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FORMULATION AND EVALUATION OF HERBAL HAIR GROWTH STIMULATING ACTIVITY OF HERBAL HAIR OIL

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Abstract:

The present study aimed to formulate and evaluate polyherbal hair oil with potential hair growth–stimulating activity using natural plant-based ingredients. The formulation was prepared using carrier oils such as coconut oil, olive oil, and castor oil, along with herbal components including fenugreek, neem, shikakai, hibiscus, moringa, orange peel, aloe vera, and peppermint oil. The prepared formulation was subjected to various physicochemical evaluations such as organoleptic properties, pH, viscosity, specific gravity, acid value, and saponification value. Additionally, safety assessment through skin irritation tests and stability studies under different conditions were performed. The results indicated that the formulation possessed acceptable physicochemical characteristics, good stability, and was non-irritant in nature. The hair growth activity, evaluated through regular application, demonstrated reduction in hair fall, improvement in hair texture, and enhancement in hair length and shine. The observed effects may be attributed to the synergistic action of the herbal ingredients, which provide nourishment, improve scalp health, and stimulate hair follicles.

In conclusion, the developed polyherbal hair oil is a safe, effective, and economical formulation that can serve as a promising alternative to synthetic hair care products for promoting hair growth and maintaining scalp health.

Keywords: *Polyherbal hair oil; Hair growth stimulation; Herbal formulation; Scalp health; Natural oils; Hair fall reduction; Phytoconstituents; Cosmeceutical formulation*

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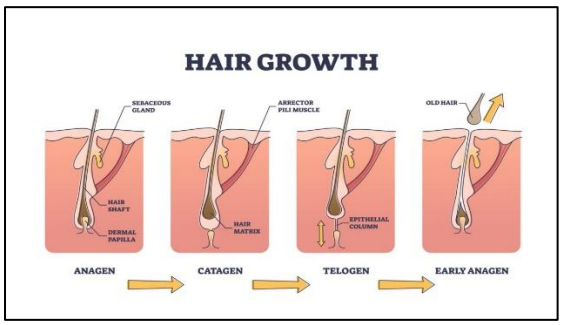
INTRODUCTION:

Cosmetics are widely used products designed to cleanse, beautify, and enhance the appearance of various parts of the human body. Among these, hair care products play a significant role in personal grooming and overall aesthetic appeal. Hair is not only an essential component of the human body but also a key factor influencing an individual's personality, confidence, and social interactions. Structurally, hair is a protective appendage of the integumentary system and is associated with sebaceous and sweat glands, contributing to functions such as thermoregulation and protection against environmental stressors.

In traditional systems of medicine, particularly Ayurveda and Unani, herbal preparations have been extensively utilized for maintaining hair health. Ancient Ayurvedic texts such as the *Charaka Samhita* emphasize the importance of regular scalp oiling using herbal formulations to prevent hair loss and promote healthy hair growth. In Indian culture, the use of herbal hair oils is deeply rooted, and the tradition of combining medicinal plant extracts with natural oils has been practiced for centuries to achieve long, strong, and lustrous hair.



Hair consists of three main structural components: the hair follicle, root, and shaft. The shaft is composed of three layers, namely the medulla, cortex, and cuticle, each contributing to the strength, elasticity, and appearance of hair. The hair growth cycle includes distinct phases such as anagen (growth phase), catagen (transitional phase), telogen (resting phase), and exogen (shedding phase). Disruption in this cycle can lead to common hair disorders such as hair fall, dandruff, premature greying, and split ends.

In recent years, there has been a growing global interest in herbal cosmetics due to increasing awareness of the adverse effects associated with synthetic chemical-based products. Herbal formulations, enriched with phytoconstituents such as flavonoids, alkaloids, vitamins, and essential fatty acids, offer a safer and more sustainable alternative. These bioactive compounds play a vital role in nourishing the scalp, improving blood circulation, strengthening hair follicles, and promoting hair growth.

