Review Article

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Botanical Medicinal Oils for Hair Care and Scalp Health

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Abstract

Hair plays a significant role in human appearance, influencing self-esteem and social interactions. This study explores the efficacy of botanical oil scalp massages as a natural and effective method for promoting hair health and growth. Oil therapy, a traditional practice rooted in various cultures, has been used for centuries to strengthen hair, prevent split ends, and minimize breakage. Recently, there has been a resurgence of interest in natural remedies, particularly botanical oils rich in vitamins, essential fatty acids, and antioxidants. This review highlights the potential of these oils in enhancing hair health and growth, focusing on their unique properties and benefits. Specific oils, such as coconut oil and argan oil, are examined for their roles in improving hair strength and resilience. Additionally, the study investigates the mechanism of scalp massage, emphasizing its ability to enhance blood circulation and deliver essential nutrients to hair follicles. Improved blood flow is crucial for nourishing hair roots, creating an optimal environment for hair growth and vitality. As more individuals shift toward sustainable and organic personal care products, the importance of botanical oil scalp massages as a natural remedy for hair health becomes increasingly relevant. This study aligns with the growing trend of integrating environmental consciousness with self-care practices, offering a holistic approach to hair care. By exploring the applications and benefits of botanical oils, this review contributes to the expanding body of knowledge on natural wellness solutions, encouraging the incorporation of nature into personal care routines.

Keywords: Medicinal Oil, Hair Care, Scalp hygiene.

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1. Introduction

One of the most significant aspects of human beauty is hair, which plays a crucial role in self-esteem and overall appearance. Healthy hair not only complements facial aesthetics but also serves as a visual reflection of one's personality and lifestyle. However, various factors such as genetic predispositions, hormonal imbalances, nutritional deficiencies, and environmental stressors can compromise hair health, leading to common issues like dryness, brittleness, and hair loss. In recent years, there has been a surge of interest in natural remedies for hair care, with botanical oils emerging as a promising solution (1). Botanical oils offer an approach to hair care, harnessing nature's remedies to nourish hair follicles, stimulate blood circulation, and improve overall hair health. These oils are abundant in essential fatty acids, vitamins, and antioxidants, effec-

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tively addressing various hair concerns, from dryness to scalp inflammation. By stimulating blood circulation and nourishing hair follicles, scalp massages with these oils can contribute to stronger, healthier hair. Each botanical oil possesses distinct characteristics contributing to hair health, including moisturizing effects, anti-inflammatory properties, and the ability to nourish the scalp. This study delves into the efficacy of various botanical oils in achieving these benefits(2, 3).

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Hair growth occurs through follicles within the skin that originates in the epidermal layer and comprises three distinct parts: infundibulum, isthmus, and inferior segment. All of these components contributes significantly to overall health and functionality of the hair (4, 5).

Adjacent to the hair bulb are sebaceous glands, which are responsible for secreting essential oils, known as sebum. This natural oil is vital for protecting the hair, as it forms a hydrophobic barrier that prevents moisture loss and shields the hair from environmental damage. By maintaining optimal hydration levels, sebum contributes to the hair's overall strength, shine, and resilience against external stressors (6, 7).

The hair shaft itself consists of two primary structures: the inner medulla, which is the core of the hair, and the cortex, which surrounds the medulla and provides the hair with its strength and color. The integrity of these structures is essential for healthy hair, as any damage can lead to issues such as brittleness and breakage (4).

Hair follicles undergo a cyclical process of hair production that is divided into several phases: the first phase is anagen (growth phase), catagen (transition phase), the next one is telogen phase (resting phase), and the last one exogen phase (shedding phase). During the anagen phase, which can last for several years, the hair actively grows and is nourished by the surrounding blood supply. The catagen phase is a short transitional period where growth ceases, and the follicle begins to shrink. Following this, the telogen phase occurs, during which the hair rests and is not actively growing. Finally, in the exogen phase, the old hair falls out, making room for new growth (4, 8, 9).

