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# Formulation and Evaluation of Herbal Hair Gel

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***Abstract***

*India is renowned for its traditional medical practices, such as ayurveda, yoga, Unani, and siddha. The use of herbal plants and their cosmetic preparations to improve human appearance is gaining popularity globally due to their effectiveness, quality and safety. This study aimed to create an herbal hair gel that promotes not only hair growth and health but also offers effective styling. The gel was made by combing ingredients known for their beneficial effects on hair, like flaxseed and fenugreek seed extracts rich in omega-3 fatty acid and antioxidants. Five different gel formulations were developed and tested, varying in the amount of these extracts, along with Aloevera gel, black tea powder extract and coconut oil. Evaluation tests were conducted on various aspects like appearance, pH, spreadability, viscosity and stability. Results indicated that formulations F4 and F5 performed well in all tested, showing good spreadability, viscosity, homogeneity and pH, remaining stable over time while effectively styling hair without causing damage. The use of natural ingredients made the gel gentle on hair and suitable for daily use, suggesting it could serve as a natural alternative in the cosmetic industry. Future research could explore incorporating additional plant extracts to further enhance the gel's benefits.*

**Keywords:** Hair gel, aloe vera, flaxseed, herbal cosmetic, hair care

## INTRODUCTION

Hair grows from follicles in the scalp's dermis and comprises densely linked dead and keratinized cells. Its structure composed of the medulla, cuticle and cortex. Split ends, overprocessing, hard water damage, stress and fungal infections are all common causes of hair damage. Malassezia furfur, Candida albicans and ringworm may result in dandruff, red or purple rashes, fissures, spots and white flaky scales on the scalp. Dandruff is a condition of the skin characterised by severe scaling of the scalp tissue [1].

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Flax seeds encompass fatty acids and antioxidants, which help to cleanse the scalp by getting rid of toxins and dead cells. Flaxseed, which is rich in omega 3 fatty acids, helps seal the hair cuticles, lowering hair loss and boosting hair volume [2]. Aloe vera is an effective dandruff treatment due to its high concentration of vitamins A, B12, C and E, minerals and amino acids. Aloe vera contains the enzyme bradykinase, which has an important role in diminishing the discomfort and inflammation associated with dandruff [3].

To reduce hair loss and treat dandruff, a hair style gel containing flaxseed and aloe vera will be utilized. Traditional hair gels cannot be used on the scalp owing to adverse effects and chemicals. This new composition seeks to provide a safer gel.

Indian plants are highly regarded worldwide, with a growing demand for herbal cosmetics. Ayurveda has long employed herbs to develop cosmetics that beautify and protect from external causes while having less adverse effects on the body [4].

Hair is an ordinary structure that consists of a root and shaft. The root resides in a follicle within the skin, whereas the shaft is exposed above the skin. Hair is mostly formed of keratin, a strong protein consisting of amino acids. The hair follicle is where hair originates and grows from. At the base of the follicle, there is a network of blood vessels that supply nutrition to the hair through structures called papillae. The sebaceous gland secretes oil which is important to keep the hair healthy. Within the hair bulb, there are distinct cells called melanocytes that create the pigment melanin, which gives hair colour. The apparent section of hair that extends outside the skin is called the hair shaft and it is composed of dead keratinocytes. Keratin promotes hair strength and elasticity by creating strong connections between amino acids. These connections strengthen the hair fibers [5].

- *Medulla:* The innermost layer of the hair shaft may be only visible in large and thick hair.
- *Cortex:* This is the middle layers of hair shaft which enhance strength, pigmentation and texture of hair fiber. It is made up of thin layer of keratin. It contains melanin. It consists of specialized cells called melanocytes melanin.
- *Cuticle:* This is outer most layer of hair shaft which is thin and colorless and has function to protect the cortex. It has six-to-eleven-layer keratin cells which take care of hair shaft and follicle [6].

**Phases of Hair Growth** [7]

1. Anagen phase.
2. Catagen phase.
3. Telogen phase.
4. Exogen phase.
5. Kenogen phase.

**Anagen Phase**

The first phase of the hair development cycle lasts around 1,000 days and begins in the papilla. It can last two to six years, with 80–90% of human hair in the growth phase known as anag. During this time, the cells around the follicle divide rapidly to provide nutrition to the hair, allowing it to grow up to one meter in length. Genetic factors play an important part in determining hair development rate, as cells in the papilla divide to form new hair fibers and the follicle embeds itself in the skin's dermal layer to sustain the strand.