Hairs oils are one of the most widely used hair care formulations and are primarily intended to nourish the scalp, reduce hair damage, and enhance hair growth. They act by forming a protective layer around the hair shaft, reducing moisture loss, and preventing damage caused by environmental factors and chemical treatments. Among various oils, coconut oil is considered an excellent base due to its high affinity for hair proteins and its ability to penetrate deeply into the hair shaft, thereby reducing protein loss. Other oils such as castor oil, olive oil, and almond oil also contribute to improving hair strength, elasticity, and shine.

The incorporation of herbal ingredients further enhances the therapeutic potential of hair oils. Medicinal plants such as fenugreek, neem, hibiscus, shikakai, aloe vera, and moringa are known for their beneficial effects on hair and scalp health. These herbs exhibit properties such as antimicrobial activity, anti-inflammatory effects, antioxidant potential, and nutrient supplementation, which collectively contribute to improved hair growth and reduced hair fall. Additionally, essential oils such as peppermint oil help stimulate blood circulation in the scalp, thereby enhancing nutrient delivery to hair follicles.

The increasing demand for natural and safe cosmetic products has led to the development of polyherbal formulations that combine multiple plant ingredients to achieve synergistic effects. Such formulations not only enhance efficacy but also minimize side effects associated with synthetic products. Therefore, the formulation and evaluation of herbal hair oil represent a promising approach for developing effective, economical, and safe hair care solutions.

In this context, the present study focuses on the formulation and evaluation of a polyherbal hair oil using selected natural ingredients with proven hair growth–promoting properties. The study aims to assess its physicochemical characteristics, safety profile, and effectiveness in stimulating hair growth, thereby providing a scientific basis for its use as a natural hair care product.

MATERIALS AND METHODS:

Materials

The herbal hair oil was formulated using a combination of medicinal plant materials and carrier oils selected based on their traditional use in hair care, availability, and reported pharmacological activities related to hair growth promotion. Fresh and dried plant materials including curry leaves (*Murraya koenigii*), onion (*Allium cepa*), kalonji seeds (*Nigella sativa*), fenugreek seeds (*Trigonella foenum-graecum*),

neem leaves (*Azadirachta indica*), hibiscus flowers (*Hibiscus rosa-sinensis*), shikakai (*Acacia concinna*), moringa leaves (*Moringa oleifera*), aloe vera (*Aloe barbadensis Miller*), and orange peels (*Citrus reticulata*) were collected from local agricultural fields and authenticated Ayurvedic stores. All plant materials were authenticated by a qualified pharmacognosist (Miss Yogita A. Waghchaure). The collected materials were washed, shade-dried, and coarsely powdered where required. Carrier oils such as coconut oil (*Cocos nucifera*), olive oil (*Olea europaea*), and castor oil (*Ricinus communis*) were procured from a reputed supplier (Daggerteli, Nashik). Peppermint oil (*Mentha piperita*) and camphor were obtained from an Ayurvedic store. All chemicals and reagents used were of analytical grade.

PLANT PROFILE

Coconut Oil (*Cocos nucifera*)

Coconut oil, obtained from the kernel of *Cocos nucifera* belonging to the family Arecaceae, is widely used as base oil in herbal formulations. It is rich in fatty acids such as lauric acid and capric acid, which contribute to its excellent moisturizing and nourishing properties. Coconut oil penetrates deeply into the hair shaft, reduces protein loss, and promotes healthy hair growth while maintaining scalp hydration.

Olive Oil (*Olea europaea*)

Olive oil is derived from the fleshy part of the fruit of *Olea europaea*, a member of the family Oleaceae. It contains bioactive constituents such as oleic acid, phenolic compounds, and squalene, which provide antioxidant and emollient properties. Olive oil helps in repairing damaged hair, strengthening hair follicles, and improving overall hair texture by providing deep conditioning.

Castor Oil (*Ricinus communis*)

Castor oil, extracted from the seeds of *Ricinus communis* of the family Euphorbiaceae, is known for its high content of ricinoleic acid and triglycerides. It plays a significant role in enhancing hair growth by improving blood circulation to the scalp. Additionally, it provides antimicrobial benefits, improves scalp health, increases hair shaft flexibility, and imparts shine to the hair.

