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Research Article

Formulation and Evaluation of Herbal Hair Oil

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Abstract

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Hair loss has become a widespread concern affecting individuals of all age groups, mainly due to factors such as stress, unhealthy lifestyle, environmental pollution, and excessive use of chemical-based hair products. These issues have increased the demand for safer and more effective natural alternatives. The present study focuses on the formulation and evaluation of herbal hair oil using traditionally recognized medicinal plants to provide a holistic solution for hair care. In this study, three different formulations of herbal hair oil were developed for specific hair types: normal hair (F1), dry hair (F2), and oily scalp (F3). The formulations were prepared using natural ingredients such as Amla (*Embolica officinalis*), Bhringraj (*Eclipta alba*), Hibiscus (*Hibiscus rosa-sinensis*), Neem (*Azadirachta indica*), Fenugreek (*Trigonella foenum-graecum*), Curry leaves (*Murraya koenigii*), and Moringa (*Moringa oleifera*), incorporated into coconut oil and almond oil as base oils. The oils were prepared using a traditional boiling (infusion) method to ensure effective extraction of bioactive constituents. Phytochemical screening of the selected ingredients confirmed the presence of important constituents such as alkaloids, flavonoids, tannins, saponins, glycosides, and phenolic compounds, which are known for their antioxidant, antimicrobial, and hair growth-promoting properties. These constituents play a significant role in nourishing the scalp, strengthening hair follicles, and reducing hair fall. The prepared formulations were evaluated for various parameters, including organoleptic properties, pH, viscosity, specific gravity, spreadability, homogeneity, and stability. All formulations showed acceptable physical characteristics, with a pleasant odor, appropriate color, and uniform consistency. The pH of all formulations was found to be within the skin-friendly range (6.0–6.5), indicating safety for scalp application. Viscosity and spreadability results confirmed ease of application and good user acceptability. The formulations also exhibited good homogeneity with no signs of grittiness or phase separation. Stability studies conducted under both normal and accelerated conditions revealed that the formulations remained stable with no significant changes in color, odor, or consistency. Among the three formulations, F2 showed higher viscosity and better nourishing properties, making it suitable for dry hair, while F3 was lighter and more appropriate for oily scalp conditions. F1 was found to be suitable for normal hair. Overall, the study concludes that the formulated herbal hair oils are safe, stable, effective, and economical. The use of natural ingredients provides a multifunctional approach by improving scalp health, reducing hair fall, and enhancing hair growth without causing harmful side effects. This work highlights the potential of herbal formulations as a reliable and eco-friendly alternative to synthetic hair care products.

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Hair plays an important role in an individual's overall appearance and confidence, making hair fall a distressing issue for many people today. Factors such as unhealthy lifestyle, stress, environmental pollution, and excessive use of chemical-based products have significantly contributed to increased hair loss problems. In this context, herbal hair oils have gained popularity as a natural and safer alternative for maintaining hair health and controlling hair fall. Unlike synthetic formulations, herbal oils are enriched with plant-based ingredients that provide nourishment to the scalp while minimizing side effects. The formulation of herbal hair oil represents a holistic approach that blends traditional knowledge with modern evaluation techniques, offering an effective and natural solution for hair fall control [1-6]



Fig.1: Ingredients for Herbal Hair Oil

1.1 Types of Hair Oil [7-11]

Hair oils can be broadly classified based on their composition, function, and origin, particularly when formulated for hair-fall control. Understanding these types helps in selecting the most suitable formulation for effective hair care.[7-9]

- a. Herbal Hair Oils
- b. Carrier Oils (Base Oils)
- c. Essential Oil-Based Hair Oils
- d. Medicated Hair Oils
- e. Mineral Oil-Based Hair Oils
- f. Aromatic/Perfumed Hair Oils
- g. Ayurvedic Hair Oil[10,11]

1.2 Advantages of Hair Oil

- a. **Natural and Safe:** Free from harsh chemicals, making it suitable for regular use.[12]
- b. **Reduces hair fall:** strengthens roots and minimizes breakage.[13]

c. **Promotes hair growth:** Nourishes follicles and supports healthy growth.

d. **Scalp health improvement:** Helps reduce dandruff and dryness.

e. **Provides Deep Conditioning:** Keeps hair soft, smooth, and manageable.[14]

f. **Enhances hair strength:** Improves texture and reduces split ends.

g. **Antimicrobial Action:** Protects against scalp infections.

h. **Eco-Friendly:** Made from plant-based ingredients, making it environmentally friendly. [15-16]

