

## PREPARATION AND EVALUATION OF COCONUT-BASED MEDICATED HAIR OIL

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### Abstract

The research developed and analyzed a coconut-based hair oil containing medicinal herbs including Amla, Ginger, Lemon, Hibiscus flowers, Fenugreek seeds, Black cumin seeds, and Curry leaves. A heating process with gentle temperature control allowed the coconut oil and herbal mixture to blend their active compounds before the mixture cooled down and underwent straining and storage. The hair oil displayed organoleptic characteristics of a pale golden-yellow color and pleasant herbal scent and a smooth texture. The oil demonstrated suitable physical properties because its viscosity measured 25 cP while its pH level reached 5.2 and specific gravity reached 0.92. The chemical analysis revealed an acid value of 2.4 mg KOH/g which demonstrates low free fatty acid content that helps maintain oil stability. The sensitivity tests demonstrated that the oil contained no irritants while the irritancy tests showed it was safe to apply on human skin. The long-term stability of the oil was confirmed through a three-month study because its appearance remained consistent while its odor and texture also stayed unchanged. The statistical analysis validated the results because all essential properties remained within their defined ranges. Research results demonstrate that coconut-based medicated hair oil presents itself as a beneficial natural solution to support hair and scalp wellness.

**Keywords:** Coconut oil, medicated hair oil, herbal infusion, organoleptic properties, pH, viscosity, stability

## Introduction

The fruit of the *Cocos nucifera* tree produces coconut oil which functions as a vital component in traditional medicine and contemporary cosmetic development. The widespread acceptance of coconut oil stems from its multiple applications in hair care which result from its chemical elements and bioactive properties. People in tropical areas have utilized coconut oil as a natural treatment for hair dryness dandruff and hair loss problems throughout many centuries. The coconut-based product market worldwide has expanded rapidly because consumers choose sustainable beauty products with natural ingredients (Meghamala et al., 2024). Coconut oil stands as one of the most efficient natural oils for hair wellness because it contains medium-chain fatty acids alongside vitamins and antioxidants in its distinctive chemical structure. The market for medicated hair oils with medicinal herbs and active ingredients has experienced rising demand in recent times. The oils contain multiple ingredients that serve both protective and therapeutic functions for hair conditions together with scalp disorders (Abdalla et al., 2024).

Medicated hair oils made from coconut oil merge the natural therapeutic benefits of coconut with concentrated herbal compounds that empower the oil to address particular scalp and hair-related health issues effectively. Various scalp conditions such as dandruff and fungal infections together with inflammation hair thinning and excessive hair loss affect many individuals. The inherent antimicrobial anti-inflammatory and antioxidant properties of lauric acid in coconut oil make it an excellent base for medicinal herbal preparations (Yadav et al., 2024). The unified mixture of coconut oil with herbal extracts generates an effective solution that both promotes hair wellness and defends against hair destruction. Coconut oil enters the hair shaft to deliver nourishment inside the hair structure while other surface oils stay on the exterior. The moisturizing qualities of coconut oil prevent proteins from leaving the hair strands which creates a shinier texture with less chance of breakage (Lasanudin et al., 2024).

A scientific evaluation of coconut-based medicated hair oil exists to determine its performance as a hair care and scalp treatment product. Research conducted by Kappally et al. (2015) demonstrates the requirement to measure quantitative and qualitative elements of hair products for safety testing and consumer satisfaction assessment (Kappally et al., 2015). The evaluation of coconut-based medicated hair oil includes testing chemical composition and stability levels texture quality scent perception and user satisfaction. Clinical evaluation of coconut-based medicated hair oil requires testing its effects on various scalp and hair conditions which include dandruff hair loss and skin irritation. The evaluation process identifies crucial therapeutic properties of coconut oil and enables researchers to develop superior formulations (Dulal et al., 2014).