Amla (*Emblica officinalis*)

Amla, also known as Indian gooseberry, belongs to the family Phyllanthaceae and is widely recognized for its high vitamin C content along with tannins and phenolic compounds. The fruit of *Emblica officinalis* is used in hair care formulations to strengthen hair roots, prevent premature greying, and promote hair growth by improving scalp health.

Fenugreek (*Trigonella foenum-graecum*)

Fenugreek, commonly known as methi, belongs to the family Fabaceae and contains important constituents such as trigonelline and flavonoids. It exhibits antifungal and anti-inflammatory properties, which help in reducing dandruff and scalp irritation. Fenugreek also strengthens hair follicles and promotes hair growth.

Neem (*Azadirachta indica*)

Neem, a medicinal plant from the family Meliaceae, is widely used for its therapeutic properties. The leaves of *Azadirachta indica* contain active constituents such as nimbin, nimbidin, and nimbidol. Neem possesses strong antimicrobial activity, improves blood circulation in the scalp, reduces hair fall, and helps maintain a healthy scalp environment.

Shikakai (*Acacia concinna*)

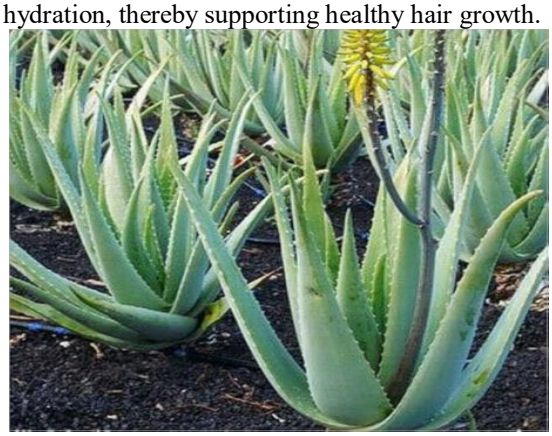
Shikakai, belonging to the family Fabaceae, is obtained from the pods or bark of *Acacia concinna*. It is rich in natural saponins, flavonoids, and sugars, making it an effective natural cleanser. Shikakai gently cleanses the scalp without stripping natural oils, promotes hair growth, and enhances hair shine and softness.

Hibiscus (*Hibiscus rosa-sinensis*)

Hibiscus, a member of the family Malvaceae, is widely used in traditional hair care. The flowers of *Hibiscus rosa-sinensis* contain flavonoids, tannins, and other bioactive compounds that help in stimulating hair growth, preventing dandruff, reducing split ends, and improving hair thickness and volume.

Aloe Vera (*Aloe barbadensis Miller*)

Aloe vera, belonging to the family Liliaceae, is known for its soothing and moisturizing properties. The gel extracted from *Aloe barbadensis Miller* contains vitamins, enzymes, amino acids, and salicylic acid. It helps in reducing scalp inflammation, promoting healing, and maintaining hydration, thereby supporting healthy hair growth.



Moringa (*Moringa oleifera*)

Moringa, from the family Moringaceae, is a nutrient-rich plant whose leaves are widely used in herbal formulations. It contains flavonoids, phenolic acids, and essential nutrients that nourish hair follicles, strengthen hair roots, and improve overall hair health.

Orange Peel (*Citrus reticulata*)

Orange peel, obtained from *Citrus reticulata* of the family Rutaceae, is rich in pectin, cellulose, and flavonoids. It helps in reducing hair fall, controlling excess oil on the scalp, and adding natural shine to the hair.

Peppermint Oil (*Mentha piperita*)

Peppermint oil, derived from the leaves of *Mentha piperita* belonging to the family Lamiaceae, contains active constituents such as menthol and menthone. It enhances blood circulation in the scalp, provides a cooling effect, and exhibits antimicrobial activity, thereby supporting hair growth and maintaining scalp health.