Herbal hair oils are gaining recognition as natural alternatives in hair care due to their numerous benefits and minimal side effects (10, 11). These formulations often consist of a blend of botanical ingredients, such as amla, hibiscus, aloe vera, and various essential oils (12, 13). Preparation methods like decoction and boiling are employed to combine multiple herbs, resulting in polyherbal formulations (11, 13).

Common benefits associated with herbal hair oils include promoting hair growth, reducing hair fall, preventing graying, and combating dandruff (11, 12). To ensure quality and safety, these formulations are evaluated for various parameters such as specific gravity, viscosity, pH, and skin irritation (10, 11). The primary objective of these herbal hair oils is to provide essential nutrients, vitamins, antioxidants, and proteins necessary for maintaining healthy hair and scalp (11, 12).

In conclusion, herbal hair oils offer a natural and holistic approach to hair care, addressing multiple hair concerns while emphasizing safety and efficacy. Their growing popularity can be attributed to the increasing demand for natural alternatives in personal care that prioritize both effectiveness and well-being.

2. Material and Methods

This article comprehensively reviews the existing literature and published studies, focusing on various plants whose oils have been employed in hair oil therapy throughout history. This investigation aims to compile a selection of these plants, highlighting their significance in traditional and contemporary practices. Each plant's therapeutic applications, including their benefits and potential uses, are systematically detailed in Table 1. By examining these references, we aim to provide a clearer understanding of these botanical oils' historical and medicinal value in hair care,

thereby contributing to the ongoing discourse in herbal medicine and cosmetic science. The keyword "botanical oil in hair care" was searched over PubMed and Google Scholar and the important and most repeated botanical oils were collected in Table 1. From 1982 until 21 august 2024 (2, 3, 8, 14-67).

3. Introduction to several beneficial oils for hair strengthening

In general, plant oils exhibit remarkable properties for hair growth and strengthening. They improve hair color and shine, increase resistance to stretching, and provide essential nutrients for hair growth. Additionally, they enhance blood circulation in the scalp, offer moisturizing and hydrating benefits, and create a protective barrier for the hair against UV light (2, 14).

4. Mode of operation of plant oils on hair

The application of plant oils can significantly influence these processes by enhancing blood circulation in the scalp, providing vital dietary components, like vitamins, minerals, and fatty acids, and enhancing the overall well-being of hair follicles and regeneration of the scalp. These oils can also promote the anagen phase, resulting in a higher concentration of hair density and reduced hair loss (2, 67).

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Table 1. In this table, the uses and scientific names of several important oils are categorized.

Oil	Scientific name	Family	Applications	Ref.
Coconut oil	*Cocus nucifera* L.	Arecaceae	Hydration, strengthening, repairing hair damage, preventing frizz, moisturizing effect, preventing protein loss, antibacterial and antifungal activity	(2, 3, 15, 17, 27-30, 68)
Onion oil	*Allium cepa* L.	Liliaceae	Avoid dandruff and hair loss, induce hair growth	(8, 31)
Argan oil	*Argania spinosa* (L.) Skeels	Sapotaceae	Repair, antioxidant, shine, heat protection, sebostatic, moisturizing effect	(16, 18, 27, 32-34)
Castor oil	*Ricinus communis* L.	Euphorbiaceae	Strengthens roots, increases hair growth, moisturizing effect, nourishing, antibacterial and antifungal activity, lubricate the shaft, flexibility increasing, antidandruff	(19-21, 27)
Almond oil	*Prunus amygdalus* Batsch.	Rosaceae	Softening, nourishing, reducing dandruff, protecting against ultraviolet (UV) damage, strengthening the hair, used as a scalp treatment	(2, 22, 23, 27, 68)
Olive oil	*Olea europaea* L.	Oleaceae	Hydration, hair regrowth, strengthening, reducing scalp inflammation, reduction of scales, stabilization of hair shedding, emollient function, antifungal effect, protection against UV	(16, 24, 25, 27, 32)
Lavender oil	*Lavandula angustifolia* L.	Lamiaceae	Stimulating blood circulation, hair growth	(16, 26, 35)
Rosemary oil	*Rosmarinus officinalis*	Labiatae	Strengthening the roots, effective for androgenetic alopecia, stimulating hair follicles, reducing hair loss, antioxidant, antimicrobial, enhancing microcapillary perfusion, increasing hair growth	(8, 16, 35-37)
False daisy oil	*Eclipta alba* L.	Asteraceae	Promoting hair growth, hair loss prevention, maintaining hair black	(38-41)
English walnut oil	*Juglans regia* L.	Juglandaceae	Growing healthy hair, avoiding dandruff, scalp itching, antibacterial activity, UV-protective effect, increasing blood circulation	(8, 42, 43)

Continued Table 1.

