

Botanical Remedies Explored: Investigating Natural Essential Oils for Alopecia Management

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ABSTRACT

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Alopecia, characterized by hair loss from the scalp or body, presents a significant challenge affecting the individuals' physical appearance and emotional well-being. Presently, several prescription drugs (finasteride) and over-the-counter drugs (minoxidil) are used to treat different types of alopecia. However, these synthetic drugs deal with limitations such as allergic contact dermatitis, burning, ejaculation dysfunction, and diminished libido. To overcome these challenges, Botanical remedies, particularly natural essential oils and essential oils, are gaining popularity as potential therapeutic agents for managing alopecia. Thus, this review paper explores the efficacy of natural essential oils in managing different types of alopecia through a comprehensive review of existing literature, research studies, and clinical trials. Various essential oils, including lavender, rosemary, peppermint, and cedarwood, are investigated for their potential mechanisms of action, such as promoting hair growth, reducing inflammation, and improving scalp health. Additionally, factors influencing the effectiveness of essential oils, such as concentration, formulation, and application methods, are discussed. The findings suggest that natural essential oils hold promise as adjunctive treatments for alopecia, offering a safe and potentially effective alternative to conventional therapies. However, further research, including clinical trials and standardized formulations, is warranted to elucidate their optimal use and efficacy in clinical practice. Thus, the review provides valuable insights into the potential role of botanical remedies in alopecia management and underscores the importance of exploring natural therapies for addressing dermatological conditions.

INTRODUCTION

Hair loss disorders consist of many abnormalities of varying aetiology called alopecia, seen in the general population. Even if this condition doesn't affect life, it affects confidence and overall personality (1). Androgenetic alopecia (AGA) is one of the most frequent types of alopecia, characterized by progressive terminal scalp hair loss with a

specific distribution pattern in genetically susceptible persons. Dihydrotestosterone (DHT) is thought to be the most powerful cause of AGA. Alopecia areata (AA) is a prevalent chronic, tissue-specific autoimmune disease that causes hair loss.

Available therapies for AA, including corticosteroids, immunomodulators, minoxidil,

and contact immunotherapy, have little efficacy and a significant risk of severe effects (2). The FDA has authorized topical minoxidil for the treatment of AGA and female pattern hair loss. However, oral finasteride is only approved for AGA (3). The recommended therapy is 1mg of oral finasteride and 5% topical minoxidil for males or 2% topical minoxidil for women (4).

These drugs have moderate results, require long-term usage, and may cause side effects (5). Essential oils are completely natural items that have been used for thousands of years. They have been used for medicinal and health purposes throughout history and are making a resurgence as an economical and safe way to treat a wide range of mental and physical problems. Rosemary essential oil is an excellent choice for individuals who have sensitive skin or experience skin and scalp discomfort. This essential oil has been shown to aid with testosterone-related hair loss, including male pattern baldness.

When used consistently, its antifungal and antibacterial qualities cleanse the scalp and help prevent hair loss. 2015 research evaluated the benefits of rosemary and Minoxidil over a 6-month period and discovered that while both promoted hair growth, those who used rosemary had a less itchy scalp at the end. If you have an itchy scalp and want to develop more hair, consider taking rosemary. Lavender essential oil has been used for thousands of years to promote healthy hair and reduce baldness, and it works well for both dry and oily scalps. In 2016, a study found that applying lavender essential oil to mice resulted in a significant increase in hair growth over a four-

ETIOLOGY/PATHOPHYSIOLOGY OF ALOPECIA

Alopecia is the lack or loss of hair in an area where it is normally present. Alopecia can be localized or widespread, transient or

permanent, and affects both sexes and all ages. This condition is a sign or symptom caused by a variety of etiologies and is categorized into

week period, as well as deeper and denser hair follicles (6). Ancient plant remedies have been used to control hair fall for a long time, but only some are scientifically proven to prevent hair fall positively (7). Hair follicles are holes in the scalp where matrix cells multiply continuously to generate hair, the hair development cycle consists of various stages. In a normal scalp, the hair cycle is classified as the anagen phase, in which consistent hair growth occurs and is left over 3-6 years. The second one is the catagen phase, which begins after the anagen phase; in this phase, hair starts to lose its diameter and contract the growth activity. The phase lasts over 3-4 weeks. The third one is the telogen phase, in which the hair starts falling out and is replaced by new hair; this phase lasts over 3-4 months.