Method of Preparation of Herbal Hair Oil

The herbal hair oil was prepared using the maceration and heat infusion method. Accurately weighed powdered plant materials were mixed with the base oils (coconut oil, olive oil, and castor oil) in a clean container. The mixture was heated gently at 60–70°C for 30–45 minutes with continuous stirring to facilitate extraction of active constituents into the oil. Aloe vera extract was added during the cooling phase to preserve its bioactive components. After complete extraction, the oil was filtered using muslin cloth to remove plant residues. Finally, peppermint oil and camphor were added to enhance therapeutic activity and fragrance. The prepared oil was stored in amber-colored glass bottles to prevent degradation.

Table 1: Formulation of Herbal Hair Oil (30 mL)

Ingredient	Quantity	Role
Coconut oil	10 mL	Base oil, scalp nourishment
Olive oil	5 mL	Moisturizer, strengthens hair
Castor oil	5 mL	Hair growth promoter
Aloe vera extract	2 mL	Hydration, scalp healing
Fenugreek powder	1 g	Anti-hair fall
Neem powder	1 g	Antimicrobial
Shikakai powder	1 g	Natural cleanser
Hibiscus powder	1 g	Hair growth stimulant
Moringa powder	1 g	Nutrient-rich
Orange peel powder	0.5 g	Adds shine
Peppermint oil	3–4 drops	Improves circulation

Collection and Authentication of Materials

All herbal ingredients including fenugreek seeds, neem leaves, shikakai, hibiscus flowers, orange peels, and moringa leaves were collected from local sources, while aloe vera gel was freshly extracted from mature leaves. The carrier oils such as coconut oil, olive oil, castor oil, and peppermint oil were procured in pharmaceutical grade. All plant materials were authenticated by a qualified expert prior to use to ensure their identity and quality.

Preparation of Herbal Powders

The collected plant materials were thoroughly washed with distilled water to remove adhering impurities and then subjected to shade drying for 5–7 days to preserve their phytoconstituents. The dried materials were pulverized using a mechanical grinder to obtain coarse powder. The powdered materials were sieved through sieve number 40 to ensure uniform particle size and were stored in airtight containers to prevent moisture absorption and degradation.

Preparation of Aloe Vera Extract

Fresh aloe vera leaves were washed, and the outer rind was carefully removed to collect the inner gel. The gel was homogenized using a mixer to obtain a uniform extract and then filtered to remove fibrous material. The prepared extract was stored under refrigerated conditions until further use to maintain its stability and bioactivity.

Preparation of Oil Base

The oil base was prepared by accurately measuring and mixing coconut oil (10 mL), olive oil (5 mL), and castor oil (5 mL) in a clean and dry beaker. The mixture was stirred thoroughly to obtain a homogeneous base, which served as the vehicle for extraction of herbal constituents.

Incorporation of Herbal Ingredients

Accurately weighed herbal powders, including fenugreek (1 g), neem (1 g), shikakai (1 g), hibiscus (1 g), orange peel (0.5 g), and moringa (1 g), were gradually added to the oil base. The mixture was continuously stirred to ensure uniform dispersion of the powders within the oil medium.

Heat-Induced Extraction Process

The prepared mixture was subjected to heat using a water bath maintained at a temperature of 60–70°C for 30–45 minutes. Continuous stirring was performed during heating to facilitate efficient extraction of phytoconstituents into the oil. Care was taken to avoid overheating, which may lead to degradation of thermolabile compounds.

Cooling and Filtration

After completion of the heating process, the mixture was allowed to cool to room temperature. The cooled preparation was filtered using muslin cloth or suitable filter paper to remove residual plant materials and obtain a clear oil.

