



Research Article

Formulation And Evaluation of Herbal Hair Mask for Lice Treatment

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ABSTRACT

Lice infestations, particularly among children, remain a widespread health concern that affects personal hygiene, comfort, and psychological well-being. Caused by the parasitic insect *Pediculus humans capitis*, lice thrive on the human scalp, feeding on blood and leading to intense itching and discomfort. Transmission typically occurs through close personal contact or the sharing of personal items, such as combs and hats. Although not life-threatening, lice infestations can result in secondary infections and social stigma. Conventional treatments often rely on chemical-based insecticides and medicated shampoos, which, despite their effectiveness, may cause skin irritation, allergic reactions, and promote resistance in lice populations. Additionally, concerns over the toxicity of synthetic agents especially in children have led to a growing interest in natural alternatives. Herbal remedies, particularly herbal hair masks, are gaining recognition for their safety, efficacy, and skin-friendly nature. Formulations containing ingredients such as Neem (*Azadirachta indica*), Tea Tree (*Melaleuca alternifolia*), Eucalyptus (*Eucalyptus globulus*), and Coconut oil possess well-documented insecticidal, antimicrobial, and anti-inflammatory properties. These natural ingredients not only help eliminate lice but also nourish the scalp, reduce irritation, and improve overall hair health. The preparation of herbal hair masks involves the strategic blending of these bioactive components with carriers and moisturizers like honey, aloe vera, or glycerin to enhance effectiveness and ease of application.

INTRODUCTION

Lice infestations, specifically *Pediculus human's capitis* (head lice), remain a significant public health issue, particularly in children aged 3 to 11 years. These ectoparasites inhabit the scalp, feeding on human blood, and cause symptoms

such as intense itching, inflammation, and secondary infections due to persistent scratching [1]. Lice are highly contagious and are primarily spread through direct head-to-head contact or sharing personal items like hats, combs, and hair accessories [2]. Although not associated with

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serious disease, lice infestation can lead to considerable psychological distress and social embarrassment, particularly among school-going children. The conventional management of head lice typically involves chemical pediculicides such as permethrin, malathion, and pyrethroids. While these agents are initially effective, their repeated use has led to significant drawbacks, including resistance development, potential toxicity, and allergic reactions in sensitive individuals [3,4]. This has sparked a renewed interest in alternative, safer, and natural treatments. In this context, herbal formulations, especially herbal hair masks, have emerged as promising solutions. These masks not only target lice effectively but also support scalp health through their antimicrobial, anti-inflammatory, and moisturizing properties [5]. Herbal remedies for lice control are rooted in traditional medicine and are increasingly supported by modern research. Commonly used herbs include *Azadirachta indica* (Neem), *Melaleuca alternifolia* (Tea Tree), *Eucalyptus globulus*, and carrier oils like coconut and olive oil. These ingredients exhibit insecticidal activity, disrupt the life cycle of lice, and reduce scalp irritation [6]. For instance, neem contains azadirachtin, a compound that interferes with insect growth and reproduction, while tea tree oil exhibits potent antimicrobial and ovicidal (egg-

killing) properties [7]. Coconut oil, widely used as a carrier, suffocates lice and improves the mask's spreadability and scalp nourishment [8].

Hair Anatomy and Its Role in Lice Infestation

Understanding the anatomy of hair is essential to formulating effective lice treatments. Hair is composed of keratin and consists of the hair shaft (visible part) and the hair follicle (embedded in the skin). The shaft has three layers: the cuticle, cortex, and medulla. The cuticle, made up of overlapping cells, acts as a barrier protecting inner layers; the cortex provides strength, elasticity, and colour and the medulla serves as a soft central core, usually found in thick hair. Hair follicles are rich in blood vessels, which provide nutrients essential for hair growth and, unfortunately, attract parasitic lice that feed on blood [9]. The lice eggs, or nits, are laid near the base of the hair shaft, close to the scalp where warmth aids in incubation. This makes it crucial for anti-lice formulations to penetrate deeply and adhere well to the scalp and hair strands. Herbal masks, due to their viscous nature and natural bioactive ingredients, are ideal for such targeted action. The ability of these masks to simultaneously treat infestation and promote hair health adds value over harsh chemical treatments.