The hair cycle repeats about 10-20 times in the average lifespan of a person (8). Essential oils can act on the skin's cellular function when applied topically on the scalp. At the same time, they dispense anti-inflammatory and antibacterial activity and boost hair shaft density, cleaning and strengthening of the stem system (9). Rosemary oil has unique biological qualities, such as vasodilation, by which the blood flow in the scalp increases, and has antimicrobial, antioxidant and cytotoxic effects (10). Lavender oil provides a base to treat hair loss by stimulating hair growth and is also compared to the 3% minoxidil treatment (8). It has been shown that pumpkin seed oil can inhibit 5-alpha reductase and has antiandrogenic properties (11).

permanent, and affects both sexes and all ages. This condition is a sign or symptom caused by a variety of etiologies and is categorized into

two types: nonscarring (the most frequent) and scarring (cicatricial) (21).

Androgenic alopecia: A potent androgen known as dihydrotestosterone (DHT) is created when testosterone is metabolized in the gonads and other areas of the body, including the liver and brain, by a metabolic enzyme called 5-alpha reductase. Approximately 10% of testosterone generated in the body is turned to



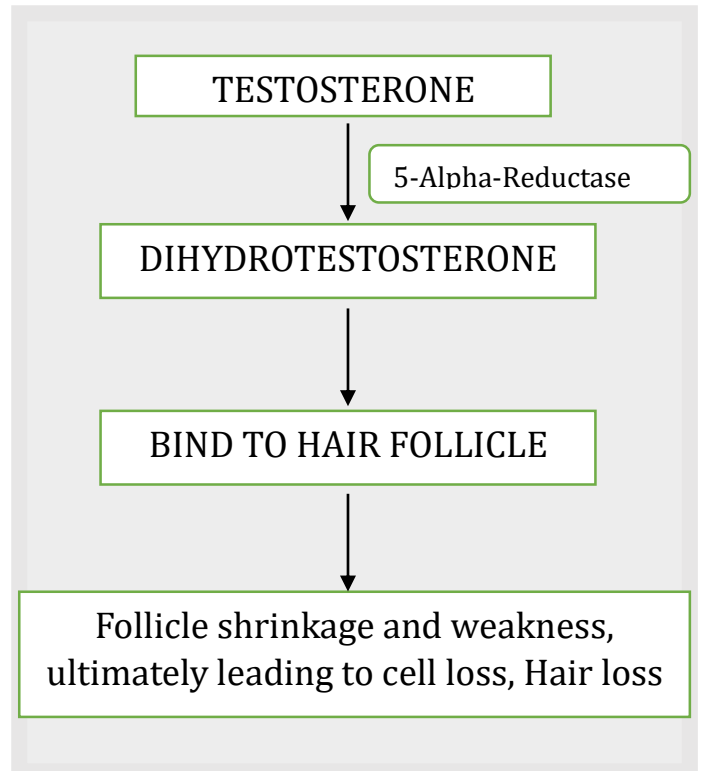
Fig 1: Androgenic Alopecia

Alopecia Areata: The pathophysiology of alopecia areata is not exactly known till now, but it indicates the thesis that the AA is caused by an autoimmune reaction mediated by the T-cells to the follicle (hair follicles). It is obliged that this autoimmune condition arises due to the genetic and environmental factors of the individual (14-15).

KEY POINTS

- In the growth phase, the hair follicles are in the immune affluent site, so these are discontinued in AA.

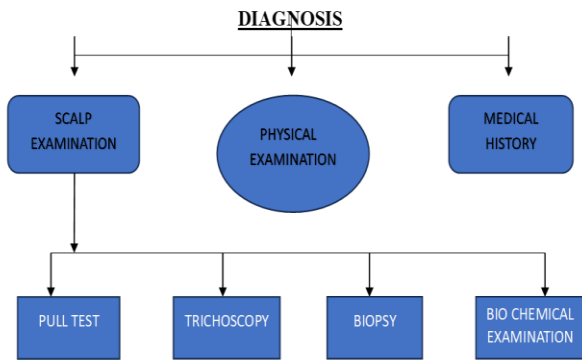
DHT. DHT, a sex steroid similar to testosterone, has a stronger binding affinity to the same receptor sites and promotes baldness more than other androgens. When androgens attach to hair follicle receptors, they produce follicle shrinkage and weakness, ultimately leading to cell loss (13).



- Then the inflammatory immune cells head to an inherited disorder of hair follicles followed by early entry into the resting phase (telogen phase) (16).