Addition of Heat-Sensitive Components

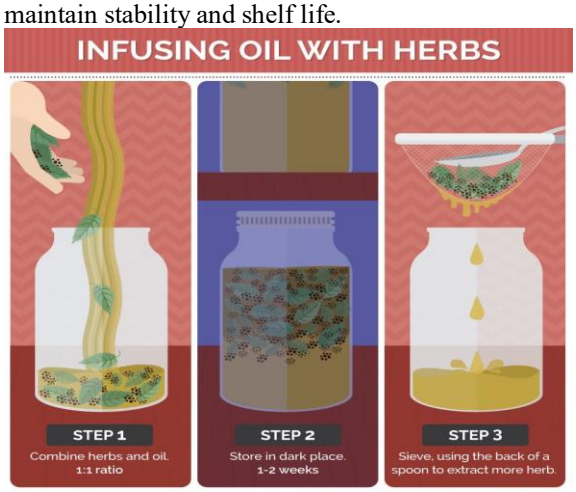
Heat-sensitive components such as aloe vera extract (2 mL) and peppermint oil (3–4 drops) were incorporated into the filtered oil. The mixture was gently stirred to ensure uniform distribution of these constituents without affecting their stability.

Final Volume Adjustment

The final volume of the formulation was adjusted to 30 mL using coconut oil, ensuring consistency and uniformity in the formulation.

Packaging and Storage

The prepared herbal hair oil was transferred into clean, dry, amber-colored glass bottles to protect it from light-induced degradation. The containers were tightly sealed, properly labeled, and stored in a cool and dry place away from direct sunlight to maintain stability and shelf life.



EVALUATION OF HERBAL HAIR OIL

The formulated herbal hair oil was subjected to comprehensive evaluation to determine its physicochemical properties, safety, stability, and effectiveness in promoting hair growth. Each parameter was assessed using standard procedures to ensure the quality and reliability of the formulation.

Organoleptic Evaluation

The organoleptic properties of the herbal hair oil were evaluated based on visual and sensory observations. Parameters such as color, odor, and appearance were carefully examined. This evaluation helps in determining the acceptability of the formulation, as these characteristics play an important role in patient compliance. The prepared oil exhibited a characteristic greenish-brown color, a pleasant herbal odor, and a clear appearance without any visible impurities, indicating good formulation quality.

Determination of pH

Although oils do not possess a direct pH, the pH of the formulation was determined by preparing an aqueous dispersion. A known quantity of the oil was mixed with distilled water and shaken thoroughly, and the pH was measured using a calibrated digital pH meter. The pH of the formulation was found to be in the range of 6.0–6.5, which is suitable for scalp application and ensures that the formulation does not cause irritation or disrupt the natural scalp environment.

Viscosity Measurement

Viscosity is an important parameter that influences the flow property and spreadability of the oil. It was determined using an Ostwald viscometer by measuring the time required for the oil to flow between two marked points. The formulation exhibited moderate viscosity, which ensures easy application, uniform spreading on the scalp, and better absorption of active constituents.

Determination of Specific Gravity

Specific gravity was measured to determine the density of the oil relative to water, which is an indicator of purity and consistency. The measurement was carried out using a specific gravity bottle by comparing the weight of oil with that of water. The obtained value was within the acceptable range (0.90–0.95), indicating proper formulation and absence of adulteration.

Determination of Acid Value

The acid value of the formulation was determined to evaluate the presence of free fatty acids, which indicate the extent of hydrolytic rancidity. The oil sample was dissolved in an alcohol-ether mixture and titrated against standard potassium hydroxide solution using phenolphthalein as an indicator. A low acid value was observed, suggesting good stability, minimal degradation, and high quality of the oil.

Determination of Saponification Value

The saponification value was determined to estimate the average molecular weight of fatty acids present in the oil. The formulation was refluxed with alcoholic potassium hydroxide and titrated with standard hydrochloric acid. The obtained value was within the standard acceptable range, indicating the presence of suitable fatty acid composition and confirming the quality of the oil base.

Skin Irritation Test

The safety of the formulation was evaluated by conducting a skin irritation test on human volunteers. A small amount of the oil was applied to a sensitive area of the skin, such as behind the

ear or on the forearm, and observed for 24 hours. No signs of redness, itching, or irritation were observed, indicating that the formulation is safe and suitable for topical application.