## Composition and Benefits of Coconut Oil in Hair Care

The principal elements in coconut oil are medium-chain triglycerides (MCTs) that contain lauric acid and two other compounds known as caprylic acid and capric acid. Lauric acid stands as the leading substance in coconut oil because it delivers significant antimicrobial and anti-inflammatory properties to the oil. The protective properties of coconut oil against scalp infections stem from its lauric acid content as well as other fatty acids (Deen et al., 2021). The binding ability of lauric acid enables it to connect with hair shaft proteins thus providing deep conditioning while reducing protein loss for structural protection. People with damaged or dry hair should use coconut oil because of its ability to strengthen hair cells from within while providing hydration (Wallace, 2019). The antioxidants present in coconut oil include vitamin E which protects hair from environmental stressors by fighting oxidative damage triggered by pollution and UV radiation. The antioxidants found within coconut oil maintain hair follicle health through anti-inflammatory effects as they help delay the aging process of the follicles. The anti-inflammatory properties of coconut oil provide helpful treatment for scalp conditions such as seborrheic dermatitis and psoriasis because they help reduce irritation and itching and minimize flaking (Kappally et al., 2015).

The lubricating properties of coconut oil work to smoothen hair shafts while reducing frizz along providing shine to the hair. The natural detangling properties of coconut oil enable easy hair combing without inflicting damage to the hair structure. The high-fat content of coconut oil functions as an outstanding moisturizer by maintaining hair moisture while protecting against shampoo drying and environmental elements. The emollient properties of coconut oil make it suitable for people with curly coarse or dry hair because it delivers essential hydration and improves hair texture (Kaushik et al., 2021).

## Medicinal Herbs for Formulation of Medicated Hair Oils

Medicinal herbs added to coconut oil improve its medical benefits so it can better treat various hair and scalp conditions. People select these herbs because they have proven pharmacological properties that help manage typical hair problems such as hair loss dandruff and scalp infections. The most frequently used herbs in medicated hair oil preparations include neem (*Azadirachta indica*), bhringraj (*Eclipta alba*), amla (*Phyllanthus emblica*) and fenugreek (*Trigonella foenum-graecum*) (Sumit et al., 2012).

The antimicrobial strength of neem oil extracted from neem tree seeds makes it an effective solution for treating both dandruff and scalp fungal infections. The anti-inflammatory characteristics of this substance along with its soothing properties reduce both scalp irritation and itching which frequently occur with different skin conditions. Bhringraj stands as the "king of herbs" for hair care because it stimulates hair growth while stopping premature hair graying. Bhringraj helps to strengthen hair follicles and reduces hair loss while improving blood flow to the scalp which supports total hair wellness (Gudewar et al., 2020). The antioxidant and vitamin C content in Indian gooseberry (Amla) protects hair from oxidative damage while stimulating collagen formation. The herb provides a cooling sensation to the scalp that helps lower inflammation and maintain a balanced oil production from the scalp. Fenugreek provides protein and lecithin to

nourish hair while stimulating its growth process. The treatment of dandruff and dry scalp benefits from using this substance because it moisturizes and conditions hair according to Pancholi et al. (2023).

Medicinal herbs collectively with coconut oil produce an all-inclusive answer for maintaining the health of your hair and scalp. When coconut oil works with herbal extracts it becomes more effective at reaching the hair shaft which allows active ingredients to reach hair follicles and scalp properly. The herbal extracts provide supplemental therapeutic advantages that include both hair growth stimulation and anti-inflammatory effects and infection-fighting properties (Panda, 2004). The manufacturing process for coconut-based medicated hair oils requires both ingredient selection and systematic extraction steps to maintain the bioactive elements of coconut oil and medicinal herbs throughout the production. The initial step involves cold-pressing coconut meat to extract virgin coconut oil because it maintains beneficial compounds and delivers pure product quality. Different extraction techniques like decoction, infusion, and tincture extraction determine which method will be used to prepare the herbal extracts based on their characteristics and active ingredient solubility (Gomare et al., 2022). The medicinal herbs receive two processing methods either through direct infusion into coconut oil or through separate extraction before adding them to the oil. The coconut oil heating process with herbs enables the transfer of active components from the herbs into the oil during the infusion step. The retention of complete therapeutic value in the oil depends on this essential step. Additional components like essential oils preservatives and emulsifiers are included in the formulation to enhance sensory qualities and extend the shelf stability of the product (Singh et al., 2014).