2. MATERIALS AND METHODS

The materials for the formulation were collected from reliable and easily accessible sources, such as local herbal markets, grocery stores, medicinal gardens, and pharmacies.[17] Fresh plant materials were properly cleaned, shade-dried, and processed to maintain their quality and active constituents. Carrier oils and other required materials were obtained from standard commercial sources to ensure purity and consistency [18, 19]. [18, 19] Overall, the collection process was simple, cost-effective, and ensured the suitability of all materials for the preparation of a safe and effective herbal hair oil. [20, 21]

2.1 Phytochemical Screening of Selected Herbal Ingredients

Phytochemical screening of the selected herbal ingredients was carried out to identify the bioactive constituents responsible for therapeutic activity in the formulated herbal hair oil.[22,23] These constituents mainly include alkaloids, flavonoids, tannins, saponins, glycosides, and phenolic compounds, which contribute to antioxidant, antimicrobial, and hair growth-promoting effects [24,25].

2.2 Method of Formulation of Herbal Hair Oil

The following steps were followed to prepare the **three formulations (F1, F2, and F3)** from the previous table. Each 100 g batch used the boiling/infusion method to extract active compounds from herbs into base oils. This traditional approach ensured stability and efficacy in hair fall control.[26-28]

Materials:

Shade-dried, powdered herbs (as per table quantities)

- Base oils (coconut, almond)
- Distilled water (50 ml for initial extraction)

➤ Equipment: stainless steel vessel, water bath/heater, mortar-pestle, muslin cloth, glass funnel, amber glass bottles, thermometer, weighing balance, and stirrer[29-30].

Procedure

Sourced fresh herbs (Amla, Bhringraj, Hibiscus, Neem, Fenugreek seeds, Curry leaves, Moringa) from medicinal gardens or verified suppliers. Washed thoroughly under running water to remove dirt. Shade-dried at room temperature (25–30 °C) for 3–5 days until crisp (moisture <10%). Ground into fine powder (40–60 mesh) using a mortar-pestle or grinder. Sieved to uniform particle size. Weighed exact quantities per formulation table (e.g., F1: 5 g Amla + 6 g Bhringraj + etc.). Stored in airtight containers. [31-33] Mixed all herb powders for one formulation (total ~ 30-40 g herbs). Added 50 ml distilled water to form a paste. Let soak for 2 hours—these hydrated actives for better oil extraction. [34,35] In a stainless-steel vessel, added base oils (e.g., F1: 60 g coconut + 10 g almond). Added herb paste/powder mixture slowly while

stirring. Placed on water bath (double boiler) at 60–80°C (avoided direct flame to prevent scorching). Heated gently with continuous stirring for **3 hours**. [40] Monitored temperature—did not exceed 90°C. Observed color change (greenish-brown extract releasing) and herbal aroma intensifying. Cooled to room temperature (25°C) naturally (2–3 h). Let mixture settle for 24 hours in a covered vessel—allowed heavy particles to sediment. Decanted supernatant oil into a glass funnel lined with 4-layer muslin cloth. Filtered dropwise under gravity (no pressure). Squeezed cloth gently for complete extraction. Collected filtrate in a clean beaker. Yield: ~80-90g oil (minor loss due to absorption). Checked for homogeneity—no grittiness or separation. Added 0.5% natural preservative (e.g., Vitamin E oil, 0.5 g) if needed for stability. Filled into sterilized amber glass bottles (50 ml/100 ml). Sealed airtight. Labeled with formulation code (F1/F2/F3), date, and batch size. Stored in cool, dark place (25°C). Shelf life: 3–6 months. [36,38]

Table:1 Formulation Table For Herbal Hair Oil

Ingredient	F1: Normal Hair (g / %)	F2: Dry Hair (g / %)	F3: Oily Scalp (g / %)
Coconut oil (base)	60 g (60%)	50 g (50%)	65 g (65%)
Almond oil	10 g (10%)	15 g (15%)	8 g (8%)
Amla powder	5 g (5%)	6 g (6%)	4 g (4%)
Bhringraj powder	6 g (6%)	5 g (5%)	7 g (7%)
Hibiscus powder	5 g (5%)	6 g (6%)	4 g (4%)
Neem powder	4 g (4%)	3 g (3%)	5 g (5%)
Fenugreek seeds (powder)	5 g (5%)	5 g (5%)	6 g (6%)
Curry leaves (powder)	3 g (3%)	3 g (3%)	2 g (2%)
Moraleaves (powder)	2 g (2%)	7 g (7%)	1 g (1%)
Total	100 g (100%)	100 g (100%)	100 g (100%)

2.3 Evaluation Methodology of Herbal Hair Oil

The formulated herbal hair oil was evaluated using a series of standard parameters to ensure quality, stability, safety, and effectiveness. The evaluation was performed under controlled laboratory conditions, and all observations were recorded systematically [39,41].