Fig 2: Alopecia



DIFFERENT TYPES OF ALOPECIA AND THEIR BIOLOGICAL PATHWAY ALOPECIA

Alopecia is the medical term for hair loss. It includes hair loss in one or more body parts but mainly involves scalp. Many factors like genetic predisposition, environmental factors, chemical exposure, medication side effects, dietary deficiencies, severe stress, protracted sickness, etc., may result in hair loss.

Types of hair loss (alopecia)

1. Androgenetic or androgenic alopecia (baldness): AGA is a genetically predisposed disorder that causes androgen-dependent hair loss in both men and women. It causes symmetrical thinning of scalp hair (17). The male genital hormone testosterone is more prevalent in males than in women, which is why it primarily affects men. Unlike the recession of the hairline in men, the disorder affects women differently, with a phenotypical presentation of thinning scalp hair. A potent androgen known as dihydrotestosterone (DHT) is created when testosterone is metabolized in the gonads and other areas of the body, including the liver and brain, by a metabolic enzyme called 5-alpha reductase. Approximately 10% of testosterone generated in the body is turned to DHT. DHT, a sex steroid similar to testosterone, has a stronger binding affinity to the same receptor sites and

promotes baldness more than other androgens. It binds for 53 minutes, whereas testosterone only lasts 35 minutes. When androgens attach to hair follicle receptors, they produce follicle shrinkage and weakness, ultimately leading to cell loss. The interaction of hair follicles with androgens leads to shorter anagen longevity and longer telogen lifespan. Approximately 40% of women and 70% of men will get androgenic alopecia over their lifetime, according to Urysiak-Czubatka *et al.*, (2012). Males who do not acquire baldness typically have lower levels of the 5-alpha reductase enzyme (13).

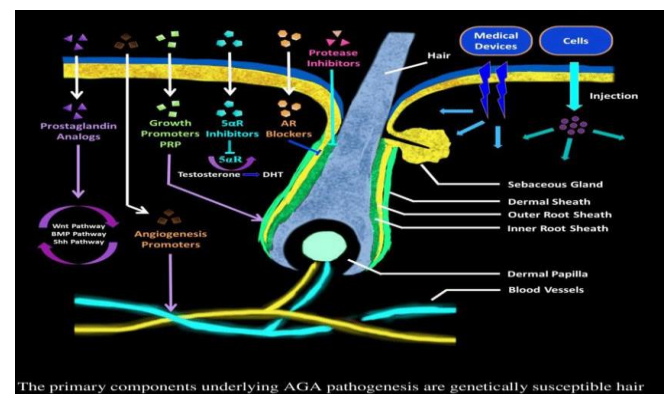


Fig 3: Biological pathway of Androgenic Alopecia

2. Alopecia areata: Alopecia areata (AA) is a dermatological illness characterized by non-scarring hair loss on the scalp and/or body, with patients experiencing unexpected and varied progression. Despite interdisciplinary attempts, its aetiology is not totally understood. However, some data shows that environmental, immunological, and genetic variables may be causing the condition (18). However, some theories also suggest that it may be an organ-explicit immune system infection that is blocked by T cells synced at hair follicles. The syndrome causes scattered bald spots on the head. If the disease is not controlled, the spots on the scalp may get larger. The illness equally afflicted men and women, while babies were the most common victims (13).

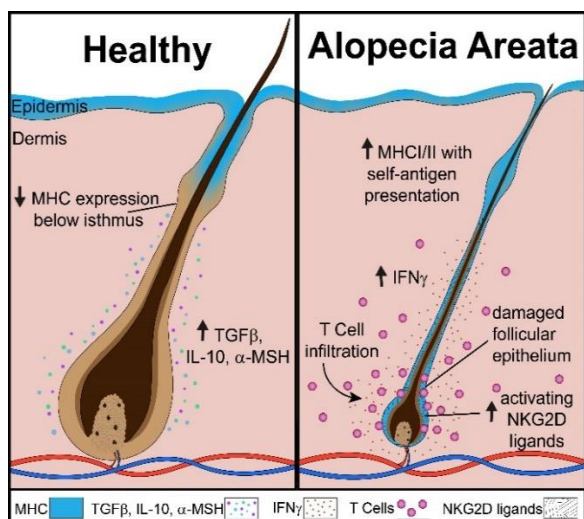


Fig 4: Biological pathway of Alopecia Areata

3. Telogen effluvium: Excessive hair loss after any stressful surgery or any troubling condition, mostly reported by women (19). Telogen effluvium occurs when hair follicles enter the dormant telogen stage prematurely, resulting in non-scarring hair loss. The condition affects the elderly, those who are physically or emotionally disturbed, and those with thyroid or hormonal imbalances. Rather than the agent itself, the degree of effluvium depends on the extent and duration of exposure to the causal agent. Telogen effluvium can be classified as critical (lasting less than six months), chronic (lasting more than six months), or chronic repetitive (13).