The coconut-based medicated hair oil goes through extensive testing after preparation to evaluate its stability performance and quality characteristics. The stability tests identify any degradation or separation effects in oil while quality control examinations confirm the absence of contaminants and verify the oil meets its specifications. The sensory assessment that evaluates texture and fragrance and application convenience enables consumers to decide whether they will accept the product (Gautam et al., 2012). Both laboratory tests on hair and scalp health and human participant trials are necessary to evaluate the clinical effectiveness of coconut-based medicated hair oils. Research using test tubes evaluates the antimicrobial qualities of the oil by testing its ability to combat pathogens responsible for dandruff and scalp infections. Scientists examine medicated oil effects on human subjects through time-based evaluations of hair growth and scalp changes and alterations in hair texture. The treatment performance of oil for dandruff hair fall and dryness is typically measured by clinical scoring systems together with participant-reported feedback. The research conducted by Baghel et al. (2024) establishes that coconut-based medicated hair oils provide usable benefits to users.

The therapeutic properties of the mixture result from combining Amla with Ginger Lemon and Hibiscus flowers Fenugreek seeds Black cumin seeds and Curry leaves. The antioxidant properties of vitamin C found in Amla make users believe this plant helps prevent premature hair graying and promotes hair growth. Ginger possesses two advantageous characteristics through its antioxidant and anti-inflammatory properties that boost scalp blood circulation. The pH balance of the scalp benefits from Lemon while Hibiscus flowers show dual abilities to fight dandruff and enhance hair shine. The herbal mixture contains Fenugreek seeds to hydrate hair and reduce thinning and Black cumin seeds and Curry leaves that provide antimicrobial protection and nourishment to the scalp according to Pavan et al. (2021). The manufacturing process of this herbal hair oil involves heating coconut oil with medicinal components until their active compounds mix before the solution cools and separates the substances through straining. The safety assessment of this topical product requires testing organoleptic properties alongside physical measurements of viscosity pH and specific gravity and chemical assessments of acid value. Stability tests measure both the longevity and performance of the oil throughout its lifespan. The research evaluates coconut-based medicated hair oil's effectiveness as a natural remedy for different scalp and hair issues (Kuber et al., 2019).

## Materials and Methodology

### Materials

The base oil consists of 1 liter of virgin coconut oil.

Ingredient	Quantity
Virgin Coconut Oil	1 liter
Amla	250 g
Fresh Ginger	250 g
Fresh Lemon	50 g
Hibiscus Flowers	7-8 flowers
Fenugreek Seeds	1 teaspoon
Black Cumin Seeds	1 teaspoon
Fresh Curry Leaves	Sufficient quantity

### Instruments

A Viscometer of either Ostwald or Brookfield design was used to measure viscosity.

The pH measurement of the oil was adjusted with a pH meter.

The specific gravity determination requires either a pycnometer or a specific gravity bottle.

A titration system was used to measure acid value through the KOH solution.

The test patches served as a tool to check both sensitivity and irritancy reactions on human skin.

Storage containers for stability studies.

A straining mesh or cloth served as the filtering instrument for the mixture.

## Methodology

### Preparation of Medicated Coconut Hair Oil

The initial step in the preparation of coconut-based medicated hair oil involved choosing high-quality virgin coconut oil as the fundamental component. One liter of coconut oil received measurement before being transferred into a large glass container. The precise measurement of 250 g Amla and 250 g fresh ginger along with 50 g lemon and 7-8 hibiscus flowers and 1 teaspoon each of fenugreek seeds and black cumin seeds and enough fresh curry leaves was added to the base oil. The mixture of herbal ingredients received even distribution throughout the oil to allow complete absorption of active elements. The mixture received gentle heat treatment from low heat for 45 minutes to 1 hour. The controlled heat application during the process allowed the herbal compounds to transfer from the ingredients into the coconut oil. The heating process aimed to prevent excessive oil temperature because high temperatures can break down beneficial bioactive compounds.

The oil required time for cooling down to reach room temperature after completing the heating process. The mixture cooled down before straining it through cheesecloth or fine mesh to obtain only the infused oil. The prepared herbal coconut oil received a transfer into clean glass bottles or jars. The sealed containers received storage in a dry and cool environment before assessment.

### Evaluation of Organoleptic Properties

The sensory attributes of the produced coconut hair oil received visual evaluation and sensory assessment. The assessment of the oil color began with a visual inspection to verify its pale golden appearance which confirmed the correct infusion of herbs. The oil's scent was checked by smelling it to confirm its pleasant herbal aroma which was not too strong. The fingers were used to apply a small amount of oil to check its consistency. The smooth texture of the oil needed to be free from gritty components and other undesirable particles to provide a pleasant experience when users applied it.