2.3.1 Evaluation of Organoleptic Properties

The organoleptic characteristics of the prepared formulations (F1, F2, and F3) were assessed through visual and sensory examinations.

Method:

A small amount of the formulation was placed in a clean, transparent glass container. The following parameters were evaluated using the sense organs:

Color: Observed visually on a white background.

Odor: Evaluated by gentle smelling to detect characteristic fragrances.

Appearance: Checked for clarity, homogeneity, and the presence of any suspended particles [43].

2.3.2 Physicochemical Evaluation

a) Determination of pH

Although the oils were non-aqueous, the pH was determined after dispersion to assess scalp compatibility.

Methods: Approximately 1 ml of herbal hair oil was mixed with 10 ml of distilled water. The mixture was shaken thoroughly to form a uniform dispersion. The pH was measured using a calibrated digital pH meter at room temperature [44, 46].

b) Viscosity Measurement

Viscosity determines the flow behavior and ease of oil application.

Method: The viscosity of the formulation was measured using a Brookfield **viscometer**. The sample was placed in the viscometer spindle container. Readings were taken at room temperature (25°C) using an appropriate spindle number and speed [42].

c) Specific Gravity

Specific gravity indicates the density of the oil compared to that of water.

Method: A clean, dry pycnometer was weighed empty (W1). It was filled with herbal oil and weighed again (W2). The same procedure was repeated using distilled water (W3). Specific gravity was calculated using the formula:

$$\text{Specific Gravity} = \frac{W2 - W1}{W3 - W1}$$

2.3.3 Spreadability Test

Spreadability determines the ease with which oil can be applied to the scalp. **Method:** A small quantity of herbal hair oil was placed between two clean, dry glass slides. A known weight (20 g) was placed on the upper slide to provide uniform pressure. The upper slide was allowed to slip over the lower slide. The time (T) taken for the upper slide to move a fixed distance (7.5 cm) was recorded in seconds [47].

Calculation:

Spreadability was calculated using the formula:

Spreadability was calculated using the formula:

$$S = \frac{M \times L}{T}$$

Where:

- S = Spreadability (g·cm/sec)
- M = Weight applied on the upper slide (20 g)
- L = Length moved by the slide (7.5 cm)
- T = Time taken (seconds)

2.3.4 Homogeneity Test

Method: The formulations were visually inspected and rubbed between the fingers. The mixture was checked for uniform consistency and the absence of lumps or grittiness [48].

2.3.5 Stability Testing

a) Physical Stability Test

Method: The prepared formulations were stored at **room temperature (25°C)**. Observations were made at regular intervals (0, 7, 15, and 30 days). The parameters observed were color change, odor change, phase separation, and consistency [49,50].

b) Accelerated Stability Study Method:

- Samples were stored under different temperature conditions.
- Room temperature (25°C)
- Elevated temperature (40–45°C)
- The formulations were observed for 1–3 months.

Parameters monitored:

- Rancidity
- Color and odor changes
- Sedimentation or separation [51,52].

3. RESULTS AND DISCUSSION

The prepared herbal hair oil formulations (F1, F2, and F3) were evaluated using various parameters to assess their quality, stability, and suitability for hair application. The results obtained from the different evaluation tests are presented below.

3.1 Phytochemical Screening

The phytochemical screening of the ingredients confirmed the presence of various bioactive constituents, such as alkaloids, flavonoids, tannins, saponins, glycosides, and phenolic compounds, which are responsible for the therapeutic efficacy of the formulated herbal hair oil.

Table 2: Phytochemical Screening of Ingredients

Ingredient	Alkaloids	Flavonoids	Tannins	Saponins	Glycosides	Phenols	Fixed Oils
Amla	+	+	+	–	–	–	–
Bhringraj	+	+	+	–	–	–	–
Hibiscus	–	+	–	+	–	+	–
Neem	+	–	+	–	+	–	–
Fenugreek	+	–	–	+	–	–	–
Curry Leaves	+	+	–	–	–	+	–
Moringa	–	+	+	+	–	–	–
Coconut Oil	–	–	–	–	–	–	+
Almond Oil	–	–	–	–	–	–	+

3.2 Organoleptic Evaluation

All formulations exhibited acceptable physical characteristics with no signs of instability,

indicating the proper blending of herbal ingredients.