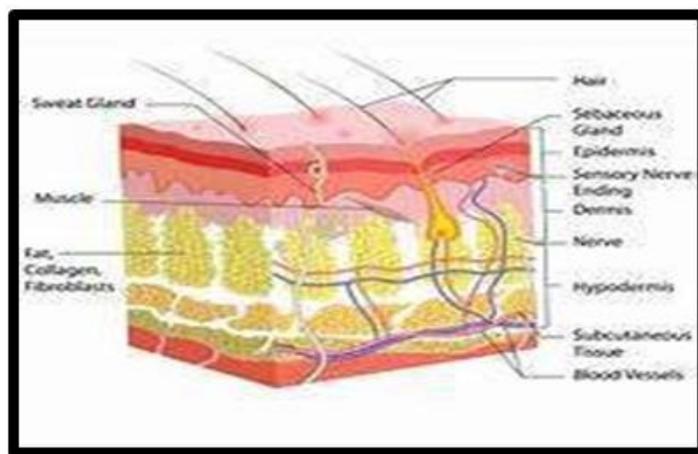


Fig No. 1: Anatomy of Hair

Herbal Hair Masks: A Natural and Holistic Approach

The formulation of an herbal hair mask for lice treatment involves a careful blend of active botanical ingredients and supportive agents. Neem and eucalyptus oils are known for their insecticidal and antiseptic effects; tea tree oil provides antifungal and anti-inflammatory benefits, while coconut oil acts as a carrier and scalp moisturizer [10]. Additional soothing agents such as aloe vera, honey, or glycerin can be included to enhance hydration and minimize scalp irritation. Research indicates that these natural formulations may be as effective as conventional treatments without the side effects. Abdel-Ghaffar et al. (2012) demonstrated that a neem-based shampoo significantly reduced lice infestation in children, without adverse effects [11]. Similarly, other studies have confirmed the effectiveness of tea tree and eucalyptus oil in killing both adult lice and their eggs [12]. These herbal products also support the natural moisture barrier of the scalp, reduce inflammation from itching, and prevent secondary infections advantages that synthetic shampoos often lack. Furthermore, herbal masks are biodegradable, non-toxic, and safer for repeated use, making them especially suitable for children and individuals with sensitive skin. They represent a more holistic and environmentally responsible alternative for lice treatment in comparison to chemical-based therapies.

Stages in the lice Life Cycle

The life cycle of head lice includes three main stages: the egg (nit), the nymph, and the adult. The process from egg to adult takes approximately 21 days, making it a relatively quick reproductive cycle that allows infestations to spread rapidly if not treated in time [13].

❖ Eggs (Nits):

Female lice lay eggs close to the scalp, attaching them firmly to the base of the hair shaft using a glue-like substance. The eggs are oval, about 0.8 mm long, and range from white to yellowish in colour. They hatch in about 7 to 10 days, depending on temperature and humidity. The warmth of the human scalp is essential for egg development; without it, the eggs do not hatch [14].

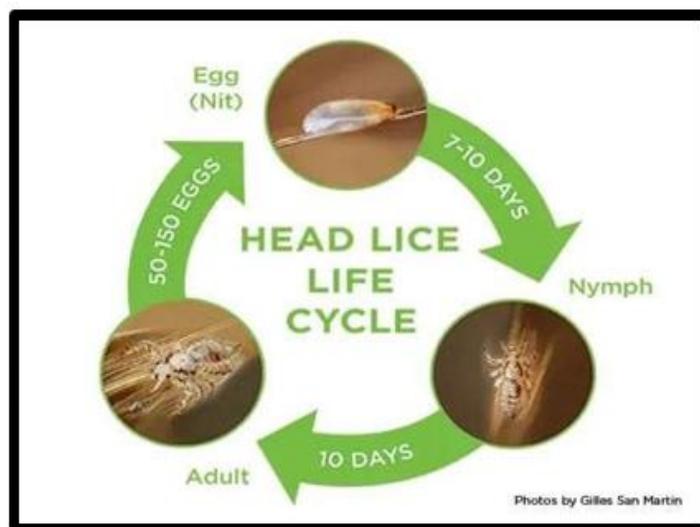
❖ Nymphs:

Once hatched, the nymph emerges as a miniature version of the adult. Nymphs go through three molts over the course of 7–10 days, gradually growing larger and developing the ability to reproduce. During this period, they begin to feed on human blood multiple times a day [15].

❖ Adults:

Fully developed adult lice are about 2–3 mm in length. They are tan to grayish-white in colour, although this can vary depending on the host's hair colour. Adults can live up to 30 days on the human scalp, but they cannot survive more than 1–2 days without a host. A female louse is capable of laying 6–10 eggs per day, which contributes significantly to the rapid growth of the infestation [16].