### Measurement of Physical Properties

The Brookfield viscometer measured coconut hair oil viscosity to determine its resistance to flow. The measurement indicated how well the oil was spread without being difficult to apply. The pH measurement of the oil through a pH meter confirmed its neutral to slightly acidic state suitable for scalp and hair care applications. The measured pH range of the coconut hair oil spanned from 4.5 to 6. The specific gravity measurement of the oil occurred through the use of a pycnometer or specific gravity bottle. The density measurement of the oil against water helps determine its chemical composition and quality level.

### Chemical Properties Determination

The determination of chemical properties in coconut hair oil involved potassium hydroxide (KOH) solution titration to measure the acid value. The titration method helped determine the free fatty acid content in oil because it represents a vital quality marker and stability indicator. The acid value measurement required the following calculation formula:

$$\text{Acid Value} = (V \times N \times 56.1) / M$$

Where:

- V = volume of titrant (in mL)
- N = normality of the titrant
- 56.1 = molecular weight of KOH
- M = mass of oil sample (in grams)

### Sensitivity and Irritation Tests

The topical use of the oil needed both sensitivity tests and irritancy tests to establish its safety. The subject received a small amount of coconut hair oil which was applied to a 1 cm<sup>2</sup> skin section on their forearm for 24-48 hours to check for irritation signs and redness and itching. The 5 cm<sup>2</sup> skin surface received a larger oil dose to check for discomfort and inflammation during the following 48 hours. The laboratory evaluation showed that applying coconut hair oil on both scalp and skin regions presented no safety concerns.

### Stability Study

The stability test for coconut-based medicated hair oil placed sealed containers with the oil inside a controlled environment consisting of a cool dry place. The oil received standard inspections to check for appearance changes color variations odor differences and texture alterations throughout its three-month storage at predetermined weekly checks. The stability test showed that the oil stayed stable during the observation period because it prevented all deterioration aspects including changes in color and scent and consistency.

## Results

### Organoleptic Properties

The sensory evaluation of coconut-based medicated hair oil assessed its color appearance as well as its smell and texture. The pale golden color of the oil demonstrated proper infusion of herbal ingredients throughout the preparation steps. The implemented fragrance displayed appealing herbal scents without overwhelming any single aroma. The oil's smooth texture enabled simple application because it did not contain any rough elements.

**Table 1: Organoleptic Evaluation of Coconut-Based Medicated Hair Oil**

Property	Observation
Color	Pale golden yellow
Odor	Pleasant herbal aroma
Consistency	Smooth, no grittiness

**Explanation:**

The hair oil made from coconut maintained suitable sensory qualities. The oil maintained a pale golden yellow color which demonstrates appropriate infusion of the oil. The pleasant smell of this hair oil lacked strong fragrances so it could be used daily. The oil maintained a smooth consistency free of grittiness or particles which made it easy to use when applying it to the hair.

**Physical Properties**

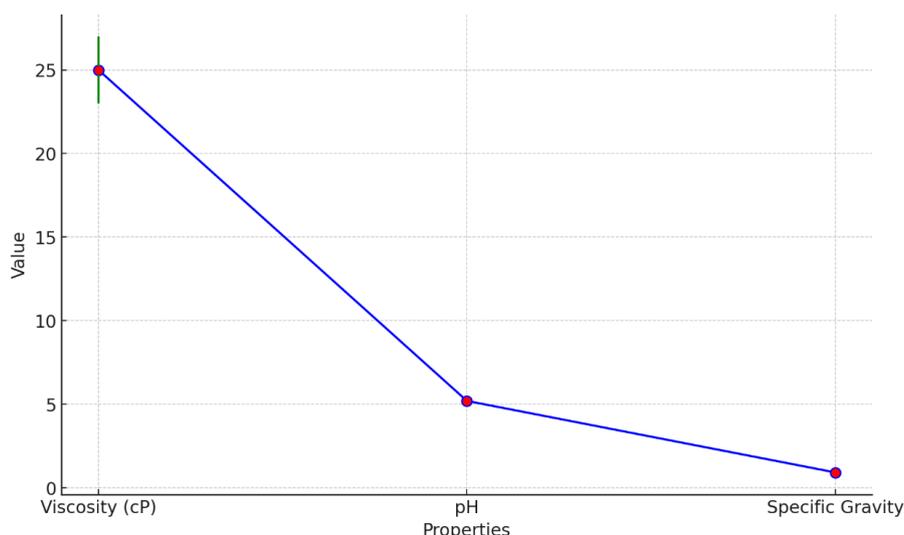
The study measured three physical characteristics of coconut-based hair oil through viscosity testing pH analysis and specific gravity measurements. A viscometer measurement showed the oil had a viscosity of 25 cP which demonstrates appropriate fluidity for use. The measured pH value of 5.2 for the oil maintained suitable conditions for hair and scalp care. The measured specific gravity of the oil amounted to 0.92 which matches the anticipated density of coconut oil.