Amla oil	*Phyllanthus emblica* L.	Euphorbeaceae	Provides nutrition to the hair, darkening of hair, stimulates hair growth, prevents premature graying of hair, and antibacterial and antifungal activity	(8, 27, 44-46, 68)
Mustard oil	*Rhamphospermum nigrum* L. Al-Shehbaz	Brassicaceae	Protection against UV, antibacterial, antioxidant, and antifungal activity	(27, 44, 47)
Fenugreek oil	*Trigonella foenum graecum* L.	Fabaceae	Androgenetic alopecia, antibacterial, emollient function, antidandruff, pityriasis sicca and antifungal activity	(27, 48-53)
Sesame oil	*Sesamum indicum* L.	Pedaliaceae	Anti-inflammatory properties, antioxidant, protection against ultraviolet (UV) damage, moisturizing agent, antibacterial effect, hair smoothing, hair growth	(2, 27, 54, 55)
Moringa oil	*Moringa oleifera* Lam.	Moringaceae	Strengthening the hair, photoprotective potential, antioxidant, antibacterial, moisturizing the scalp	(2, 56, 57)
Garlic oil	*Allium sativum* L.	Amaryllidaceae	Increases capillary skin perfusion, promoting hair growth, an antibacterial effect	(2, 16, 58)
Pumpkin seed oil	*Cucurbita pepo* L.	Cucurbitaceae	Hair growth, reducing hair loss 5- alpha reductase antagonist, antioxidant, antiandrogenic effect	(2, 16, 36, 59-62)
Tea tree oil	*Melaleuca alternifolia*	Myrtaceae	Anti-inflammatory properties, treat androgenic alopecia, antidandruff, antimicrobial antibacterial, antiviral, and anti-fungal properties improvement of hair damage	(15, 16, 63)
Cedarwood oil	*Cedrus* sp.	Pinaceae	Tightening the follicles, facilitating hair regrowth and recovery, cleaning the scalp, anti-dandruff, enhancing the circulation of the scalp	(2, 35, 37)
Miracle Fruit Oil	*Synsepalum dulcificum* (Schumach. & Thonn.)	Sapotaceae	Reduces hair breakage, treats damaged hair, is waterproof, antioxidant, lubricates, moisturizes, strengthens, protects the hair, smoothing the cuticle cracks	(64, 66)
Betel Leaves oil	*Piper betle* L.	Piperaceae	Rapid hair growth lowers hair loss, prevents dandruff, hair thinning, and dry scalp, treats premature grey hair, strengthening the hair strands' split ends	(2, 65, 67)

Research has demonstrated that plant oils can penetrate hair fibers, with a particular affinity for the lipid-rich cell membrane complex. The efficacy of this penetration is influenced by the chain length and degree of unsaturation of fatty acids, with shorter and more unsaturated chains exhibiting higher penetration rates. These oils have been shown to enhance hair's fatigue strength and resistance to heat damage, highlighting their potential for improving hair health (69, 70).

Nanoemulsions containing plant oils, such as coconut and ojon oil, have been developed to repair chemically damaged hair, resulting in improved mechanical properties and thermal stability (70, 71). The unique fatty acid composition of various plant oils and kinds of butter can impact several hair properties, including combing force, gloss, and split end formation. While most oils and butter tested did not affect hair tensile properties, they generally enhanced wet combing and increased hair gloss (72). Collectively, these findings suggest that plant oil-based treatments can effectively improve hair health and appearance through multiple mechanisms, offering a promising avenue for developing natural hair care products.

