



## Research Article

# Formulation and Evaluation of Herbal Hair Oil

Devram Jori<sup>1</sup>, Tanishk Kardile\*<sup>2</sup>, Somnath Datir<sup>2</sup>, Sanket Bhadekar<sup>2</sup>

<sup>1</sup>Assistant Professor, Department of Quality Assurance Technique, Vidya Niketan Institute of Pharmacy and Research Center, Bota.

<sup>2</sup>B. Pharmacy, Vidya Niketan Institute of Pharmacy and Research Center, Bota

Herbal hair oils are natural preparations obtained by extracting the active constituents of medicinal plants into a suitable oil base. This research focuses on the formulation and physical, chemical, phytochemical, and biological evaluation of polyherbal hair oil batches (F1 and F2) incorporating foundational botanical ingredients such as Neem, Amla, Aloe vera, Hibiscus, and Fenugreek into a pure Coconut oil base. Systematic evaluation parameters including organoleptic tests, physicochemical analysis (acid value, saponification value, iodine value, viscosity, specific gravity), phytochemical screening, stability testing and skin irritation monitoring were executed to ensure batch uniformity, therapeutic efficacy, and skin safety. The results provide standard regulatory verification profiles for stable natural cosmetic preparations with enhanced safety boundaries.

**Keywords:** Herbal Hair Oil.

## INTRODUCTION

Herbal hair oils are natural preparations obtained by extracting the active constituents of medicinal plants into a suitable oil base [1]. These oils have been widely used in traditional systems like Ayurveda for the treatment of various conditions related to skin, hair, and general health [1]. Medicinal plants such as Neem, Bhringraj, and Amla contain bioactive compounds like alkaloids, flavonoids, and tannins, which exhibit therapeutic properties [1]. These constituents are extracted into carrier oils like Coconut oil or Sesame oil, making them easy to apply and enhancing their absorption through the skin [1]. The formulation of herbal hair oil involves selecting appropriate plant materials, choosing a suitable extraction method, and ensuring proper processing to preserve the active ingredients [1]. However, simply preparing the oil is not sufficient—its quality, safety, and efficacy must be ensured through systematic evaluation [1]. Evaluation of herbal hair oils includes physical, chemical, and biological testing to confirm their stability, purity, and therapeutic effectiveness [1]. This ensures that the final product is safe for use

and provides consistent results [1]. In recent years, herbal hair oils have gained increasing importance due to their natural origin, fewer side effects, and better compatibility with the human body, making them a preferred alternative to synthetic formulations [1].

### 1.1. Concept of Herbal hair oils

Herbal hair oils are liquid dosage forms prepared by incorporating medicinal plant materials into a lipid (oil) base [1]. The main objective is to transfer the bioactive constituents of plants into the oil so that they can be easily applied and absorbed through the skin [1]. Unlike synthetic formulations, herbal hair oils rely on natural plant extracts, making them widely accepted due to their safety and compatibility with the human body [1]. The oil base serves not only as a solvent but also enhances permeation of active compounds into deeper layers of the skin [1].

### 1.2. Role in Traditional Systems

Herbal hair oils have a significant role in Ayurveda, where they are referred to as Taila [1]. They are considered one of the most effective dosage forms for external therapies [1]. Classical Ayurvedic texts such as Charaka Samhita and Sushruta Samhita provide detailed formulations and methods for preparing medicated oils [1]. These oils are traditionally used for:

- Abhyanga (therapeutic massage) to improve blood circulation [1]
- Treatment of skin diseases and infections [1]
- Hair nourishment and growth promotion [1]
- Relief from pain, inflammation, and stiffness [1]

Their continued use highlights their effectiveness and cultural importance [1].

### 1.3. Scientific Basis of Herbal hair oil Preparation

**A. Extraction Principle:** The preparation of herbal hair oils is based on the principle of solvent extraction, where oil acts as a solvent to dissolve fat-soluble active constituents from plant materials [1]. During the process: heat or time facilitates the release of phytochemicals; water (if used) helps in extracting water-soluble components initially; and continuous heating removes moisture, leaving active compounds in oil [1].

**B. Role of Oil as a Carrier:** The oil base performs multiple functions including enhancing drug solubility, improving skin penetration, providing an emollient (softening) effect, and protecting active ingredients from degradation [1]. Commonly used oils include Coconut oil (cooling, nourishing) and Sesame oil (stable and deeply penetrating) [1].

### 1.4. Phytochemical Basis of Activity

Medicinal plants used in herbal hair oils contain various bioactive compounds, such as alkaloids (affect physiological functions), flavonoids (act as antioxidants and protect tissues), tannins (promote healing and reduce infections), and terpenoids (exhibit anti-inflammatory and antimicrobial effects) [1]. Examples of commonly used plants include Neem (antimicrobial), Amla (antioxidant), and Bhringraj (promotes hair growth) [1]. The therapeutic

effectiveness of herbal hair oils depends on the type and concentration of these phytochemicals [1].