Hair Growth Cycle

Hair growth cycle consists of four stages as shown as follow:

- ❖ **Anagen (Growing) Phase:** The anagen phase is the growth phase of the hair. The anagen phase will last from between 2-6 years. A new hair pushes the new hair that stopped growing up and out of the follicle.
- ❖ **Catagen (Transition) Phase:** The catagen phase is a transitional stage and 3% of all hairs are in this phase at any given time. This phase lasts for 2-3 weeks.
- ❖ **Telogen (Resting) Phase:** The telogen phase is the resting phase which lasts for about 2-3 months. During the telogen phase, the hair follicle is at rest and the club hair is completely formed ^[16].
- ❖ **Exogen (Shedding) Phase:** The exogen stage is the shedding period of the hair cycle. It usually lasts 2 to 4 months. It's normal to shed about 50 to 150 hairs on a daily basis. After the exogen phase, the follicle then returns to the anagen phase and the cycle repeats.

MATERIALS AND EQUIPMENTS

The ingredients used in the formulation of the herbal hair mask were procured from reputable suppliers [17].

MATERIALS

Table No. 1- List of Materials

Sr. No	Ingredients	Manufacturer
1	Neem oil	Prerana Agro Industries (Maharashtra)
2	Eucalyptus oil	Gupta Aromatics Pvt. Ltd. (Ghaziabad)
3	Tea tree oil	Arora Aromatics Pvt. Ltd. (India)
4	Coconut oil	Marico Ltd.
5	Camphor	Geeta Products (Gujarat)

❖ Equipment's:

Table No. 2- List of Equipment's

S. No.	Equipment Name	Manufacturer
1	Digital Weighing Balance	Nitiraj Engineers Ltd.
2	pH Meter	National scientific apparatus work Manufacturer
3	Water Bath	Lab India Instruments Pvt. Ltd.
4	Hot Plate	Adarsh lab Manufacturer

METHODS AND EVALUATION

METHODS

Collection and Authentication of Materials

All the herbal oils and ingredients used for the formulation were procured from authentic and reputed sources. Neem Oil, Coconut Oil, Tea Tree Oil, Eucalyptus Oil, and Camphor were purchased from an authorized herbal raw material supplier [18]. All the ingredients were authenticated based on their organoleptic properties and standard physical characteristics (colour, odour, solubility, etc.)

Formulation Design

The formulation was designed to create a Herbal Hair Oil Mask effective against head lice, with minor variations across three batches for comparative evaluation. The formulations varied slightly in the proportion of Neem oil, Coconut oil, Tea tree oil, Eucalyptus oil, and Camphor to optimize anti-lice activity, Spreadability, and scalp nourishment properties. The exact compositions for Batch 1, Batch 2, and Batch 3 are shown in the Formulation Table [19].

Preparation of Herbal Hair Oil Mask

General Method for All Batches:

1. Heating Base Oil

The measured quantity of Coconut oil was taken into a clean beaker. It was mildly heated on a water bath at around 40–50°C to make it slightly warm and fluid. (Important: Overheating was avoided to prevent loss of volatile components [20].

2. Addition of Neem Oil

After slight heating, the premeasured quantity of Neem oil was added slowly into the warm Coconut oil with continuous stirring to ensure homogenous mixing [21].

3. Incorporation of Essential Oils

After uniform mixing of base oils, the calculated quantities of Tea tree oil and Eucalyptus oil were added dropwise. Continuous stirring was maintained to evenly distribute essential oils into the base [22].

4. Addition of Camphor

Camphor was accurately weighed and added into the oil blend. It was stirred continuously until complete dissolution of camphor crystals was observed. The solution was kept on mild heating if necessary to assist camphor dissolution [23].

5. Cooling and Final Mixing

After complete mixing, the oil mask was allowed to cool naturally at room temperature. A final stirring was given to ensure uniformity [24].

6. Filling and Storage

The prepared herbal oil masks of each batch were transferred into sterile, amber-coloured glass bottles to protect from light exposure. Bottles were labelled properly with batch number, date of manufacture, and composition [25].

