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Formulation and Evaluation of Hair Fall Control Herbal Hair Oil

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Abstract: *Hair fall is a significant concern affecting millions globally, often leading to psychological distress and reduced self-esteem. The increasing demand for natural and safe alternatives to synthetic hair care products has paved the way for herbal formulations. This research focuses on the formulation and evaluation of an effective herbal hair oil intended for hair fall control. Various medicinal plants with proven benefits such as Emblica officinalis (Amla), Eclipta alba (Bhringraj), Hibiscus rosasinensis (Hibiscus), Azadirachta indica (Neem), and Cocos nucifera (Coconut oil base) were selected based on their traditional use and scientific validation. The formulated hair oil underwent several evaluations including organoleptic parameters, pH, viscosity, acid value, saponification value, and stability studies. The oil demonstrated significant improvement in hair strength, reduced hair breakage, and enhanced scalp health during in-vivo and ex-vivo evaluations. The phytoconstituents such as flavonoids, alkaloids, and tannins present in the herbs exhibited synergistic action, contributing to improved hair follicle nourishment and reduced hair fall. This study also incorporates a thorough literature survey to validate the effectiveness of the chosen herbs and describes their mechanism of action at the molecular level.*
Overall, the research emphasizes the potential of herbal hair oils as a sustainable, cost-effective, and efficacious solution for managing hair fall, and highlights the advantages of incorporating traditional knowledge into modern pharmaceutical and cosmetic formulations

Keywords: Herbal hair oil ,Hair fall control ,Polyherbal formulation ,Amla ,Bhringraj ,Hibiscus ,Neem Coconutoil ,Phytoconstituents ,Scalp nourishment ,Natural cosmetics ,Hair care.

I. INTRODUCTION

In recent years, there has been a significant shift toward integrating traditional herbal wisdom with modern formulation techniques to create safer, more effective, and scientifically validated hair care products. Herbal medicine systems such as Ayurveda, Siddha, and Unani offer a deep reservoir of
therapeutic knowledge, particularly in managing hair and scalp disorders. These systems have long advocated the use of botanicals like Emblica officinalis (Amla), Bacopa monnieri (Brahmi), Eclipta Alba (Bhringraj), and Azadirachta indica (Neem) for hair strengthening and hair loss prevention. However, traditional practices often lacked standardized procedures and measurable evaluation criteria. Modern pharmaceutics bridges this gap by applying analytical methods, physicochemical testing, and clinical evaluations to optimize and validate these herbal remedies1-3.

The formulation of herbal hair oil now includes not just the selection of herbs based on their pharmacological activity but also the use of suitable carriers (like coconut, almond, or sesame oil), precise extraction techniques, and comprehensive quality control parameters. This integration helps overcome limitations like short shelf life, poor absorption, and inconsistency in herbal treatments. Furthermore, nanotechnology and green chemistry are being increasingly explored to enhance the delivery and sustainability of herbal ingredients. As a result, the convergence of ancient herbal practices with advanced pharmaceutical techniques presents an innovative and promising pathway in the development of effective hair fall control solutions, reinforcing the credibility and acceptance of herbal formulations in both local and global markets4-5.

Carrier oils play a vital role in the formulation of herbal hair oils, not only serving as a medium for extracting active phytoconstituents but also imparting therapeutic benefits on their own. Oils such as coconut, sesame, castor, and almond are widely used because of their excellent emollient, penetrating, and nourishing properties. Among them,

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coconut oil is particularly valued for its low molecular weight and high affinity for hair proteins, allowing it to penetrate the hair shaft and reduce protein loss significantly. Sesame oil is rich in antioxidants and essential fatty acids, making it a suitable base for enhancing scalp health and promoting blood circulation. Castor oil, due to its high ricinoleic acid content, possesses anti-inflammatory and antimicrobial activity, contributing to follicular health. Almond oil, packed with vitamin E and omega fatty acids, supports scalp moisturization and smoothens the hair cuticle. The selection of a suitable carrier oil is critical in ensuring optimal solubility, stability, and bioavailability of the herbal actives. Moreover, the combination of carrier oils in appropriate proportions may produce a synergistic effect, thereby amplifying the efficacy of the final formulation. As formulation science progresses, more emphasis is being laid on evaluating oil viscosity, spreadability, saponification value, and compatibility with herbal extracts to ensure a stable and efficacious product6-8.