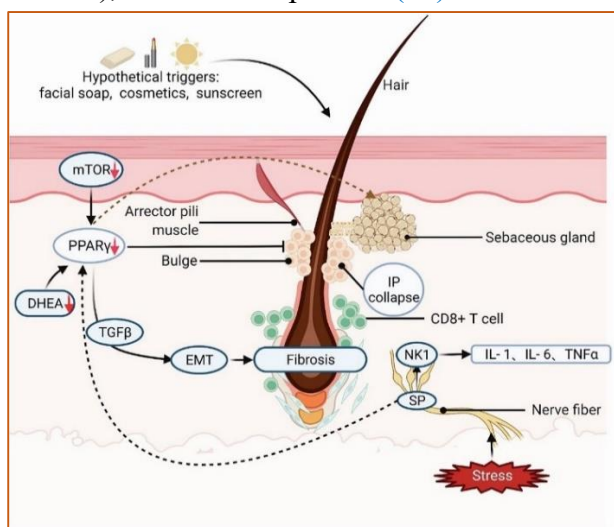


Fig 4: Biological pathway of Telogen effluvium

4. Chemotherapy-induced alopecia: A common fear associated with chemotherapy is hair loss, which leads some patients to refuse or skip treatment. Chemotherapy therapies target not just neoplastic cancer cells but also rapidly developing cell types. This triggers an attack on the keratinocytes in the fast-growing hair fibre during the active growth phase, which results in hair loss. Approximately 60% of hair matrix keratinocytes remain in the synthesis (S) stage during the anagen stage, which is the fastest time for any cell in the body to reproduce. Chemotherapeutic drugs target fast-growing malignant neoplastic cells while also eliminating fast-growing keratinocytes in the hair matrix during the anagen growth phase. As a result, follicles in the anagen stage experience a quicker dystrophic catagen phase, which leads to hair breakage and darkening. Chemotherapy causes 90% of scalp hairs to transition from anagen to telogen, resulting in club hair without replacement. In the hair cycle, this results in prolonged telogen and shorter anagen phases. Hair that is lost due to chemotherapy often comes back when the patient stops taking the drug since the treatment normally has little effect on cycling follicular stem cells, which develop new hair follicles that subsequently produce new hair strands. To maintain healthy hair follicles during chemotherapy, telogen arrest and catagen suppression are necessary treatment strategies. Treatment with medicines that prevent follicular keratinocyte apoptosis might resolve this issue (13). Many plants have been found to provide effective treatment with few side effects as compared to pharmaceutical products (20).

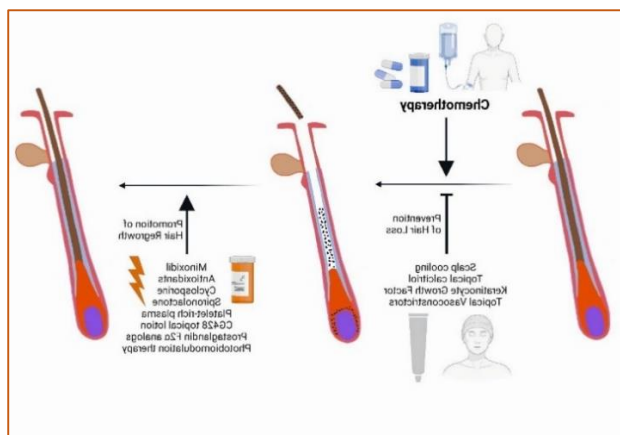


Fig 5: Biological pathway of Chemotherapy-induced alopecia.

