ml of distilled water. One drop of Indian ink was then introduced. After sealing the tube, it was shaken vigorously 10 times. The degree of ink dispersion within the foam was observed and categorized as none, light, moderate, or heavy-indicating the hair conditioner's ability to retain or repel dirt.

3. Cleansing Action: Wool yarn (5 g) was first coated with grease, then submerged in 200 ml of water containing 1 g of the test hair conditioner. The solution was maintained at 35 ± 1°C and

agitated at 50 rpm for 4 minutes. Post-treatment, the yarn was dried and reweighed. The weight reduction corresponded to the percentage of grease removed, reflecting the cleansing efficacy of the formulation.

4. Stability Testing: Formulated conditioners were stored at $37 \pm 2°C$ for a period of six weeks to evaluate their physical stability. Samples were monitored at weekly intervals for any signs of phase separation, discoloration, or changes in viscosity and texture.

5. Moisturizing Time (Sinking Time Test): A 1 g steel ball (20 cm^3) was gently placed on the surface of 60 ml of diluted hair conditioner. The time required for the ball to fully sink was recorded. Shorter sinking time indicated lower resistance and better moisture retention properties.

6. Viscosity Measurement: Viscosity was measured using a Brookfield viscometer equipped with a suitable spindle. The spindle was immersed in the hair conditioner sample and rotated at a standardized speed. The resistance to rotation, expressed in centipoise, indicated the thickness and spreadability of the formulation.

7. Wetting Time: The wetting efficiency of the formulation was evaluated by observing the time required for a standard disc to sink completely into the hair conditioner. This test reflects the surfactant's ability to reduce surface tension and enhance contact with hair strands.

8. Organoleptic (Physical) Evaluation: Each conditioner sample was assessed for key sensory attributes, including:

- Color: Visual uniformity and shade consistency.
- Odor: Pleasantness and herbal fragrance.
- Texture: Smoothness and homogeneity upon touch.

RESULT AND DISCUSSION:

The results of the research demonstrated that the developed herbal hair conditioner exhibited favorable physicochemical properties, including optimal pH, desirable viscosity, good spreadability, and satisfactory cleansing and moisturizing performance. Among the four formulations tested (F1, F2, F3, and F4) (Table 3), F2, which was rich in Aloe vera and Hibiscus, showed superior moisturizing time and wetting efficiency, indicating better hydration and manageability. The hair conditioners remained physically stable over six weeks with no signs of phase separation or degradation. Organoleptic evaluations confirmed consumer-friendly attributes, such as a pleasant herbal fragrance, smooth texture, and attractive appearance. These findings support the effectiveness of the herbal hair conditioner formulation in improving hair health and user satisfaction. Creating a herbal hair conditioner is essential in comparison to synthetic alternatives due to growing concerns over the long-term effects of chemical ingredients. Conventional conditioners often contain synthetic agents like parabens, silicones, and quaternary ammonium compounds, which may cause scalp irritation, hair damage, and environmental harm. In contrast, herbal conditioners harness the therapeutic properties of natural ingredients such as Amla, Shikakai, Aloe vera, and Hibiscus, which are rich in bioactive compounds, vitamins, and antioxidants. These not only nourish and protect hair without adverse effects but also align with the increasing demand for eco-conscious, safe, and sustainable personal care products. Moreover, integrating traditional botanical wisdom with modern formulation science helps preserve cultural heritage while providing scientifically validated, effective solutions for holistic hair care.

CONCLUSION

This study successfully developed and evaluated an innovative herbal hair conditioner that

integrates traditional botanical wisdom with modern cosmetic formulation techniques. By utilizing time-tested herbal ingredients-such as Amla, Shikakai, Henna, Hibiscus, Aloe vera, Fenugreek, Reetha, Jatamansi, Coconut oil, and Rose water, research aimed to offer a safe, effective, and sustainable alternative to synthetic hair conditioners. The four formulations (F1, F2, F3, and F4) demonstrated excellent physicochemical stability, acceptable pH values within the ideal range for hair care, and favorable sensory characteristics, including smooth texture and pleasant herbal aroma. Among the variants, F2 stood out with enhanced moisturizing and wetting properties due to its Aloe vera and Hibiscus-rich content, confirming its superior conditioning performance. All formulations maintained structural integrity and showed no signs of separation, discoloration, or microbial instability during the six-week storage period. Organoleptic tests further supported consumer acceptability, indicating that herbal ingredients not only provide functional benefits but also enhance user experience through natural fragrance and feel. This research underscores the growing necessity to shift from synthetic to herbal personal care products in response to increasing concerns about chemical exposure and environmental sustainability. The herbal hair conditioner developed in this study offers a promising, eco-conscious alternative that meets modern cosmetic standards while honoring traditional practices. Future work could focus on clinical testing, extended shelf-life studies, and scaling up production to meet commercial demand. Ultimately, this research contributes meaningfully to the advancement of safe, effective, and holistic hair care solutions in the global cosmetic industry.

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