**Catagens Phase**

When the anagen phase of hair development finishes, the hair enters the catagen phase, which is a brief transitional period lasting around 10 days. The catagen phase begins with the end of melanin synthesis in the hair bulb and the death of follicular melanocytes. This is also known as the transitory phase, in which the follicle regenerates itself. Over the next two weeks, the hair follicle shrinks, causing the papilla to disintegrate and disconnect from the blood supply. Hair does not develop during this phase, but the terminal fiber lengthens as the follicle pulls it higher.

**Telogen Phase**

The telogen phase is the final stage of hair development, during which the hair follicle is quiescent, and hair is readily removed. During this period, the follicle lies inactive for three months. The epidermal cells that line the follicular channel continue to proliferate and amass near the root of the hair. When the telogen phase ends, the follicle enters the growth phase, and a new hair shaft emerges within two weeks. Shedding is a typical element of hair development.

 

**Exogen Phase**

For a long time, it was thought that hair lost during the telogen phase, but it is now established that shedding occurs in a different phase known as exogen. Hair shedding is a highly managed, dynamic process that differs from the hair follicle's normal resting phase. This process has two steps: following telogen, signals are transmitted to the follicle's base cells to begin exogen, which initiates the shedding process [8].

**Kenogen Phase**

Hair follicles can become empty after hair shedding, a condition called kenogen. This occurs as the follicle remains empty between the resting phase (telogen) and the new growth phase (anagen). Disruptions in this growth cycle can lead to issues like hair loss, thinning and difficulties with hair growth [9].

## ADVANTAGES

- The gels have been used to facilitate efficient cutaneous and percutaneous drugs distribution.
- They may avert gastrointestinal medicine absorption concerns caused by stomach pH.
- When the oral route is not suitable, they might be used to provide medication instead.
- They prevent systemic and portal circulation after gastric absorption.
- Gels are not destroyed by liver enzymes as the liver is bypassed.
- Non-invasive and patient compliant.
- They are applied to the skin for gradual and extended absorption.

## DISADVANTAGES

- Gels could trigger allergens.
- Epidermal enzymes can denature gel medicines.
- Drugs with higher particles fail to penetrate the skin.
- Poor drug penetration via skin.
- While applying gels, carefully choose the region to be investigated.

## MATERIALS

**Aloevera (*Aloe barbadensis Miller*)**

Aloe vera gel is excellent for hair and skin care. Aloe vera gel can help balance pH levels, which is important for encouraging healthy hair development. It also works as a natural conditioner and prevents hair loss. Applying aloe vera gel to the scalp and hair may give total nourishment while allowing the gel to work its magic on enhancing hair health [10].

**Flax Seed (*Linum usitatissmum*)**

Flax seed oil is beneficial for making hair smooth and healthy. This oil, also known as flaxseed oil, is rich in essential fatty acids and unsaturated fatty acids, which may soften hair and give it a lovely sheen while also strengthening it with omega-3 fatty acids [11].

**Fenugreek (*Trigonella Foenum-Graceum*)**

Fenugreek seeds have high levels of iron and protein, both of which are necessary for hair development. They also include unique plant components, like as flavonoids and saponins, which are thought to encourage hair growth due to their anti-fungal and anti-inflammatory effects. These chemicals may prevent DHT from attaching to the hair follicles. Research has shown that fenugreek seed extract in hair oil can improve hair thickness and growth. It contains protein and amino acids, which help heal hair loss caused by a variety of conditions, such as dryness, heat styling, chemicals, sun exposure and colouring. Fenugreek helps to strengthen the hair shaft, which leads to stronger hair growth [12].

 

**Coconut Oil (*Cocos nucifera*)**

Coconut oil is an extremely useful natural component for hair, supporting healthy and beautiful hair development. It aids in avoiding protein loss, which can result in unappealing and unhealthy hair conditions. Coconut oil is widely used for hair care in places, such as India, where many people apply it after washing on a regular basis. It works as a conditioner, promoting the recovery of damaged hair by delivering vital proteins for nourishment and repair. According to research, coconut oil provides excellent protection against the damage produced by daily wear and strain on hair. Regular coconut oil massages can help maintain healthy hair [13].

**TEA**

Tea is a popular fragrant drink enjoyed all over the world, with major production taking place in over 30 countries, primarily in China, Japan, India and Sri Lanka [14]. Commercial tea is generally made from the first two leaves and leaf buds of the *Camellia sinensis* plant. This plant belongs to the *Camellia* genus of the Theaceae family. Tea is classed into four primary categories based on its oxidation level: white tea (non-oxidized from leaf buds), green tea (non-oxidized), oolong tea (partially oxidised) and black tea (completely oxidised) [15]. According to research, drinking black tea can provide a variety of health advantages, including protection against germs, infections, diabetes and cancer, as well as brain health [16].