Stability Studies

Stability studies were carried out to assess the physical and chemical stability of the formulation under different storage conditions. The herbal hair oil was stored at room temperature and at elevated temperature (approximately 40°C) for a specified period. Parameters such as color, odor, and phase separation were monitored. No significant changes were observed, indicating that the formulation is stable under normal storage conditions.

Hair Growth Activity

The hair growth promoting activity of the formulation was evaluated through non-clinical studies on human volunteers. The oil was applied to the scalp three times a week for a period of 2–4 weeks. Parameters such as reduction in hair fall, improvement in hair texture, increase in hair length, and enhancement in shine were observed. The formulation demonstrated noticeable improvement in hair thickness, reduced hair fall, and enhanced hair smoothness, indicating its effectiveness as a hair growth stimulant.

Spreadability Test

Spreadability is an important parameter that determines the ease of application of the formulation. It was evaluated by placing a small amount of oil between two glass slides and applying a certain weight. The extent of spreading was measured, which indicates how easily the oil can be applied on the scalp. The formulation showed good spreadability, ensuring convenient application and uniform distribution.

RESULTS AND DISCUSSION

The herbal hair growth oil was successfully formulated using a combination of natural oils and plant-derived ingredients. The prepared formulation was evaluated for various physicochemical, safety, stability, and performance parameters. The findings obtained from the study are discussed below.

Organoleptic Properties

The formulated herbal hair oil exhibited a characteristic greenish-brown color, which is attributed to the presence of multiple herbal constituents such as neem, hibiscus, and moringa. The odor was found to be pleasant and herbal, indicating the presence of natural aromatic compounds and the addition of peppermint oil. The formulation appeared clear and free from visible impurities, suggesting effective filtration and uniform dispersion of ingredients. These organoleptic properties are important for patient acceptability and indicate good formulation quality.

Physicochemical Parameters

pH

The pH of the aqueous dispersion of the herbal hair oil was found to be in the range of 6.0–6.5, which is close to the natural pH of the scalp. This ensures that the formulation is non-irritant and maintains the physiological balance of the scalp environment, thereby supporting healthy hair growth.

Viscosity

The viscosity of the formulation was observed to be moderate, which is ideal for topical application. This ensures easy spreading of the oil on the scalp and adequate retention time, allowing better absorption of active constituents into the hair follicles.

Specific Gravity

The specific gravity of the herbal oil was found within the range of 0.90–0.95, which is comparable to standard hair oils. This indicates the purity, consistency, and absence of adulteration in the formulation.

Acid Value

The acid value of the formulation was low, suggesting minimal presence of free fatty acids. This indicates that the oil is stable, less prone to rancidity, and of good quality.

Saponification Value

The saponification value was found within the acceptable range, indicating the presence of appropriate fatty acid composition. This confirms the suitability of the oil base and its compatibility with herbal constituents.

Skin Irritation Test

The skin irritation study revealed that the formulation did not produce any signs of redness, itching, or inflammation upon application to human skin. This confirms that the herbal hair oil is safe for topical use and does not cause adverse dermatological reactions.

Stability Study

The stability study demonstrated that the formulation remained physically stable under different storage conditions, including room temperature and elevated temperature. No significant changes were observed in color, odor, consistency, or phase separation. This indicates good compatibility among the ingredients and ensures longer shelf life of the product.

Hair Growth Activity

The hair growth activity was evaluated through regular application of the herbal oil over a period of 2–4 weeks. The results showed a noticeable reduction in hair fall, improvement in hair texture, and enhanced shine and smoothness. A slight increase in hair length was also observed. These effects may be attributed to the synergistic action of bioactive compounds present in ingredients such as fenugreek, hibiscus, neem, and moringa, which nourish the scalp, improve blood circulation, and strengthen hair follicles.

Spreadability
The formulation exhibited good spreadability, indicating ease of application on the scalp. Proper spreadability ensures uniform distribution of the oil, which enhances the contact of active constituents with the scalp and improves therapeutic efficacy.