The absorption mechanisms of microingredients in herbal oils for scalp therapy involve various pathways. Topical application on the scalp is a primary method, with the unique anatomical features of the scalp facilitating the absorption of therapeutic agents (73). This route effectively addresses head and neck ailments, as well as psychosomatic disor-

ders.

Herbal hair oils, containing ingredients such as Bhringraj and Amla, function by nourishing the scalp, promoting blood circulation, and providing antimicrobial benefits (74). Essential oils within these formulations possess antioxidant, anti-inflammatory, and antimicrobial properties; however, their complex actions on the scalp and hair shaft remain to be fully elucidated (75).

Furthermore, topical application allows for localized effects and transdermal absorption, enabling therapeutic compounds to penetrate the skin barrier and exert systemic effects. The synergistic interaction among various essential oil constituents can amplify therapeutic outcomes in aromatherapy applications.

In summary, the absorption pathways of herbal oils for scalp therapy involve a combination of localized effects, transdermal absorption, as well as the synergistic interactions of essential oil components. Continued research into these intricate processes will contribute to a deeper understanding of the therapeutic potential and optimal use of herbal oil-based treatments for scalp and hair health.

5. Benefits and potential limitations of using herbal oils in therapy

The utilization of plant oils as extracts from the natural environment presents a multitude of advantages. The historical application of plants as hair enhancers extends back to ancient civilizations, establishing a long-standing tradition. There is a notable increase in public acceptance and tolerance toward plant-based products, largely due to the renewability of these resources. These resources can be cultivated with relative ease, and the potential for biotechnological manipulation to enhance the yield of active compounds exists. Furthermore, these substances typically demonstrate fewer adverse effects and are perceived as safer alternatives to conventional pharmaceutical interventions. As a result, there is a growing demand for plant-based products, which underscores a promising trajectory for economic growth in this sector in the foreseeable future (2, 3, 67, 68).

Herbal therapies, including essential oils, have gained popularity for treating various conditions. However, they are not without potential adverse effects and limitations. Allergic reactions, such as contact dermatitis and IgE-mediated symptoms, are known risks associated with their use (76). Some herbal remedies may contain toxic substances like arsenic or mercury, leading to skin lesions and organ toxicity affecting the liver, kidneys, and heart (77). Essential oils, while showing promise in managing some health conditions, can have sensitizing effects and must adhere to consumer safety regulations, such as those mandated by the European Union (78). Additionally, adulteration of herbal products with steroids poses a significant concern (76). However, more systematic research is needed to comprehensively understand the efficacy and safety of herbal oil therapies. As interest in natural remedies continues to grow, it is crucial to strike a balance between embracing their potential benefits and acknowledging their potential risks and limitations.

6. Some recent innovations in herbal oil extraction

Herbal oil extraction is a process used to obtain essential oils, fixed oils, and other aromatic compounds from plants, which could be used in aromatherapy, cosmetics, medicine, and food industries. Old methods like hydrodistillation and steam distillation, in which water or steam is passed through plant material, although it's cost-effective and preserves the aromatic compounds effectively, but it's not suitable for heat-sensitive plants (79). And cold press method (Expression), that plant material is mechanically pressed to release the oils without the use of heat, also it is cost-effective and heat-free but only has application in special plants (80). Solvent extraction

method uses solvents like hexane or ethanol to dissolve the essential oils, that solvents may remain in the oil, posing health risks, and also is expensive and requires specialized equipment (81). Enfleurage method is an expensive and not suitable for large-scale production that, plants are placed on a layer of fat to absorb their essential oils (82). Maceration also is an old method that plant material is soaked in a carrier oil to extract its essential oils. Then the mixture is heated and strained to separate the oil (83). In this paragraph, some traditional methods of extracting plant extracts and oils were mentioned. Below, we will discuss some modern methods and the advantages of each of these techniques.

6.1. Ultrasonic-Assisted Extraction (UAE)

Ultrasonic waves are used to break down plant cell walls, releasing the essential oils. This method is often combined with solvents or water. It is a fast method that is suitable for heat-sensitive compounds. But it is a small scale method that requires specialized equipment (84, 85).