Rosemary oil

Hair growth impact in C3H/He mice. The study examined how shaving the dorsal regions of C3H mice affected their hair development. The Rosemary oil-treated group saw significantly increased hair growth after 16 days of treatment. These studies indicate that Rosemary oil promotes hair development without affecting the androgenetic pathway. We found that Rosemary oil improved hair growth in an AGA mouse model and a hair growth activating model, inhibited 5 α R activity and DHT binding to androgenetic receptor, and identified 12-MCA as the active constituent of 5 α R and DHT-binding inhibition. Rosemary oil shows promise for treating both AGA and non-AGA. Further research is needed to understand the processes and active principle behind the hair growth impact in C3H mice (23).

Lavender oil

This study evaluated the effectiveness of lavender oil as a hair growth stimulant to 3% MXD, a US-FDA-approved medication, and aims to inform the development of hair loss remedies. To investigate the hair-growth-boosting impact of Lavender oil, morphological and histological observations were conducted on C57BL/6 mice's back skin after percutaneous administration. At week 4, the PC, E1, and E2 groups had significantly

higher hair follicle numbers, depths, and dermal thickness than the N and VC groups, indicating that LO promotes hair development (8).

Pumpkin seed oil

Ninety people aged 20-65 with mild to moderate AGA were first enrolled at a tertiary hospital in Yangsan. The individuals did not use any topical treatments, medications, or supplements for hair loss, such as finasteride, 5 α -reductase inhibitors, minoxidil, steroids, or hormonal products, in the three months before the trial began. Based on this study, participants were given pumpkin seed oil for 24 weeks. Hair counts and diameters were assessed using photolithography at baseline, 12 and 24 weeks. The intervention and control groups showed substantial differences in hair count changes after 24 weeks (21). The study suggests that PSO may improve AGA and should be investigated as an alternate therapy. Further research is needed to validate the findings of this preliminary study and understand the mechanism behind PSO's beneficial benefits on AGA.






Peppermint oil

Experiments indicate that 3% PEO promotes hair development by preserving the vascularization of the hair dermal papilla, perhaps triggering the early anagen stage. PEO has been shown to increase hair development in animal models, making it a potential alternative therapy for treating or preventing hair loss in people. Shaving, the mice's hair follicles synchronized in the telogen stage, resulting in pink hue. Animals were randomly assigned to four groups based on their topical treatment. Based on topical administration, the animals were randomized into four groups: 3% minoxidil (MXD), jojoba oil (JO), saline (SA), and 3% peppermint oil (PEO, diluted in jojoba oil). For 4 weeks, each drug (100 μ l) was





administered topically to the shaved dorsal region once day, 6 days per week. This study's animal care and methodology followed IACUC

and OECD requirements. Observe hair growth of peppermint oil Is comparatively similar to 3% minoxidil ⁽²⁴⁾

DIFFERENT TYPES OF NATURAL OILS USED IN ALOPECIA

Sr. No.	Natural oils	Figure	Mechanism
1.	Rosemary		<p>Its distinctive properties include vasodilation, which increases blood flow to the hair follicle. Rosemary oil contains rosamarinic acid and urosolic acid, which inhibit 5 alpha-reductase (20).</p>
2.	Lavender oil		<p>It improves blood circulation in the scalp, strengthens hair follicles, and inhibits 5 alpha-reductase. it stimulates hair growth as compared to therapy with 3% minoxidil (8).</p>
3.	Peppermint oil		<p>Peppermint oil may stimulate hair development by increasing the conservation of vascularization of hair dermal papilla, which may contribute to the induction of the early anagen stage of the active growth phase of hair follicles. Compared to 3% minoxidil (21).</p>
4.	Pumpkin seed oil		<p>Pumpkin seed oil prevents the synthesis of DHT, the hormone that causes hair loss. It naturally targets the hair development cycle, beginning with the catagen and telogen phases and helping to reduce excess shedding. It subsequently stimulates follicle development, initiating a new cycle of the anagen phase (11).</p>
5.	Lemongrass oil		<p>Lemongrass oil is an excellent stimulant. It helps to open up hair follicles and improves circulation. It helps to eliminate dirt and filth that get trapped inside the pores, boosting hair development (22).</p>