### 1.5. Importance of Proper Formulation

Formulation is a critical step that determines the quality and effectiveness of herbal hair oil [1]. It involves: selection of appropriate plant materials, choosing a suitable base oil, deciding the correct ratio of ingredients, and applying the proper extraction technique [1]. Proper formulation ensures: maximum extraction of active constituents, uniform distribution of compounds, stability during storage, and desired therapeutic action [1]. Improper formulation may result in loss of active ingredients, rancidity or spoilage, and reduced effectiveness [1].

### 1.6. Need for Evaluation and Standardization

Herbal formulations often show variability due to differences in plant species or quality, geographical and environmental conditions, and harvesting and storage methods [1]. Therefore, evaluation is essential to maintain quality control, ensure safety for human use, achieve batch-to-batch consistency, and detect adulteration and contamination [1]. Standardization helps in making herbal hair oils more reliable and acceptable in modern medicine [1].

### 1.7. Parameters for Evaluation

Standardization parameters encompass physical (organoleptic) evaluation (color, odor, appearance, and texture), physicochemical evaluation (acid value, iodine value, saponification value, viscosity, and specific gravity), phytochemical evaluation (confirms presence of active compounds), microbial evaluation (detects harmful microorganisms), and stability testing under different temperature, light, and humidity thresholds [1].

### 1.8. Applications and Uses

Herbal hair oils have wide applications in hair care (promotes growth, reduces dandruff), skin care (moisturizes and treats skin conditions), pain management (reduces inflammation and joint pain), massage therapy, and aromatherapy [1].

### 1.9. Modern Perspective

In recent years, there has been a global shift toward natural and herbal products due to concerns about synthetic chemicals [1]. Herbal hair oils are gaining importance in cosmetic industries, pharmaceutical formulations, and wellness therapies [1]. However, modern usage requires scientific validation, quality assurance, and regulatory approval [1].

## 2. Selection of Ingredients in Herbal Hair Oil Formulation

### 2.1. Selection of Herbal Drugs (Plant Materials)

Herbal drugs are the main active components responsible for the therapeutic effect of the oil [2].

#### A. Criteria for Selection:

**i. Therapeutic Purpose:** The selection of herbs depends on the intended use of the oil, such as Bhringraj for hair growth, Neem for antimicrobial action, and Amla for nourishment [2].

**ii. Quality of Raw Material:** Plant material should be fresh or properly dried, and must be free from dust, insects, fungi, and adulterants [2]. Poor-quality herbs reduce effectiveness and may cause spoilage [2].

**iii. Correct Identification:** Proper botanical identification is essential to avoid substitution or adulteration, which may lead to loss of activity or harmful effects [2].

**iv. Part of Plant Used:** Different parts of the plant have different active constituents, including leaves (volatile oils and flavonoids), roots (alkaloids), seeds (fixed oils), and bark (tannins) [2]. Selection depends on where the maximum active compounds are present [2].

### 2.2. Selection of Base Oil (Carrier Oil)

The base oil acts as a vehicle to extract and deliver active constituents [2].

#### A. Criteria for Selection:

**i. Solubility:** The oil should effectively dissolve lipophilic (fat-soluble) compounds to ensure maximum extraction of active ingredients [2].

**ii. Stability:** Oil should resist oxidation and rancidity to increase the shelf life of the formulation [2].

**iii. Skin Penetration:** Oil should have good permeation ability to deliver drugs into deeper skin layers [2].

**iv. Safety:** Must be non-toxic, non-irritant, and hypoallergenic, making it suitable for long-term application [2]. Examples include Coconut oil (provides cooling effect and nourishment) and Sesame oil (deep penetration and high stability, widely used in Ayurveda) [2].

### 2.3. Selection of Additives

Additives are included to improve quality, stability, and acceptability of the herbal hair oil [2]. Antioxidants like Vitamin E prevent oxidation of oils and delay rancidity while maintaining color, odor, and effectiveness [2]. Preservatives prevent the growth of microorganisms, which is especially important if water is used during preparation [2]. Fragrances (essential oils) improve aroma and user acceptance, while natural coloring agents improve structural appearance without affecting stability or safety [2].

### 2.4. Selection Based on Compatibility, Availability, Safety, and Preparation Method

All ingredients must be compatible with each other to prevent chemical reactions that degrade active constituents, reduce effectiveness, or lead to product instability [2]. Materials should be easily available throughout the year and cost-effective for large-scale production [2]. Safety boundaries dictate that materials must be safe, non-toxic, non-irritating, and free from pesticide residues, heavy metals, or microbial contamination [2]. Finally, the method of preparation is guided by component limits: heat-stable components (hard plant materials like roots and bark) can be extracted using boiling or decoction methods, whereas heat-sensitive components require cold maceration or gentle heating to prevent structural destruction of volatile or delicate compounds [2].