Herbal ingredients used in hair oil formulations contain a variety of phytoconstituents that are pharmacologically active and contribute directly to hair growth promotion and follicle strengthening. Compounds such as alkaloids, flavonoids, saponins, tannins, glycosides, triterpenoids, and essential oils exert multiple actions like anti-inflammatory, antifungal, antioxidant, and vasodilatory effects on the scalp. For instance, Eclipta Alba contains wedelolactone and ecliptine, which promote hair growth by enhancing the anagen phase of the hair cycle. Emblica officinalis is rich in vitamin C and Gallic acid, which provide nourishment and prevent oxidative stress. Bacopa monnieri contains Bacosides that improve blood circulation and reduce cortisol-induced hair fall. These phytoconstituents not only act on hair follicles but also repair damaged scalp tissue, balance sebum production, and prevent microbial infections, making them integral to a holistic hair fall management strategy9-10.

Scalp health is foundational for maintaining robust hair growth and preventing hair fall. Factors such as excessive sebum secretion, microbial colonization, dandruff, clogged hair follicles, and poor blood circulation significantly impair the hair growth cycle. A healthy scalp provides a conducive environment for follicular activity, supporting the growth of thick, healthy hair. Herbal oils are formulated with ingredients that possess antimicrobial, antifungal, and anti-inflammatory properties which alleviate scalp conditions such as seborrheic dermatitis, folliculitis, and fungal infections. Neem oil, tea tree oil, and tulsi extract are widely included in formulations for their scalp-purifying abilities. Regular massage with herbal oils enhances microcirculation, promotes lymphatic drainage, and reduces stress—all of which contribute to a reduction in hair shedding and the stimulation of new growth. Therefore, ensuring scalp vitality is a critical target in any hair fall control regimen11-12.

Ayurveda, the ancient Indian system of medicine, provides a comprehensive explanation of hair fall under the condition termed Khalitya, which refers to excessive hair loss or baldness. According to Ayurvedic texts, hair health is primarily governed by the balance of three doshas: Vata, Pitta, and Kapha. An aggravation of Pitta is considered the main culprit for hair fall, as it leads to excessive heat and inflammation in the scalp, resulting in follicular damage. Herbs such as Bhringraj (King of Hair), Amla, Brahmi, and Jatamansi are traditionally prescribed for pacifying Pitta and nourishing the scalp. These herbs are often processed in a base of sesame or coconut oil using classical Taila paka vidhi (medicated oil preparation method). This holistic approach addresses the root cause by detoxifying the scalp, improving liver function, enhancing digestion (Agni), and reducing stress—thereby promoting sustainable hair regrowth13-14.

Recent years have witnessed a surge in scientific interest toward herbal hair oil formulations, with a growing number of studies being conducted on plant-based ingredients and their mechanisms of action. Techniques such as gas chromatography-mass spectrometry (GC-MS), high-performance thin-layer chromatography (HPTLC), and Fourier-transform infrared spectroscopy (FTIR) are used to characterize the phytochemical profile of herbs. In-vitro assays such as antioxidant (DPPH, FRAP) and antimicrobial tests, as well as in-vivo models involving animal subjects (e.g., C57BL/6 mice), are employed to evaluate efficacy. These approaches offer valuable insights into how herbal oils can modulate hair follicle cycles, inhibit 5-alpha-reductase enzyme activity, or enhance dermal papilla cell proliferation. Clinical trials involving human subjects are also being designed to establish evidence-based claims regarding the safety and effectiveness of herbal hair oils.

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LITERATURE SURVEY:

1. Kumar, S. et al. (2016)21
Title: Formulation and Evaluation of Herbal Hair Oil Containing Bhringraj and Amla Summary: This study showed that Bhringraj and Amla oil significantly reduced hair fall and improved hair texture through their antioxidant and follicle-stimulating properties.
2. Chattopadhyay, D. (2011)22
Title: Herbal Cosmetics and Recent Trends in the Skin and Hair Care Industry
Summary: The paper highlighted the increasing consumer preference for herbal products and emphasized the efficacy of Ayurvedic herbs in controlling hair fall and enhancing scalp health.
3. Patel, M. et al. (2019)23
Title: Development of Polyherbal Hair Oil with Enhanced Efficacy
Summary: Developed a multi-herb formulation with Tulsi, Aloe vera, and Neem, showing better antimicrobial and hair-strengthening activity compared to single-herb formulations.
4. Prajapati, S. et al. (2014)24
Title: Standardization and Formulation of Herbal Hair Oil
Summary: Demonstrated the importance of standardizing raw herbal ingredients for consistency and validated the physicochemical parameters of hair oil for stability and quality.
5. Bhalerao, S. et al. (2012)25
Title: Evaluation of Hair Growth Potential of Herbal Formulations
Summary: Used Wistar rats to assess hair growth, confirming that herbal oil led to faster hair regrowth compared to control groups.
6. Nema, R. K. et al. (2013)26
Title: Formulation and Evaluation of Herbal Hair Oil for Hair Growth Activity
Summary: Formulated a herbal oil with Hibiscus and Brahmi, which significantly increased hair follicle numbers and improved follicular density in in vivo testing.
7. Garg, A. et al. (2020)27
Title: Comparative Study Between Synthetic and Herbal Hair Oils
Summary: Revealed that herbal oils caused fewer side effects and were more effective in long- term hair growth maintenance than mineral oil-based products.
8. Sharma, R. (2018)28
Title: Therapeutic Potential of Bhringraj (Eclipta alba) in Hair Fall
Summary: Found that wedelolactone, a component of Bhringraj, promoted hair regrowth by enhancing blood circulation and reducing oxidative stress.
9. Bhutani, K. K. et al. (2015)29
Title: Ayurvedic Herbs in Hair Care: A Scientific Review
Summary: Reviewed the bioactive compounds in Amla, Jatamansi, and Bhringraj, confirming their roles in promoting the anagen phase and inhibiting hair follicle apoptosis.
10. Saini, M. et al. (2021)30
Title: Herbal Hair Oil Formulation for Scalp Nourishment and Hair Strengthening Summary: Prepared and tested a herbal oil with Neem and Tea tree oil, reporting strong antimicrobial activity and improved scalp conditions leading to hair retention.
11. Mali, R. G. et al. (2017)31
Title: Evaluation of Herbal Hair Oils for Their Antioxidant Properties
Summary: The study revealed that oils containing polyphenol-rich herbs like Amla and Hibiscus neutralized free radicals and preserved follicular integrity.
12. Tiwari, R. et al. (2012)32
Title: Role of Essential Oils in Herbal Hair Preparations

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Summary: Investigated the use of Rosemary and Lavender oils, confirming their DHTblocking and blood circulation-enhancing properties for hair regrowth.

13. Verma, A. et al. (2016)33

Title: Hibiscus rosa-sinensis Extract for Hair Growth Stimulation

Summary: Demonstrated that the flavonoids in Hibiscus helped increase follicle length and reduced telogen phase duration in test subjects.

14. Dey, A. et al. (2013)34

Title: Traditional Herbal Remedies for Hair Disorders

Summary: Documented Indian tribal knowledge about herbs such as Reetha, Shikakai, and Amla for preventing hair loss and maintaining scalp health.

15. Kapoor, V. P. (2019)35

Title: Bioactive Compounds in Herbal Oils for Hair Health

Summary: Identified major bioactives like tannins, alkaloids, and saponins in herbal oils that contribute to follicle stimulation and anti-inflammatory effects.

16. Rao, N. et al. (2015)36

Title: Clinical Evaluation of Ayurvedic Hair Oil on Hair Fall Reduction

Summary: Conducted human clinical trials and observed a 45% reduction in hair fall after 6 weeks of using a polyherbal formulation.

17. Joshi, A. et al. (2020)37

Title: Herbal Hair Oil with Amla and Curry Leaves: A Novel Combination

Summary: Developed a unique blend that showed a significant increase in follicle anchoring and reduction in hair breakage.

18. Saxena, R. et al. (2017)38

Title: Effect of Jatamansi and Brahmi on Hair Growth Cycle

Summary: Found that these herbs delayed catagen phase onset and prolonged anagen phase in in vivo mouse models.

19. Kaur, P. et al. (2016)39

Title: Cold-Pressed Herbal Oils and Their Role in Hair Therapy

Summary: Suggested that cold-pressed oils retain more active phytochemicals and offer superior antioxidant properties beneficial for hair nourishment.

20. Das, K. et al. (2021)40

Title: Comparative Evaluation of Herbal Oils for Alopecia

Summary: Compared five herbal oils and concluded that formulations with Bhringraj and Amla showed the most significant hair regrowth activity.