DETAILS ABOUT COMMERCIALLY AVAILABLE PRODUCTS

S. No	Commercially available product	Figure	Trademark	Commercial names
1.	<p>The first herb we think of when we think about hair growth is rosemary. Our superior-grade Rosemary Essential Oil, which is steam distilled from fresh rosemary in Uttarakhand, can support healthier scalps and stronger hair. Mix it into your hair masks or carrier oils to promote hair growth. Little goes a long way: Rosemary essential oil lasts a long time because you only need a few drops in carrier oil. For a consistent two-year shelf life, store it somewhere cold and dry energizing aroma is well-liked for aromatherapy as it may enhance mental clarity and relaxation (25).</p>			<p>Rosemary Essential oil</p>
2.	<p>Lavender oil, which has strong anti-inflammatory qualities, helps unclog pores and stop acne and pimples from coming back. By rubbing the oil into your scalp, you may prevent dandruff and encourage hair growth.</p> <p>100% Certified Organic, Free of Parabens, Silicon, Sulfate, and 100% Transparent. In charge. Enduring (26).</p>			<p>Organic Essential oils: Lavender</p>

<p>3.</p>	<p>One of the most adaptable oils available is peppermint essential oil, which may be utilized to treat a wide range of medical conditions. It may be used for anything from digestive issues to hair, skin, and respiratory issues. By promoting blood circulation, peppermint oil helps to maintain the health of the scalp and hair follicles, which promotes healthy hair development (27).</p>			<p>Peppermint 100% pure essential oil</p>
<p>4.</p>	<p>An underappreciated oil for haircare is pumpkin seed oil. In addition to strengthening hair strands and encouraging hair growth, it also prevents the synthesis of DHT, a hormone linked to hair loss. It also protects the hair from environmental damage, feeds the scalp, and gives it gloss and lustre (28).</p>			<p>Pumpkin seed oil</p>
<p>5.</p>	<p>The leaves and stalks of the lemongrass plant are used to obtain the 100% pure Homeda Lemon Grass Essential Oil. The essential oil of lemongrass will leave your scalp smelling fresh (29).</p>			<p>Lemongrass Essential Oil for Diffuser, Room Freshener, Hair Growth, Skin, Face</p>

FUTURE PROSPECTIVE

The essential oils are generally extracts of plants. Due to the fewer side effects and good capability, the use of essential oil has captured the inquisitiveness in contrast to the typical treatment of Minoxidil Finasteride.

So here is a comparison of essential oils with minoxidil which is going to treat alopecia., as well as their future prospects.

1. Efficacy

- MINOXIDIL: it is a deep-rooted treatment specifically for androgenic alopecia. As it stimulates the hair cycle (growth phase/anagen phase) also promotes blood flow in the hair follicles
- ESSENTIAL OILS: PEPPERMINT OIL, ROSEMARY OIL, LAVENDER OIL, CEDARWOOD have been seen undertaking the stimulation of hair growth

and cease hair loss. They perform by enhancing the circulation of the scalp, supplying nutrients to the follicles and influencing anti-inflammatory activity.

2. Side-effects

- MINOXIDIL: side effects of minoxidil are itching on the scalp, intolerant skin, dryness barrenness. In some other cases, if you are using minoxidil, it may also show undesirable hair growth on other parts rather than the scalp.
- ESSENTIAL OILS: These are most probably examined to be safe when used conveniently. But sometimes, they produce allergic reactions, like itching and barrenness. So, it is very necessary to adulterate it by making it thin and, before using it topically, perform a patch test.

3. Cost

- MINOXIDIL: It is present in the non-prescription forms, also at the same time expensive, and also extendedly used.
- ESSENTIAL OIL: Those are substantially more reasonable than minoxidil, and since they are used in lesser amounts, they might be worthwhile options.

4. Prospective Outlook

- Research: The proceeding studies are surveying essential oils for the treatment of hair loss. As many researchers have been supervising, we could also achieve the best appreciation of the mechanism of action and ideal formulations of different kinds of alopecia.
- Multimodality Treatment: The prospective for multimodality of herbal oils with other compared hair loss treatments, like minoxidil and finasteride in order to increase the effectiveness and simultaneously cease the side effects.

- Stratified Medicines: The personalised medicines or stratified proceeds towards the treatment of alopecia and might include recognising specific herbal oils that show the best results for the patients grounded on their individual pattern of hair loss and their root cause.

So, minoxidil is the general treatment for hair loss; essential oils recommend herbal replacement with the capacity and effectiveness and fewer side effects. Pursuing studies and clinical trials would contribute to clarifying their role in alopecia control. Demonstrating the ideal agreements for their use.

CONCLUSION

The investigations found that essential oils have beneficial benefits on the scalp, including anti-hair loss, anti-inflammatory, antibacterial, antioxidant, anxiety-relieving, and stimulating properties. Additionally, their lipophilic nature helps maintain a healthy microbial balance in the scalp and skin. US Food and Drug Administration has only authorised Finasteride and topical minoxidil as a treatment for male AGA.