Table 2: Compiled Evaluation Results of Herbal Hair Oil

Parameter	Result/Observation	Interpretation
Color	Greenish-brown	Presence of herbal constituents
Odor	Pleasant herbal aroma	Good acceptability
Appearance	Clear, no impurities	Proper formulation
pH	6.0 – 6.5	Suitable for scalp
Viscosity	Moderate	Good spreadability
Specific Gravity	0.90 – 0.95	Standard range
Acid Value	Low	Indicates stability
Saponification Value	Acceptable range	Good oil quality
Skin Irritation	No irritation observed	Safe for use
Stability	No changes observed	Stable formulation
Hair Fall	Reduced	Positive effect
Hair Texture	Improved	Conditioning effect
Hair Length	Slight increase	Growth promotion
Shine & Smoothness	Increased	Nourishing effect
Spreadability	Good	Easy application

The results of the present study demonstrate that the formulated herbal hair oil possesses desirable physicochemical properties, good stability, and excellent safety profile. The observed improvement in hair growth parameters indicates that the formulation is effective and may serve as a promising natural alternative for hair care management.

DISCUSSION:
The findings of the present study demonstrate that the developed polyherbal hair oil exhibits significant potential in promoting hair growth and improving overall hair health. The effectiveness of the formulation can be attributed to the synergistic interaction of its individual components, each contributing specific therapeutic benefits.

The base oils, namely coconut oil, olive oil, and castor oil, played a fundamental role in providing essential fatty acids and deep nourishment to the scalp. Coconut oil enhances protein retention in hair, olive oil offers antioxidant protection and conditioning effects, while castor oil, rich in ricinoleic acid, is known to improve blood circulation and stimulate hair growth. The incorporated herbal ingredients significantly contributed to the therapeutic efficacy of the formulation. Fenugreek helped in reducing hair fall and strengthening hair roots due to its rich protein and nicotinic acid content. Hibiscus acted as a natural hair growth promoter and prevented premature greying. Neem provided potent antimicrobial activity, thereby maintaining scalp hygiene and preventing infections. Shikakai functioned as a natural cleanser and conditioner, improving hair texture and shine. Moringa supplied essential nutrients and antioxidants that nourish hair follicles and improve hair strength. Orange peel contributed to scalp health and enhanced hair shine, while aloe vera provided hydration, soothing effects, and anti-inflammatory action. Peppermint oil improved blood circulation in the scalp and stimulated hair follicles, thereby enhancing hair growth.

The physicochemical evaluation confirmed that the formulation possesses desirable properties such as appropriate viscosity, suitable pH, and good stability. The absence of skin irritation further supports its safety for topical application. The observed improvement in hair growth parameters may be attributed to enhanced scalp nourishment, improved microcirculation, and strengthening of hair follicles. Thus, the integration of traditional herbal knowledge with scientific formulation approaches resulted in stable, safe, and effective hair oil with promising hair growth–promoting activity.

CONCLUSION:
The present study successfully formulated and evaluated polyherbal hair oil using a combination of natural oils and medicinal plant extracts. The formulation method was simple, economical, and suitable for large-scale production, making it feasible for commercial application. The evaluation results confirmed that the prepared formulation possesses acceptable physicochemical characteristics, including suitable pH, moderate viscosity, and good stability under various storage conditions. The formulation was found to be non-

irritant and safe for topical use. The hair growth study demonstrated significant improvement in hair condition, including reduction in hair fall, enhancement in hair texture, and increase in hair growth upon regular application. These beneficial effects can be attributed to the synergistic action of herbal ingredients, which provide essential nutrients, improve scalp health, and stimulate hair follicles.

In conclusion, the formulated polyherbal hair oil represents a safe, effective, and natural alternative to synthetic hair care products. It holds promising potential for use in hair growth promotion and scalp health management, and further clinical studies may be conducted to validate its efficacy on a larger scale.

CONFLICT OF INTEREST:

The authors declare that there are no conflicts of interest regarding the publication of this research work.

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