Table 3: Organoleptic Evaluation of Herbal Hair Oil

Parameter	F1	F2	F3
Color	Light green	Greenish brown	Dark green
Odor	Pleasant herbal	Mild herbal	Strong herbal
Appearance	Clear, uniform	Slightly viscous	Uniform

3.3 pH Determination

The pH values of all formulations were within the skin-friendly range (5.5–7.0), confirming their

suitability for topical use or scalp application, and indicating safety and non-irritancy.

Table 4: pH of Herbal Hair Oil Formulations

Formulation	pH (Mean $\pm$ SD)
F1	6.2 $\pm$ 0.1
F2	6.5 $\pm$ 0.2
F3	6.0 $\pm$ 0.1

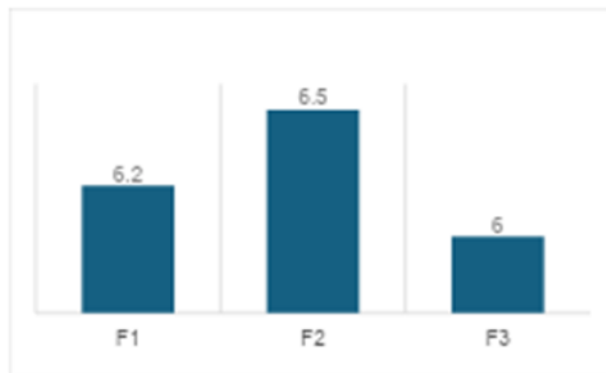


Fig.2: Graphical representation of pH

3.4 Viscosity Measurement

Viscosity plays an important role in determining the ease of application and spreadability of oil. F2

showed slightly higher viscosity, indicating better nourishment, whereas F3 had a lower viscosity, making it suitable for oily scalps.

Table 5: Viscosity Measurement

Formulation	Viscosity (cP)
F1	120 $\pm$ 5
F2	135 $\pm$ 6
F3	110 $\pm$ 4

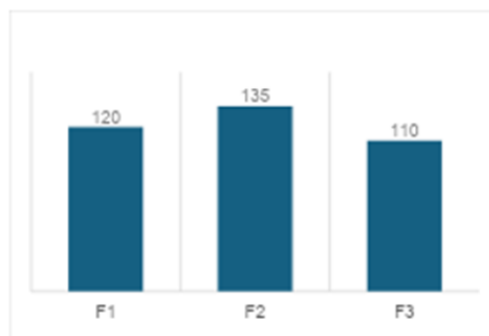


Fig.3: Graphical Representation of Viscosity

3.5 Specific Gravity

All formulations exhibited specific gravity values close to those of standard oils. The results indicate

good consistency, purity, and absence of adulteration in the prepared formulations.

Table 6: Specific Gravity of Herbal Hair Oil

Formulation	Specific Gravity
F1	0.91 ± 0.01
F2	0.92 ± 0.01
F3	0.89 ± 0.01

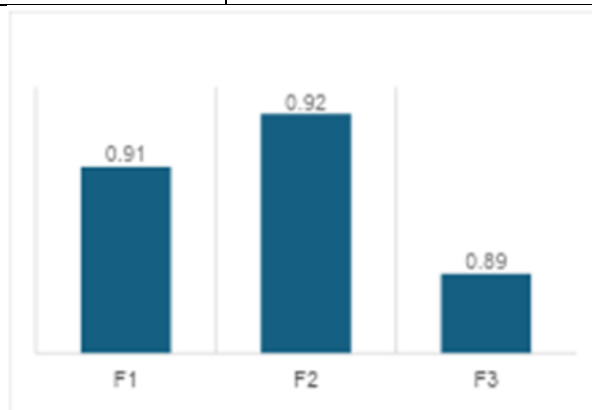


Fig.4: Graphical Representation of Specific Gravity

3

3.6 Spreadability Test

The spreadability of a formulation determines its ease of application to the scalp. All formulations

showed good spreadability, with F2 showing the best performance owing to its balanced viscosity.