AIM & OBJECTIVES:

Aim:

To formulate and evaluate an effective herbal hair oil for controlling hair fall Objectives:

1. To select suitable herbal ingredients with known hair fall control properties.[1]
2. To preparea stable herbal hair oil formulation using the selected plants.
3. To evaluate the formulated hair oil for physicochemical parameters like pH, viscosity, and spreadability.[2]
4. To test the efficacy of the herbal hair oil through in-vitro and in-vivo methods for hair fall reduction.
5. To assess the safety profile by conducting irritation and toxicity studies. [3]

5. PLANT PROFILE:

Table.1: Plant Profile

Plant Name	Botanical Name	Family	Parts Used	Phytoconstituents	Usesin Hair Care
Amla	Phyllanthus emblica	Phyllanthaceae	Fruit	VitaminC,tannins, flavonoids	Promotes hair growth, strengthenshair

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					follicles.
Bhringraj	Eclipta alba	Asteraceae	Whole plant	Wedelolactone, coumestans	Stimulateshair growth, prevents hair fall.
Hibiscus	Hibiscus rosa-sinensis	Malvaceae	Flower, leaves	Anthocyanins, mucilage	Nourishesscalp, prevents premature graying & hair fall.

Amla :

Amla is a potent source of vitamin C and antioxidants. It promotes hair growth, prevents premature greying, strengthens hair follicles, and improves shine. It also helps reduce dandruff and scalp irritation [12].

Fig.1: Amla (Emblicaofficinalis) Bhringraj (Eclipta Alba) :

Known as “Kesharaja” (king of hair) in Ayurveda, bhringraj promotes hair growth, darkens hair, and prevents hair fall. It improves blood circulation in the scalp and rejuvenates hair follicles [13]

Fig.2.Bhringraj (Eclipta Alba) Hibiscus (Hibiscus rosa-sinensis) :

Hibiscus flowers and leaves are used for stimulating hair growth and conditioning.They are rich in amino acids, flavonoids, and vitamin C, promoting hair thickness and shine15

Fig.3.Hibiscus (Hibiscus rosa-sinensis)

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MATERIAL & METHODS:

Table.2: Material & their Source

Materials	Source	Purpose/Use
Amla Fruit Extract	Herbal supplier/local market	Hair strengthening and growth
Bhringraj Extract	Herbal supplier/local market	Hair fall control
Hibiscus Extract	Herbal supplier/local market	Scalp nourishment and hair conditioning
CarrierOil (Coconut Oil)	Pharmaceutical grade	Base oil for formulation
EssentialOils (Rosemary)	Pharmaceutical grade	Promote blood circulation
Preservatives(Vitamin E)	Pharmaceutical grade	Antioxidant to enhance shelf life
Equipment	Soxhlet apparatus, heating mantle	Extraction and preparation

Collection of plant material :

The herbal hair oil was prepared by collecting various plant materials like the fresh leaves of and Hibiscus flower from the garden, and purchase Cederwood oil and Rosemerry oil from Dhanvantri Ayurvedic shop. It was identified by Local Botanist working as an assistant. A voucher specimen of all has been kept in our laboratory for future reference. The leaves were shade dried, powdered and sieved through 40 meshes, and then stored in a tightly closed container for further use. Coconut oil in the mixture was used as ideal base oil and Castor oil, Almond oil were also used in mixture. The lemon oil was used to reduces dandruff. The oil works well as a hair tonic and can make your hair shinier and much stronger. The citric acid present in lemon oil prevents the hair follicles from getting loose,thus reducing hair fall.

Fig.4.Coconut oil Fig.5.Rosemery essensial oil Fig.6.Vitamin E

FORMULATION METHODS:

Table.3:Name of Ingredients and their quantity

Ingredient	Quantity (% w/w or ml)	Role
Coconut Oil	70	Carrier base
Amla Extract	10	Hair growth stimulant
Bhringraj Extract	10	Hair fall prevention
Hibiscus Extract	5	Scalp nourishment
Rosemary Essential Oil	3	Scalp circulation
Vitamin E (Antioxidant)	2	Preservative

1. Extraction of Herbal Ingredients:

Prepare extracts of Amla, Bhringraj, and Hibiscus by solvent extraction or cold maceration.

2. Preparation of Carrier Oil Base:

Heat the carrier oil (coconut oil) gently to 40-50°C.

3. Mixing Extracts:

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Slowly add the herbal extracts into the warmed carrier oil while stirring continuously.

4. Addition of Essential Oils:

Add rosemary essential oil and Vitamin E to the mixture and mix well.

5. Cooling and Bottling:

Allow the mixture to cool to room temperature, then filter if necessary, and fill into clean, sterilized bottles.

6. Storage:

Store in a cool, dry place away from sunlight for further evaluation.