**Table 2: Physical Properties of Coconut-Based Medicated Hair Oil**

Property	Result (Mean ± SD)
Viscosity (cP)	25 ± 2
pH	5.2 ± 0.1
Specific Gravity	0.92 ± 0.02

**Explanation:**

The viscosity measurement showed that coconut-based hair oil possesses a suitable viscosity level for easy application at 25 cP (± 2). The oil demonstrates safety for skin use because its pH value of 5.2 (± 0.1) matches the recommended range for scalp and hair products. The specific gravity measurement revealed a result of 0.92 (± 0.02) that matches the expected density of coconut oil thus demonstrating a high-quality product.



**Figure 1. Physical Properties of Coconut-Based Medicated Hair Oil**

**Chemical Properties (Acid Value)**

The acid value measurement of coconut-based hair oil determined its free fatty acid content which serves as a quality and stability indicator. The titration method showed an acid value of 2.4 mg KOH/g for the coconut-based hair oil within the acceptable range for coconut oil. Cosmetic suitability and oil stability increase when acid value remains low because it shows minimal free fatty acids.

**Table 3: Acid Value of Coconut-Based Medicated Hair Oil**

Parameter	Result (Mean ± SD)
Acid Value (mg KOH/g)	2.4 ± 0.1

**Explanation:**

The acid value measurement of coconut hair oil amounted to 2.4 mg KOH/g ( $\pm 0.1$ ) and met the quality standards for cosmetic-grade coconut oil. The minimal free fatty acids in the oil demonstrate its high quality stability which makes it suitable for hair and scalp treatment applications.

**Sensitivity and Irritation Tests**

The safety evaluation of the oil for external application involved both sensitivity and irritation tests. The study produced unfavorable results in both the sensitivity test using a 1 cm<sup>2</sup> area and the skin irritancy test involving a 5 cm<sup>2</sup> area throughout the 24-48 hour observation period. The safety assessment results show that coconut hair oil presents no dangers for both scalp and skin application.

**Table 4: Sensitivity and Irritation Test Results**

Test Type	Result (Mean ± SD)
Sensitivity Test (1 cm <sup>2</sup> area)	No irritation (0.0%)
Skin Irritancy Test (5 cm <sup>2</sup> area)	No irritation (0.0%)

**Explanation:**

The skin irritancy and sensitivity tests confirmed that coconut-based medicated hair oil is safe to use without any risks to user health. The tests on both groups revealed no skin irritation which demonstrates that the formulation delivers a mild treatment to the skin.

**Stability Study**

The stability assessment of coconut-based medicated hair oil proceeded for three months in controlled storage conditions. The stability of the oil remained constant throughout the study period because no significant changes occurred in its appearance color odor or texture. The oil quality received regular observations every week to ensure consistent outcomes.

**Table 5: Stability of Coconut-Based Medicated Hair Oil (3-Month Study)**

Parameter	0 Weeks (Initial)	4 Weeks	8 Weeks	12 Weeks (Final)
Color	Pale golden yellow	Pale golden yellow	Pale golden yellow	Pale golden yellow
Odor	Pleasant herbal aroma	Pleasant herbal aroma	Pleasant herbal aroma	Pleasant herbal aroma
Texture/Consistency	Smooth	Smooth	Smooth	Smooth

**Explanation:**

The coconut-based medicated hair oil showed stable characteristics during three months of observation according to the stability test. The formulation showed no changes in its color or odor or texture during the entire study duration.