Table 7: Spreadability Test

Formulation	Weight (g)	Spreadability (g·cm/sec)	Interpretation
F1	20	25	Good
F2	20	18.75	Moderate
F3	20	30	Excellent

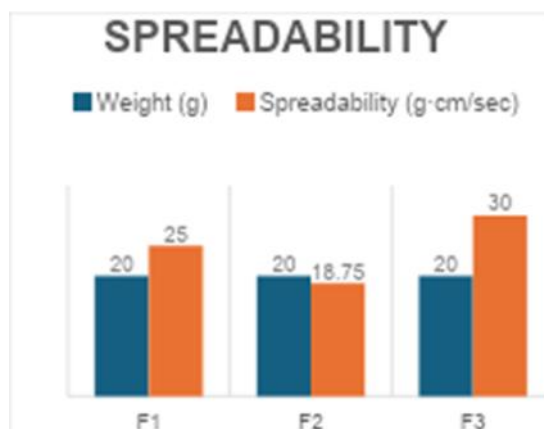


Fig.5: Graphical Representation of Spreadability

3.7 Homogeneity Test All formulations were tested for uniformity and consistency. No lumps or

phase separation was observed, confirming good formulation stability.

Table 8: Homogeneity Test

Formulation	Observation
F1	Smooth, uniform, no grittiness
F2	Slightly thick but homogeneous
F3	Smooth, light, and uniform

3.8 Physical Stability

The physical stability study conducted at room temperature (25°C) showed that all formulations (F1, F2, and F3) remained stable throughout the study period. No significant changes in color, odor, or phase separation were observed, indicating good

compatibility of the ingredients. The formulations maintained their uniformity and consistency, confirming that they are physically stable under normal storage conditions and suitable for regular use.

Table 9: Physical Stability Study (at 25°C)

Day	F1	F2	F3
0	No change	No change	No change
7	Stable	Stable	Stable
15	No separation	No separation	No separation
30	Stable, no rancidity	Stable	Stable

3.9 Accelerated Stability Study

The accelerated stability study performed at an elevated temperature (40°C) showed minor variations in color and odor in some formulations. F2 exhibited slight darkening and a mild increase in odor intensity, whereas F3 showed no significant change in its characteristics. These variations may be attributed to the presence of herbal constituents and differences in oil

composition. However, no phase separation, rancidity, or major degradation was observed in any of the formulations. All formulations retained their overall stability, indicating good resistance to temperature variations. These results suggest that the formulations are stable even under stressed conditions and possess an acceptable shelf life.

Table 10: Accelerated Stability Study (at 40°C)

Parameter	F1	F2	F3
Color Change	No significant change	Slight darkening	No change
Odor Change	No change	Slight increase	No significant change
Rancidity	Absent	Absent	Absent
Phase Separation	Absent	Absent	Absent

CONCLUSION

The present study successfully formulated and evaluated a herbal hair oil using natural ingredients, such as Amla, Bhringraj, Hibiscus, Neem, Fenugreek, curry leaves, and Moringa, incorporated in suitable base oils, such as coconut and almond oils. The formulation was developed using a traditional infusion method, which ensured the effective extraction of active constituents from the selected herbs. The evaluation of the prepared formulations (F1, F2, and F3) demonstrated that all formulations possessed acceptable organoleptic properties, including a pleasant odor, appropriate color, and uniform appearance. These characteristics indicate good consumer acceptability and proper ingredient blending. The physicochemical parameters, such as pH, viscosity, and specific gravity, were within acceptable limits. The pH values were within the

skin-friendly range, confirming that the formulations were safe and non-irritating for scalp application. The viscosity of the oils was appropriate, ensuring ease of application and good spreadability of the formulations. The formulations also exhibited good homogeneity, indicating a uniform distribution of all components. Spreadability and homogeneity tests confirmed that the oils can be easily applied and are free from lumps or grittiness, which enhances user convenience and product quality. Stability studies, including both physical and accelerated conditions, showed that all formulations remained stable, with no significant changes in color, odor, or phase separation. This indicates that the prepared herbal hair oil has good shelf stability and is resistant to environmental stress. The phytochemical screening confirmed the presence of important bioactive constituents such as flavonoids, tannins,

alkaloids, and saponins, which are known for their antioxidant, antimicrobial, and hair growth-promoting properties. These constituents contribute to the overall effectiveness of the formulation in improving scalp health and reducing hair fall.

Among the three formulations,

- F1 was found suitable for normal hair,
- F2 showed better nourishing properties and is ideal for dry hair,
- F3 was lighter in consistency and suitable for oily scalp conditions.

Overall, the study concluded that the formulated herbal hair oil is safe, stable, effective, and economical, making it a suitable natural alternative to synthetic hair care products. The use of herbal ingredients provides multiple benefits, including nourishment of hair follicles, reduction of hair fall, improvement of scalp health, and enhancement of hair growth.

Thus, this formulation represents a holistic and eco-friendly approach to hair care by combining traditional herbal knowledge with modern evaluation methods.

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