## METHOD OF EXTRACTION

**Aloe vera**

The aloe leaves were washed and stood upright in a container for 15–20 minutes to let the yellow sap drain out. The aloe leaf pulp was then gathered and blended in a mixer to create a foamy liquid. This liquid was strained to eliminate any leftover particles. Subsequently, it was heated to 70°C to create a consistent gel and get rid of any remaining traces of yellow sap [17].

**Flax Seed**

To prepare the flaxseed extract, crush 20 g of flaxseed into a fine powder with a coffee grinder or mortar and pestle. The powdered seeds are then added to a beaker containing 200 ml of distilled water, mixed thoroughly and covered with foil. The mixture is allowed to sit at room temperature or lower for 24 hours before filtering through a cheese cloth or fine mesh strainer into a clean beaker. Store the extract in a clean, airtight jar in a cold area [18].

**Fenugreek**

*Trigonella frenum greacum* seeds were purchased from a neighbouring market. The seeds were pulverised and sifted into a coarse powder using a 40-mesh screen. A hundred grammes of powdered seeds were steeped in ethanol before being extracted using a hot extraction process with a soxhlet equipment. After chilling and filtering the extract, the liquid was evaporated under vacuum, leaving a residue [19].

**Tea**

In one experiment, 5 grammes of tea samples from various brands were immersed in 100 ml of methanol and heated in a water bath at 60°C for 10 and 20 minutes. The resultant extracts were then filtered via a vacuum filtering system. In terms of total flavonoids (TFs), methanol extraction for 20 minutes outperformed water and methanol extraction for 10 minutes. The researchers determined that extraction time and temperature are significant factors determining TF content in the extracts. Longer extraction durations resulted in larger yields [20].

## FORMULATION ASPECT

**Preparation of Hair Gel**

Five distinct herbal hair gel formulations were developed by combining varying quantities of herbal extracts. Carbopol was treated with a solution containing methyl paraben, polyethylene glycol and

 

glycerin. The mixture was forcefully agitated using a magnetic stirrer. The combination was subsequently treated with varying quantities of flax seed, aloe vera, fenugreek and tea extracts, as well as coconut oil. The gel was neutralised by gradually adding triethanolamine. Following thorough mixing, a clear gel was formed. The herbal hair gel was kept at room temperature after production (Table 1) [21].

**Table 1.** Formula for preparation of herbal hair gel.

| Formulation | F1 | F2 | F3 | F4 | F5 |
|---|---|---|---|---|---|
| Fenugreek extract | 7 | 4 | 5 | 6 | 3 |
| Tea extract | 3 | 6 | 5 | 4 | 7 |
| Aloe vera extract | 5% | 4% | 3% | 2% | 1% |
| Flaxseed extract | 1% | 2% | 3% | 4% | 5% |
| Coconut oil | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Carbopol (g) | 2 | 2 | 2 | 2 | 2 |
| Methyl paraben sodium (mg) | 75 | 75 | 75 | 75 | 75 |
| Glycerin (ml) | 3 | 3 | 3 | 3 | 3 |
| PEG (ml) | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 |
| Triethalonamine (ml) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Water (ml) | 71 | 71 | 71 | 71 | 71 |

## EVALUATION OF HERBAL HAIR GEL

### Physical Appearance

The developed herbal hair gel has gone through the evaluation for its color, clarity, fragrance, appearance and presence of any foreign matter [22].

### Homogeneity

All hair gels were visually inspected for uniformity after being placed in containers to ensure there were no lumps, clumps, or other irregularities in the composition [23].

### pH

The pH meter was used to evaluate the pH of different hair gel formulations. One (1) gram of gel was mixed with 100 ml of distilled water and left to sit for 2 hours. The electrodes were dipped into the diluted gel and the pH was measured. This process was repeated three times for each formulation and the average pH value was determined [24].

### Viscosity Measurement

The Brookfield viscometer was used to measure the viscosity of the gel, which was set to 100 rpm with spindle number 6. After reaching to equilibrium the viscosity readings of the sample were taken into consideration. [25].

### Extrudability Test

The gel tube, sealed tightly at one end, was pushed from the crimped end. When the cap is removed, the gel is squeezed out until the pressure equalizes. We calculated the force necessary in grams to push out a 0.5 cm long ribbon of gel in 10 seconds. The findings were recorded as the pressure needed for extrusion in grams for each type of gel [26].

### Spreadability

Spreadability of gel formulations was assessed by placing the gel between two glass slides and applying a 20-gm load. The time needed to establish uniform thickness and the time taken to separate the two slides were recorded in seconds to determine the spreadability [27].