## 3. Formulation

### 3.1. Herbal (Active) Ingredients & Taxonomy

#### 1. Neem Powder:

#### • Taxonomy:

**Kingdom:** Plantae

**Division:** Magnoliophyta

**Class:** Magnoliopsida

**Order:** Sapindales

**Family:** Meliaceae

**Genus:** Azadirachta



**Fig.1 Neem**

**Species:** Azadirachta indica

Neem contains active compounds such as azadirachtin, nimbin, nimbidin, and various limonoids [2, 13]. These compounds give neem strong antibacterial, antifungal, and anti-inflammatory properties [2]. In herbal hair oils, neem is mainly used to treat dandruff, scalp infections, itching, acne, and other skin disorders to maintain skin hygiene [2, 13, 28].

## 2. Amla Powder:

### • Taxonomy:

**Kingdom:** Plantae

**Division:** Magnoliophyta

**Class:** Magnoliopsida

**Order:** Malpighiales

**Family:** Phyllanthaceae

**Genus:** Phyllanthus

**Species:** Phyllanthus emblica



**Fig.2 Amla**

Amla is highly valued in hair care formulations, rich in vitamin C, tannins, and polyphenolic compounds, yielding strong antioxidant properties to protect follicles from oxidative damage [2, 14]. In hair oils, it strengthens hair roots, reduces hair fall, prevents premature greying, and improves microcirculation [2, 14, 29].

## 3. Aloe vera:

### • Taxonomy:

**Kingdom:** Plantae

**Division:** Magnoliophyta

**Class:** Liliopsida

**Order:** Asparagales

**Family:** Asphodelaceae

**Genus:** Aloe



**Fig.3 Aloe Vera**

**Species:** Aloe vera (Aloe barbadensis Miller)  
Contains polysaccharides, enzymes, amino acids, vitamins, and minerals, offering moisturizing,

soothing, and hydration effects to reduce scalp irritation, dryness, and itching [2, 18, 34].

#### 4. Hibiscus:

##### • Taxonomy:

**Kingdom:** Plantae

**Division:** Magnoliophyta

**Class:** Magnoliopsida

**Order:** Malvales

**Family:** Malvaceae

**Genus:** Hibiscus



**Fig.4 Hibiscus**

**Species:** Hibiscus rosa-sinensis

Contains amino acids, flavonoids, vitamins, and mucilage to promote hair growth, strengthen roots, reduce hair fall, and act as a natural conditioner improving shine, softness, and texture [3, 32].

#### 5. Fenugreek:

##### • Taxonomy:

**Kingdom:** Plantae

**Division:** Magnoliophyta

**Class:** Magnoliopsida

**Order:** Fabales

**Family:** Fabaceae

**Genus:** Trigonella

**Species:** Trigonella foenum-graecum



**Fig.5 Fenugreek**

Contains proteins, saponins, flavonoids, and nicotinic acid to strengthen hair shafts, reduce hair fall, manage dandruff, and maintain deep hydration [31].

#### 6. Coconut oil:

##### • Taxonomy:

**Kingdom:** Plantae

**Division:** Magnoliophyta

**Class:** Liliopsida

**Order:** Arecales

**Family:** Arecaceae

**Genus:** Cocos



**Fig. 6 Coconut Oil**

**Species:** Cocos nucifera

Rich in medium-chain fatty acids (lauric acid) to penetrate deeply into the hair shaft, minimize protein

loss, strengthen roots, and provide cooling nourishment [2, 16, 36].

**Table 1. Formulation Table**

Sr. No.	Ingredient	Formulation (F1)	Formulation (F2)
1	Neem	3g	5g
2	Amla	6g	5g
3	Aloe vera	5g	5g
4	Hibiscus	4g	5g
5	Fenugreek	3g	5g
6	Coconut oil	60ml	70ml
7	Vitamin E	2ml	2ml
8	Camphor	5g	6g

### 3.2. Procedure for Preparation of Herbal hair oil

**Step 1:** Collection and Preparation of Raw Materials: Collect all herbal ingredients such as neem, amla, bhringraj, hibiscus, brahmi, turmeric, fenugreek, and aloe vera. Wash thoroughly to remove dust and impurities, dry under shade (except aloe vera), and mill into a coarse powder to optimize surface area extraction parameters [2, 41].

**Step 2:** Preparation of Herbal Mixture: Mix all powdered herbal drugs in the required proportions. Aloe vera gel can be added fresh or slightly crushed, and fenugreek seeds can be soaked overnight for better extraction efficiency [2].