6.2. Microwave-Assisted Extraction (MAE)

Microwave energy is used to heat the plant material, causing the cell walls to rupture and release the essential oils. It is a fast method which reduces solvent usage. But may cause degradation of heat sensitive compounds (86, 87).

6.3. Hydrodiffusion and Gravity (HDG)

It is a modern extraction method that uses steam and gravity to extract essential oils from plant materials. In this process, steam is introduced from the top of the extraction chamber, and the essential oils are carried downward by gravity along with the condensed water. The mixture is then collected and separated into oil and water phases. Operates at lower temperatures compared to steam distillation, preserving heat-sensitive compounds, and uses less energy because it relies on gravity to move the steam and oils. Some of the disadvantages of this method are needing specialized equipment and time-consuming but suitable for both small-scale and industrial applications (88, 89).

6.4. Supercritical Fluid Extraction (SFE)

This method uses carbon dioxide under high pressure and low temperature to extract oils. The CO_2 acts as a solvent, and when the pressure is released, it evaporates, leaving behind pure oil. This high-quality method is without any solvent residues, which preserves heat-sensitive compounds. But it is an expensive equipment and operational costs also it's not suitable for large-scale production (90, 91).

6.5. Enzymatic extraction

Enzymatic extraction is ideal for high-quality methods but is not yet widely used due to cost and difficulty. It is an environmentally friendly method that suit to heat sensitive plants (92, 93).

These are some of the most popular ways to extract herbal oil nowadays that with considering each of benefits choose which one should use (94-97).

7. Some environmental impact of using herbal oils

The cultivation and harvesting of specific plants can result in a loss of biodiversity. Practices such as deforestation, monocropping, and the overharvesting of wild species contribute to the unsustainable production of essential oils, increasing the risk of more species in critical condition being added to the red list of endangered species. The manufacturing of essential oils is highly resource-intensive. This elevated demand for raw materials can lead to the overexploitation of plant resources, further stressing the environment. Additionally, increased pesticide use can be detrimental to human health. Greater cultivation can also result in more water contamination and soil degradation. These practices generate significant waste and energy consumption, contributing to increased carbon dioxide emissions and global warming (98-100).

8. The efficacy of oils derived from herbal extracts in clinical and animal studies

Several clinical and animal studies have been conducted to evaluate the efficacy of oils derived from herbal extracts. However, for many oils, there are still no reliable and valid studies conducted under predetermined conditions with placebos and control groups. This indicates a significant potential for further research in this area. Nevertheless, a summary of some of the studies that have been conducted is provided below.

For example, significant examinations show that aromatherapy had really influence on alopecia areata and 44% of patients show improvement compared to 15% of patients in the control group (101). In another study, the effect of rosemary oil compared to minoxidil was examined after 6 months, and each group showed a major increase in hair count (102). In another study anti-bacterial effect of coconut oil against some bacteria include Escherichia coli, Proteus vulgaris, Pseudomonas aeruginosa, and Bacillus subtilis measured, coconut oil could degenerated the lipid membrane in different types of bacteria (27, 29).

Onion oil has been researched for its potential to encourage hair regrowth and address hair loss. A clinical study showed that applying onion juice topically led to notable regrowth in patients with alopecia areata, likely due to its high sulfur content and its capacity to improve circulation to the scalp. The regrowth of terminal coarse hairs commenced following two weeks of treatment with crude onion juice. After four weeks, hair re-growth was documented in 17 patients (73.9%), and at six weeks, hair re-growth was noted in 20 patients (86.9%) (103).

Argan oil is rich in antioxidants and fatty acids, which may support hair health. A study highlighted its moisturizing properties, which can reduce hair breakage and improve overall hair condition. Its linoleic acid and oleic acid help prevent hair loss. Additionally, argan oil contains tocopherol, which protects hair from UV damage. Some studies in mice have shown a promotion in hair growth (104).