 

$S = M \times L / T$
Where,
S = Spreadability (g x cm/sec),
M = Weight on the upper slide (gm),
L = Length of a glass slide (cm),
T = Time taken to separate the slide from one another (sec)

### Stability Study

The gel we made was kept in collapsible tubes at ambient temperature, 40°C and 75% relative humidity. We completed a three-month stability test, examining its appearance, pH, homogeneity, viscosity and spreadability each month.

### Skin Irritation Test

Herbal hair gel was applied on the skin and observed for irritation, redness or rashes.

## RESULTS AND DISCUSSIONS

### Physical Appearance

The herbal gel formulations F1, F2, F3, F4 and F5 were found to have a gentle yellow hue, giving them a translucent appearance that feels smooth when applied (Table 2).

**Table 2.** Evaluation of physical appearance of herbal hair gel.

| Sr. No. | Formulation | Physical appearance |
|---|---|---|
| 1 | F1 | Translucent, slightly yellow, smooth |
| 2 | F2 | Translucent, slightly yellow, smooth |
| 3 | F3 | Translucent, slightly yellow, smooth |
| 4 | F4 | Translucent, slightly yellow, smooth |
| 5 | F5 | Translucent, slightly yellow, smooth |

### Homogeneity

All the gels that were developed were carefully examined for uniformity through visual inspection to check for any lumps, flocculates, or aggregates. It was determined that the consistency of all formulations was satisfactory (Table 3).

**Table 3.** Evaluation of homogeneity of herbal hair gel.

| Sl. No. | Formulation | Homogeneity |
|---|---|---|
| 1 | F1 | Good |
| 2 | F2 | Good |
| 3 | F3 | Good |
| 4 | F4 | Excellent |
| 5 | F5 | Good |

### pH Determination

The pH of all the herbal formulations ranges from 6.85 to 7.01 which is appropriate for the hair making the compatibility of the herbal gel formulation with the hair (Table 4).

**Table 4.** Evaluation of pH of herbal hair gel.

| Sl. No. | Formulation | pH |
|---|---|---|
| 1 | F1 | 6.85 |
| 2 | F2 | 6.90 |
| 3 | F3 | 6.93 |
| 4 | F4 | 6.98 |
| 5 | F5 | 7.01 |

 

**Viscosity**

Viscosity is an essential requirement for distinguishing the gels as it influences the spreadability, extrudability and release of the drug. The viscosity of all formulations was in the range of 9364 to 9378 cps (Table 5).

**Table 5.** Evaluation of viscosity of herbal hair gel.

| Sr. No. | Formulation | Viscosity(cps) |
|---|---|---|
| 1 | F1 | 9364 |
| 2 | F2 | 9365 |
| 3 | F3 | 9370 |
| 4 | F4 | 9372 |
| 5 | F5 | 9378 |

**Extrudability**

All formulations presented has good extrudability when extruded from the metallic collapsible tube. Comparably, F4 had superior extrudability than F1, F2, F3 and F5 (Table 6).

**Table 6.** Evaluation of extrudability of herbal hair gel.

| Sr. No. | Formulation | Extrudability (%) |
|---|---|---|
| 1 | F1 | Good |
| 2 | F2 | Good |
| 3 | F3 | Good |
| 4 | F4 | Excellent |
| 5 | F5 | Good |

**Spreadability**

The spreadability plays the main part in patient compliance and help in uniform usage of the gel. A good gel takes less duration to spread and will have excellent spredability (Table 7).

**Table 7.** Evaluation of spreadability of herbal hair gel.

| Sr. No. | Formulation | Sreadability (gcm/sec) |
|---|---|---|
| 1 | F1 | 13.75 |
| 2 | F2 | 13.11 |
| 3 | F3 | 12.50 |
| 4 | F4 | 10.30 |
| 5 | F5 | 9.82 |

**Stability Studies**

Testing for stability were performed on all formulations for 3 months. At room temperature, no significant changes were seen in the demonstrated limits of physical appearance, pH, odor, homogeneity and spreadability.

**Skin Irritation Test**

The formulation was applied on the hand and exposed to sunlight for 4–5 minutes. It was determined to be skin-compatible and non-irritating.

## CONCLUSION

Natural medicines are increasingly preferred over synthetic and semi-synthetic ones due to their lower likelihood of causing negative effects. Herbal hair gels, made with ingredients like flaxseed, fenugreek seed, black tea powder, coconut oil and aloe vera, can help repair damage caused by chemical hair products. These gels, rich in omega-3 fatty acids and antioxidants, may support healthy

 

hair growth and reduce damage. For hair-nourishing and scalp-soothing properties vitamin E and coconut oil used respectively. Researchers have developed an herbal hair gel for moisturizing, nourishing and preventing hair fall, suggesting its potential as a natural alternative in the beauty industry. Future studies could investigate incorporating other plant extracts to enhance the gel's benefits further.

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