**Step 3:** Mixing with Base Oils: Take coconut oil and sesame oil in a clean stainless steel vessel and add the prepared herbal mixture into the oil, ensuring full uniform immersion [2].

**Step 4:** Heating (Extraction Process): Heat the mixture on a low flame (60–80°C) with continuous stirring to prevent burning, maintaining parameters until all moisture content evaporates and active constituents transfer completely [4, 41].

**Step 5:** Completion of Extraction: The process is complete when no moisture bubbles are visible, the herbal residue becomes crisp, and the oil matrix turns clear and highly aromatic [4].

**Step 6:** Filtration: Allow the mixture to cool slightly, filter using a clean muslin cloth or filter paper to clear

solid residues, and collect clear herbal hair oil in a clean container [2].

**Step 7:** Addition of Additives: Add Vitamin E (0.5–1%) as an antioxidant and essential oil drops (lavender/rosemary) for aroma optimization under uniform distribution mixing [2].

**Step 8:** Packaging and Storage: Transfer the stable oil into amber-colored airtight bottles, store in a cool, dry place away from direct sunlight, and apply standard regulatory label controls [2, 11].

## 4. Evaluation

### 4.1. Evaluation of Herbal hair oil

Evaluation of herbal hair oil is done to ensure quality, safety, stability, and therapeutic effectiveness of the formulation prepared from herbal ingredients like Neem, Amla, Bhringraj with base oils such as Coconut oil and Sesame oil [2].

#### 1. Organoleptic Evaluation (Physical Appearance Test):

Definition: It is the simplest method based on senses (eyes, nose, touch) [2, 22]. Parameters include Color (green, yellow, brown depending on herbs used), Odor (characteristic herbal smell), Appearance (clear or slightly turbid), and Texture (smooth, non-sticky) [2]. Its importance resides in quick identification of quality and detecting early signs of spoilage or batch contamination [2, 22].

#### 2. Physicochemical Evaluation:

These tests determine the chemical quality and stability of herbal hair oil [2, 12].

**2.1 Acid Value:** Measures free fatty acids present in oil. Lower acid value corresponds to better quality oil and indicates resistance to rancidity or degradation [2, 12].

**2.2 Saponification Value:** Represents the amount of alkali needed to saponify 1 g of oil. It indicates the average molecular weight of fatty acids and assists in quality standardization [2, 12].

**2.3 Iodine Value:** Measures the degree of unsaturation in oil. A higher value indicates more unsaturated oils, determining shelf stability (more unsaturation = less stable) [2, 12].

**2.4 Viscosity:** Measures thickness or flow of oil, affecting application on skin and hair to ensure optimal consistency [2, 12].

**2.5 Specific Gravity:** Ratio of density of oil compared to water, utilized for standard purity comparisons [2, 12].

### 3. Phytochemical Evaluation:

Test to confirm the presence of bioactive compounds [2, 43]. Tests are performed specifically for Alkaloids, Flavonoids, Tannins, Saponins, and Terpenoids to confirm explicit therapeutic activity and ensure correct extraction from herbal drugs [2, 43].

### 4. Microbial Evaluation:

Checks contamination by microorganisms [2, 38]. Standard tests measure bacterial count, fungal count, and overall sterility to ensure absolute safety for skin application while preventing infection risks and spoilage [2, 38].

### 5. Stability Studies:

Checks how herbal hair oil behaves over time under different conditions [11, 39]. Conditions tested include room temperature, high temperature, humidity exposure, and light exposure [11]. Observations focus on tracking changes in color,

odor, phase separation, or precipitation to determine definitive product shelf life [11, 39].

### 6. Skin Irritation Test:

Method: Applied on a small skin area and observed for redness, itching, or swelling [2, 22]. This confirms the non-toxic, safe nature for human use and validates dermal biocompatibility [2, 22].

### 7. Rancidity Test:

Checks oxidation of oil via specific indicators like bad smell, dark color change, and increased acid value to verify ongoing product freshness and usability [2, 12].

## CONCLUSION

Herbal hair oil formulation is a process of preparing medicated oils using medicinal plants such as Neem, Amla, and Bhringraj in suitable base oils like Coconut oil and Sesame oil [1, 2]. These ingredients work together to provide therapeutic benefits such as antimicrobial, antioxidant, nourishing, and hair growth-promoting effects [1]. The evaluation of herbal hair oils is essential to ensure quality, safety, stability, and effectiveness of the final product [2]. It includes organoleptic, physicochemical, phytochemical, microbial, and stability studies [2, 12]. These tests help in detecting impurities, preventing rancidity, and maintaining consistency of the formulation [2]. In conclusion, proper formulation and systematic evaluation ensure that herbal hair oils are safe, effective, stable, and suitable for therapeutic and cosmetic use, making them an important dosage form in traditional and modern herbal medicine systems [1, 2].

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