However, it is not recommended to use these synthetic medications first safe and effective treatment of alopecia because they have many side effects. Therefore, natural medications are substituted because of lesser side effects. Plant extracts are been recently used as hair tonics or hair growth treatments, as well as for the prevention of alopecia. These extracts stimulate scalp metabolism of hair follicles due to increased blood flow, dermal papilla activation, anti-restorative activity and by improvement of nourishment of hair follicles. Due to these factors i.e., low toxicity and preference for natural sources, Essential oils are a part of most cosmetic products that promote therapeutic action on conditioning of the hair shaft and the

scalp. Rosemary oil has vasodilator properties and therefore improves blood circulation to hair follicles.

The vasodilating qualities of rosemary essential oil are also well-known for encouraging improved blood circulation in hair follicles. Studies were created to examine the clinical effectiveness of pumpkin seed oil, and its results were compared with minoxidil 5% topical foam. It is known that pumpkin seed oil

alters skin permeability and stimulates the development of hair by improving vascular formation in the dermal papilla of hair. This may aid in the first stages of hair growth and maybe a suggestive method for treating hair loss. Therefore, essential oils are a safe and effective method for the treatment of alopecia. They have fewer side effects and improve blood flow to the scalp also block DHT, finally leading to stimulation of hair growth.

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CONFLICTS OF INTEREST.

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

REFERENCE

- 1) Stough, D., Stenn, K., Haber, R., Parsley, W.M., Vogel, J.E., Whiting, D.A. and Washenik, K. (2005) Psychological effect, pathophysiology, and management of androgenetic alopecia in men. *Mayo Clin. Proc.*, 80, 1316-1322.
- 2) Guo H, Gao WV, Endo H, McElwee KJ. Experimental and early investigational drugs for androgenetic alopecia. *Expert Opin Investig Drugs*. 2017 Aug;26(8):917-932. doi: 10.1080/13543784.2017.1353598. Epub 2017 Jul 12. PMID: 28689433.
- 3) Freitas E, Nogueira M, Rosell Diaz A, Rodriguez Lomba E, Lefevre M, Alband N, Mohme S. Journal Club: A review of topical and intralesional therapeutics for different types of alopecia. *Eur J Dermatol*. 2022 Jul 1;32(4):555-556. English. doi: 10.1684/ejd.2022.4346. PMID: 36301771.
- 4) Valente Duarte de Sousa IC, Tosti A. New investigational drugs for androgenetic alopecia. *Expert Opin Investig Drugs*. 2013;22:573-89
- 5) Levy LL, Emer JJ. Female pattern alopecia: current perspectives. *Int J Womens Health*. 2013;5:541-56.
- 6) Zhitnik S. Top 5 Essential Oils That Are Perfect for Hair Growth and Loss And How to Use Them. Aug 12, 2020.
- 7) Messenger, A.G. and Rundegren, J. (2004) Minoxidil: mechanisms of action on hair growth. *Br. J. Dermatol.*, 150, 186-194. 2
- 8) Lee BH, Lee JS, Kim YC. Hair Growth-Promoting Effects of Lavender Oil in C57BL/6 Mice. *Toxicol Res*. 2016 Apr;32(2):103-8. doi: 10.5487/TR.2016.32.2.103. Epub 2016 Apr 30. PMID: 27123160; PMCID: PMC4843973.
- 9) Abelan US, de Oliveira AC, Cacoci ÉSP, Martins TEA, Giacon VM, Velasco MVR, Lima CRRC. Potential use of essential oils in cosmetic and dermatological hair products: A review. *J Cosmet Dermatol*. 2022 Apr;21(4):1407-1418. doi: 10.1111/jocd.14286. Epub 2021 Jun 23. PMID: 34129742.
- 10) Miroddi M, Calapai G, Isola S, Minciullo PL, Gangemi S. Rosmarinus officinalis L. as cause of contact dermatitis. *Allergol Immunopathol (Madr)*. 2014 Nov-Dec;42(6):616-9. doi: 10.1016/j.aller.2013.04.006. Epub 2013 Jul 1. PMID: 23827646.
- 11) Cho YH, Lee SY, Jeong DW, Choi EJ, Kim YJ, Lee JG, Yi YH, Cha HS. Effect of pumpkin seed oil on hair growth in men with androgenetic alopecia: a randomized, double-blind, placebo-controlled trial. *Evid Based Complement Alternat Med*. 2014;2014:549721. doi: 10.1155/2014/549721. Epub 2014 Apr 23. PMID: 24864154; PMCID: PMC4017725.
- 12) Al Aboud AM, Zito PM. Alopecia. [Updated 2023 Apr 16]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK538178>