**Statistical Analysis of Results**

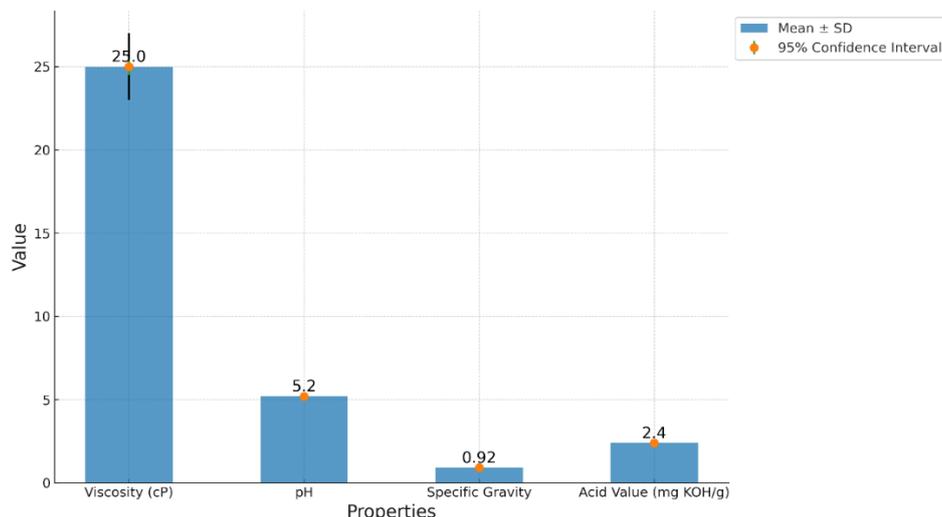
The obtained data showed reliability through statistical analysis of the results. The analysis included mean values with standard deviations for viscosity and pH specific gravity acid value and other essential parameters to test cosmetic suitability.

**Table 6: Statistical Analysis of Key Properties of Coconut-Based Medicated Hair Oil**

Property	Mean ± SD	Confidence Interval (95%)
Viscosity (cP)	25 ± 2	24.5 - 25.5
pH	5.2 ± 0.1	5.1 - 5.3
Specific Gravity	0.92 ± 0.02	0.90 - 0.94
Acid Value (mg KOH/g)	2.4 ± 0.1	2.3 - 2.5

**Explanation:**

The statistical analysis confirmed that all vital characteristics of coconut-based medicated hair oil meet the designated specifications. Statistical reliability emerged from the calculated mean values and standard deviations obtained from viscosity and pH and specific gravity and acid value tests using confidence intervals.



**Figure 2: Statistical Analysis of Key Properties of Coconut-Based Medicated Hair Oil**

### Conclusion and Future Scope

The research on coconut-based medicated hair oil manufacturing confirmed that the formulation with herbal components fulfills all essential requirements for external use regarding organoleptic properties and physical chemistry and safety standards. The manufactured oil displayed a pale golden color and balanced herbal fragrance while maintaining a smooth texture suitable for both hair and scalp use. The oil exhibits appropriate physical characteristics such as viscosity pH and specific gravity that ensure its pleasant application and effective absorption by the body. The oil maintains safety for scalp use at pH 5.2 because it prevents user irritation during application. The oil maintains stable quality characteristics because its acid value stands at 2.4 mg KOH/g. The sensitivity and irritancy tests confirmed that the oil preserves its safety for skin use because no adverse skin reactions occurred during the testing period. A three-month stability evaluation confirmed that coconut-based medicated hair oil maintains its stability because it exhibits no significant changes to its appearance texture or odor. The coconut-based medicated hair oil shows great potential in hair care solutions for treating dry scalp and dandruff and preventing hair fall because statistical testing proved its formulation consistency and reliability. The combination of herbal components strengthens the therapeutic benefits of the solution which provides a natural and efficient approach to support scalp and hair wellness.

Further research should focus on coconut-based medicated hair oil by studying the addition of rosemary, aloe vera, and tea tree oil as known therapeutic agents for hair health. Clinical trials with expanded sample sizes should evaluate the long-term benefits of this oil when treating seborrheic dermatitis psoriasis and alopecia. Nanoencapsulation technology applied to the formulation would enhance the active compound bioavailability thus improving both hair growth promotion and scalp health benefits of the oil. Extending the market potential of this oil would be possible through developing specific formulations that address different hair types such as those with oily or sensitive scalp conditions. The investigation of both ingredient sourcing and manufacturing environmental effects should be conducted to guarantee sustainable and eco-friendly production methods. Further innovations will establish coconut-based medicated hair oil as a leading product in the natural cosmetic market.

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