Formulation Table

Table No. 3-Formulation Table

Sr. No	Ingredients	Batch-1	Batch-2	Batch-3
1	Neem oil	8.5 ml	6.95 ml	8.75 ml
2	Eucalyptus oil	1.8 ml	1.3 ml	2.5 ml
3	Tea tree oil	1.8 ml	2.5 ml	1.3 ml
4	Coconut oil	12.5 ml	13.95 ml	11.95 ml



5	Camphor	0.4 g	0.3 g	0.5 g
	Total	25 ml	25 ml	25 ml

Evaluation

The evaluation of any topical herbal formulation is incomplete without thorough physicochemical and organoleptic testing. These parameters ensure the product is stable, user- friendly, and effective. For a herbal hair oil mask intended for lice treatment, such evaluations confirm that the ingredients are well integrated, safe for the scalp, and offer a pleasant user experience.

1. Organoleptic Evaluation

Organoleptic parameters involve sensory characteristics such as colour, odour, texture, and general appearance, which directly affect user acceptability and compliance. These factors also provide insight into the stability of the formulation [26].

❖ Colour:

A uniform and natural colour indicates proper ingredient dispersion and formulation stability. In this formulation, the colour appeared Dark Reddish to Brown due to the combination of Neem, Coconut, and Tea Tree oils. No colour change was observed during storage.

❖ Odour:

Herbal formulations often have a characteristic aroma. The odour of the hair oil mask was found to be mild, fresh, and pleasant, primarily influenced by Tea Tree oil, Eucalyptus oil, and Neem oil. No rancid or unpleasant smell was detected, indicating stability [27].

❖ Texture:

The texture was evaluated by applying a small amount to the fingers. The oil mask was smooth, non-sticky, and lightweight, allowing easy application on scalp and hair without greasiness.

❖ Appearance:

A homogeneous, clear, and smooth appearance without any phase separation or cloudiness was observed. The formulation remained stable and uniform during the study period.

2. Physicochemical Evaluation

These parameters assess the chemical and physical characteristics of the formulation. They are essential to ensure quality control, therapeutic efficacy, and shelf life [28].

1. pH Measurement

Method:

About 1 mL of the oil was mixed in 10 mL distilled water, and the pH was measured using a digital pH meter.

Observation:

The pH of all batches ranged from 5.5 to 6.0, which is suitable for scalp application and does not cause irritation [29].

2. Spreadability

Method:

A fixed quantity of the oil was placed between two glass slides, and a weight was applied. The diameter of spread was measured.

Observation:



The Spreadability was found to be good, with a spread diameter of about 6–7 cm, showing excellent spreading capacity and ease of application [29].

RESULTS AND DISCUSSION

Results

1. Organoleptic Properties

The prepared herbal hair oil mask was evaluated for its physical, chemical, and performance characteristics.

The results obtained are summarized as follows:

Colour: The formulation exhibited a Dark Reddish to Brown appearance, indicating the presence of herbal ingredients like Neem and Tea Tree oil.

Odour: The oil mask had a pleasant herbal fragrance, mainly due to essential oils like Tea Tree and Eucalyptus, enhancing user acceptability.

Texture: The formulation showed a smooth, lightweight texture, ensuring easy application on hair and scalp.

Table No. 4- Organoleptic Observation Table

Sr.no	Organoleptic Properties	F-1	F-2	F-3
1	Colour	Light Reddish to Brown	Dark Reddish to Brown	Dark Reddish to Brown
2	Odour	Mild Herbal fragrance	Fresh herbal smell	Pleasant tea tree and eucalyptus
3	Texture	Smooth	Smooth	Smooth, Soft
4	Appearance	Homogeneous	Homogeneous	Homogeneous
5	Washability	Easy	Easy	Easy

Discussion

The organoleptic evaluation of the three batches (F1, F2, and F3) of the herbal hair oil mask revealed consistency in desirable physical and sensory characteristics. The colour variations ranging from Dark Reddish To Brown correlate with the natural of herbal constituents such as neem oil, tea tree oil, and eucalyptus oil. These variations are acceptable and expected in herbal formulations due to differences in ingredient concentrations or natural pigment content. The odour was reported as mild to pleasantly herbal across all formulations, with specific mention of tea tree and eucalyptus in F3 contributing to a fresh and soothing fragrance. This enhances the consumer acceptability of the product, especially

for daily or weekly use. In terms of texture, all three batches exhibited a smooth and soft consistency, which supports effortless application and good sensory feel during use. The appearance remained homogeneous across formulations, suggesting good emulsification and no phase separation, indicating physical stability. The washability was recorded as easy for all batches, confirming that the product can be removed without excessive effort or shampooing, which adds to its convenience and usability.

pH Test Result

Table No. 5- pH Test Observation Table

Sr.no	Formulation	F1	F2	F3
1	pH	5.6	5.5	5.8





Fig No. 3: pH Test

Discussion

The pH of all three batches of the herbal hair oil mask ranged between 5.4 and 6.2 which lies within the mildly acidic to near-neutral range. This is appropriate for scalp application, minimizing the potential for irritation or disruption of the scalp's natural acid mantle.