- 13) Rambwawasvika H, Dzomba P, Gwatidzo L. Alopecia types, current and future treatment. *J Dermatol Cosmetol*. 2021;5(4):93-9.
- 14) Alkhalifah A, Alsantali A, Wang E, McElwee KJ, Shapiro J. Alopecia areata update: Part I. Clinical picture, histopathology, and pathogenesis. *J Am Acad Dermatol*. 2010;62:177-88.
- 15) Carroll JM, McElwee KJ, King LE, Byrne MC, Sundberg JP. Gene array profiling and immunomodulation studies define a cell-mediated immune response underlying the pathogenesis of alopecia areata in a mouse model and humans. *J Invest Dermatol*. 2002;119:392-402
- 17) Starace M, Orlando G, Alessandrini A, Piraccini BM. Female Androgenetic Alopecia: An Update on Diagnosis and Management. *Am J Clin Dermatol*. 2020 Feb;21(1):69-84. doi: 10.1007/s40257-019-00479-x. PMID: 31677111.
- 18) Motofei IG, Rowland DL, Tampa M, Sarbu MI, Mitran MI, Mitran CI, Stoian AP, Diaconu CC, Paunica S, Georgescu SR. Finasteride and androgenic alopecia; from therapeutic options to medical implications. *J Dermatolog Treat*. 2020 Jun;31(4):415-421. doi: 10.1080/09546634.2019.1595507. Epub 2019 Apr 2. PMID: 30897009.
- 19) Juárez-Rendón KJ, Rivera Sánchez G, Reyes-López MÁ, García-Ortiz JE, Bocanegra-García V, Guardiola-Avila I, Altamirano-García ML. Alopecia Areata. Current situation and perspectives. *Arch Argent Pediatr*. 2017 Dec 1;115(6):e404-e411. English, Spanish. doi: 10.5546/aap.2017.eng.e404. PMID: 29087123.
- 20) Rebora A. Telogen effluvium: a comprehensive review. *Clin Cosmet Investig Dermatol*. 2019 Aug 21;12:583-590. doi: 10.2147/CCID.S200471. PMID: 31686886; PMCID: PMC6709511.
- 21) Dhariwala MY, Ravikumar P. An overview of herbal alternatives in androgenetic alopecia. *J Cosmet Dermatol*. 2019 Aug;18(4):966-975. doi: 10.1111/jocd.12930. Epub 2019 Apr 13. PMID: 30980598.
- 22) Oh JY, Park MA, Kim YC. Peppermint Oil Promotes Hair Growth without Toxic Signs. *Toxicol Res*. 2014 Dec;30(4):297-304. doi: 10.5487/TR.2014.30.4.297. PMID: 25584150; PMCID: PMC4289931.
- 23) de Groot A, Schmidt E. Essential Oils, Part V: Peppermint Oil, Lavender Oil, and Lemongrass Oil. *Dermatitis*. 2016 Nov/Dec;27(6):325-332. doi: 10.1097/DER.0000000000000218. PMID: 27775966.
- 24) Murata K, Noguchi K, Kondo M, Onishi M, Watanabe N, Okamura K, Matsuda H. Promotion of hair growth by *Rosmarinus officinalis* leaf extract. *Phytother Res*. 2013 Feb;27(2):212-7. doi: 10.1002/ptr.4712. Epub 2012 Apr 20. PMID: 22517595.
- 25) Oh JY, Park MA, Kim YC. Peppermint Oil Promotes Hair Growth without Toxic Signs. *Toxicol Res*. 2014 Dec;30(4):297-304. doi: 10.5487/TR.2014.30.4.297. PMID: 25584150; PMCID: PMC4289931.
- 26) <https://blenditrawapothecary.in/products/rosemary-essential-oil>
- 27) <https://www.organicharvest.in/product/organic-essential-oil-lavender-10ml.html>
- 28) <https://www.goodvibesonly.in/products/pure-peppermint-essential-oil>
- 29) <https://blenditrawapothecary.in/products/pumpkin-seed-oil-120ml>
- 30) <https://www.shudhonline.com/products/lemongrass>