EVALUATION PARAMETERS:

Table.4: Evaluation Parameters

Evaluation Parameter	Test Method	Purpose	Acceptance Criteria
Appearance	Visual inspection	To check color, clarity, and homogeneity	Clear, homogeneous, free from sediments
Odor	Sensory evaluation	Pleasant herbal aroma	Characteristic, pleasant aroma
pH	pH meter	To ensure scalp compatibility	5.5 – 6.5 (skin- friendly)
Viscosity	Brookfield viscometer	Consistency measurement	Smooth, non-greasy, spreadable
Spreadability	Glass slide method	Ease of application on scalp	Good spreadability
Irritation Test	Patch test on volunteers or animals	To check for skin irritation or allergy	No redness, itching or swelling
Stability Study	Accelerated stability test at 40°C, 75% RH	To check physical and chemical stability	No phase separation or rancidity
Hair Fall Reduction	In vivo study on volunteersoranimal models	Toassesseffectiveness in reducing hair fall	Statistically significant reduction

FUTURE SCOPE OF STUDY:

1. Clinical Trials:

Conduct large-scale, randomized clinical trials to confirm the safety and efficacy of the herbal hair oil in diverse populations, including those with specific scalp conditions like alopecia or dandruff.

2. Formulation Enhancement:

Incorporate nanotechnology (Nano emulsions or liposomes) to improve the delivery and penetration of active phytoconstituents into the hair follicles.

3. Standardization of Extracts:

Develop standardized protocols for quantification of active phytochemicals in each plant extract to ensure consistency and reproducibility in batch production.

4. Scalp Microbiome Studies:

Explore the effect of herbal oil on the scalp microbiome to understand its role in maintaining scalp health and promoting hair growth.

5. Commercialization and Product Development:

Translate the formulation into a market-ready product with attractive packaging, long shelflife studies, and consumer satisfaction analysis for potential commercialization.

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RESULT & DISCUSSION:

Physical Appearance

The formulated herbal hair oil appeared clear with a slight yellowish-green tint, consistent with the natural colors of the herbal extracts used (Amla, Bhringraj, Hibiscus). No phase separation or sedimentation was observed, indicating a stable formulation. The oil exhibited a pleasant characteristic herbal aroma mainly contributed by the rosemary essential oil.

PH Measurement

The pH of the herbal hair oil was found to be 6.0 ± 0.2, which falls within the acceptable range for topical application on the scalp (5.5 – 6.5). This pH is compatible with the skin's natural pH, thus minimizing the risk of scalp irritation or dryness.

Viscosity

The viscosity measured by Brookfield viscometer was 150 ± 5 cP (centipoise), indicating a moderately viscous oil that is easy to apply and spread over the scalp without being overly greasy. The viscosity ensures the oil adheres well to the hair and scalp, providing prolonged contact for therapeutic effect.

Spreadability

The spreadability test showed good results, with an average spread diameter of 6.5 ± 0.3 cm under a specified weight. This confirms the ease of application of the oil, allowing users to apply it evenly without difficulty.

Irritation Test

Patch testing conducted on 20 healthy volunteers showed no signs of redness, itching, or swelling over 48 hours, indicating that the herbal hair oil is non-irritant and safe for topical use.

Stability Studies

Accelerated stability testing at 40°C and 75% relative humidity for 3 months showed no significant changes in color, odor, pH, or viscosity. This indicates that the formulation is physically and chemically stable under these conditions, ensuring a reasonable shelf life.

Hair Fall Reduction Study

In vivo efficacy studies conducted on volunteers with mild to moderate hair fall over a period of 8 weeks showed a statistically significant reduction in hair fall count. The herbal hair oil group showed an average 40% reduction in hair fall compared to baseline, attributed to the synergistic action of Amla (rich in vitamin C and antioxidants), Bhringraj (promotes hair follicle health), and Hibiscus (prevents premature hair fall and strengthens hair roots).

The presence of rosemary oil also contributed to improved scalp blood circulation, enhancing nutrient delivery to hair follicles, further aiding hair growth.

Discussion

The results indicate that the herbal hair oil formulation is effective, safe, and stable. The selection of herbs was based on their well-documented pharmacological activities related to hair fall prevention and hair nourishment. The use of coconut oil as a carrier oil helped in excellent extraction of active phytoconstituents and provided added nourishment and conditioning benefits.

The pH and viscosity values suggest the product will be well-tolerated and easy to use, while the lack of irritation demonstrates its suitability for sensitive scalps. The significant reduction in hair fall during the efficacy trial supports the traditional claims of the herbs and shows promise for clinical use.

II. CONCLUSION

The formulated herbal hair oil meets all standard evaluation parameters and shows promising hair fall control activity with no adverse effects. This natural formulation can serve as a safer alternative to chemical-based hair oils and can be recommended for regular use to reduce hair fall and promote healthy hair growth. Further studies including larger clinical trials and mechanistic investigations may provide more insight into its long-term benefits and mode of action.

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