Spreadability Test

The purpose of the spreadability test is to assess how easily the herbal hair oil mask can be applied and distributed over the scalp and hair. Good spreadability ensures uniform application, improved absorption, and user comfort. In this test, a fixed amount of the hair oil mask is placed between two clean glass slides. A standard weight (usually 500 grams) is then gently placed on the upper slide, allowing the mask to spread evenly under pressure. After a set duration, typically one minute, the diameter of the spread area is measured in millimetres. A larger diameter indicates better spreadability, which is desirable for hair mask formulations as it ensures ease of use and effective coverage.

Result

Table No. 6- Spreadability Test Observation Table

Sr.no	Formulation	F1	F2	F3
1	Spreadability	6.5	6.8	7



Fig No. 4: Spreadability Test

The spreadability test showed that the herbal hair oil mask spreads efficiently, with diameters of 6.5 cm (F1), 6.8 cm (F2), and 7 cm (F3). These values suggest excellent spreadability, ensuring that the mask can be evenly distributed over the scalp and

Discussion



hair strands with minimal effort. Good spreadability is a vital property for hair care products, as it enhances product performance, allows even delivery of active ingredients, and contributes to the overall user experience. The slight variation between batches may be due to minor differences in viscosity or oil composition but remains within acceptable limits.

2. Washability Test

Result Table no. 7- Washability Test Observation Table

Sr.no	Formulation	F1	F2	F3
1	Washability	Easy	Easy	Easy



Fig No. 5: Washability Test

Discussion

The washability of all three batches (F1, F2, and F3) of the herbal hair oil mask was evaluated to determine how easily the product could be removed from the hair and scalp after application. The results demonstrated that all batches were easily washable with lukewarm water and mild shampoo, without leaving behind any greasy residue or causing excessive foaming or buildup. This easy washability is an important attribute for hair oil masks, as it enhances user convenience, especially for individuals with busy routines or sensitive scalps. The ease of removal also indicates that the formulation contains a balanced amount of oils and emulsifiers, allowing for efficient cleansing while still delivering the desired conditioning effects.

3. Viscosity Test

The viscosity test evaluates the resistance of the herbal hair oil mask to flow, which directly influences application, retention, and spreadability. The test was conducted using a digital viscometer at room temperature ($25 \pm 2^\circ\text{C}$). Viscosity values are expressed in millipascal-seconds (mPa·s), where a higher value indicates a thicker formulation. An ideal viscosity ensures the product is neither too runny nor too thick, supporting ease of use and effective scalp coverage.

Result

Table No. 8 – Viscosity Test Observation Table

Sr.no	Formulation	F1	F2	F3
1	viscosity (mPa·s)	1.97	2.16	2.76

DISCUSSION



The viscosity values for the three formulations were recorded as 1.94 mPa·s (F1), 2.16 mPa·s (F2), and 2.76 mPa·s (F3). These results indicate that all formulations possess moderate viscosity suitable for topical application. F3 exhibited the highest viscosity, suggesting a thicker consistency that may provide better adherence to the scalp and prolonged contact time for therapeutic action. F1, with the lowest viscosity, may offer easier spreadability but shorter retention. The variation in viscosity is likely due to differences in the ratios of coconut oil, neem oil, and eucalyptus or tea tree oil used in each formulation. Overall, all formulations fall within an acceptable viscosity range for hair mask applications.

CONCLUSION

The study of herbal hair masks highlights their potential as a safe, effective, and natural remedy for lice infestations. Compared to conventional chemical treatments, herbal formulations offer significant benefits such as reduced toxicity, minimal side effects, and added scalp nourishment. The combination of essential oils like neem, tea tree, eucalyptus, and coconut oil exhibit synergistic insecticidal, antiseptic, and soothing effects. These properties make herbal hair masks an appealing alternative in both paediatric and adult populations. Further clinical studies are recommended to standardize formulations and confirm their efficacy through evidence-based research.

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