Ricinoleic acid content in caster oil may improve blood circulation to the scalp, potentially aiding in hair growth (105). Olive oil is recognized for its moisturizing properties and potential to reduce dandruff. A study indicated that topical application of olive oil can help in treating dandruff by providing hydration to the scalp. Using oleuropein in olive on mice induces hair growth (106). Lavender oil has been studied for its potential to promote hair growth. A study demonstrated that topical application of lavender oil could induce hair growth in mice, possibly due to its anti-inflammatory and antimicrobial properties (26). Rosemary oil has been shown to improve hair growth and may be effective against androgenetic alopecia. A randomized trial found that rosemary oil was as effective as minoxidil in promoting hair growth (107, 108).

Amla oil is rich in vitamin C and antioxidants, which may help in preventing hair loss and greying. Some studies suggest that it can strengthen hair and promote growth, although comprehensive clinical trials are lacking. Fenugreek oil has shown the potential to promote hair growth and reduce dandruff. Although some studies indicated that its application could improve scalp health as well, more research need to be proven. Pumpkin seed oil has been linked to improved hair growth in some studies, potentially due to its high zinc content, which is important for hair health (109).

9. Discussion and Conclusion

This study used articles from different literature databases for example Scopus, PubMed, and Google Scholar, as well as a manual search. These findings indicate that incorporating essential oils into treatment regimens may provide a complementary strategy to conventional therapies. The mechanisms through which aromatherapy exerts its effects are still under investigation. Still, it is recom-

mended that the anti-inflammatory properties of certain essential oils could significantly contribute to promoting hair regrowth. In conclusion, this review posits that botanical oil scalp massages represent a promising approach to hair care, combining traditional wisdom with a contemporary understanding of hair health. The findings suggest that integrating these practices into regular hair care routines may yield significant benefits, supporting the cosmetic and psychological aspects of hair health. Additionally, the psychological benefits of aromatherapy, such as reduced stress and anxiety, may further enhance its effectiveness in managing alopecia areata, as emotional well-being is linked to hair health. As patients and practitioners increasingly seek holistic treatments, the growing body of evidence supporting aromatherapy could lead to more integrative approaches in dermatology. Future studies with larger sample sizes and rigorous methodologies are crucial to solidifying these findings and acquiring a more profound insight into the potential of aromatherapy in managing alopecia areata.

The utilization of plant oils as extracts from the natural environment presents a multitude of advantages that are increasingly recognized in both scientific and commercial contexts. The historical application of plants as hair enhancers extends back to ancient civilizations, establishing a long-standing tradition that underscores their cultural significance and efficacy. Various cultures have employed botanical substances for their beneficial properties, which reflects a deep-rooted understanding of natural remedies.

This article has elucidated the exceptional properties of plants, which are characterized by their minimal side effects and widespread acceptance among consumers because there is a notable increase in public acceptance and tolerance toward plant-based products, largely due to several factors, a significant reason is the renewability of these resources. Plant oils can be cultivated with relative ease, making them a sustainable choice in contrast to synthetic alternatives. This aspect not only contributes to environmental sustainability but also supports agricultural economies by providing farmers with viable crops that can be cultivated year-round. Furthermore, advancements in agricultural practices and biotechnological innovations have opened avenues for the manipulation of plants to enhance the yield of active compounds.

The therapeutic advantages of essential oils were examined in detail, revealing their calming effects alongside their capacity to fortify roots of hair and improve blood flow to the scalp, thereby promoting hair growth.

Moreover, various plant species offer distinctive benefits; some demonstrate antioxidant properties, while others exhibit antibacterial and antifungal activities. Certain oils contribute to hair elasticity and smoothness, while others protect against harmful UV radiation.

In conclusion, the efficacy of plant-based oils presents reliable and promising solutions for integration into diverse skincare formulations tailored to consumer demands. This not only signifies a promising future in this domain but also highlights substantial potential for economic investment. The findings emphasize the necessity for continued research and development to fully leverage these natural resources for health and beauty applications, ultimately leading to innovative products that meet the increasing consumer preference for safe and effective natural alternatives.

Conflict of Interest

The authors declare that they have no conflict of interest.

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