# BOTANICAL APPROACHES TO ALOPECIA: A SCIENTIFIC EVALUATION OF EFFICACY, MECHANISMS, AND SAFETY PROFILES

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**ABSTRACT**

Hair loss is a big problem that many individuals face. In contrast to alopecia areata, which is an immune system ailment that damages a person's hair, androgenic alopecia is a type of hair loss that occurs naturally and can be caused by several elements, such as heredity and environmental factors, or a combination of them. Individuals of all races and ages are affected by alopecia areata. Males and females are more prone to having this disorder, and both adults and children are affected by alopecia areata. Alopecia areata is characterized by small, round, or oval patches of non-scarring hair loss in any place where hair develops. There are two types of baldness. Male and female are other names for androgenic alopecia, in particular male hormones. Androgens are the primary initiating factor. The enzyme 5-alpha reductase converts testosterone into DHT. It has been demonstrated to affect hair follicles that are genetically vulnerable to its effects. In these types of hair follicles, there is a change that makes the hairs grow lighter, shorter, and smaller. Patients are treated for androgenetic and areata hair loss. Currently a wide range of allopathic medications are accessible, including finasteride and azelaic acid. Dithranol, systemic cortisone, zinc, minoxidil, dithranol, corticosteroids immunosuppressants and irritants Nevertheless, it has not been shown that any of these therapies provide patients with positive, long-lasting results. The use of these drugs is also associated with synthetic adverse effects, including dermatitis, pruritus, erythema, scaliness, itching, etc. present review articles focus on the use of various herbal preparations that have favorable effects and the least adverse effects Some examples of herbs are fenugreek, bhringraj, garlic, onion, amla, aloe vera, tulsi, and coconut. Pumpkin seeds decrease the risk of hair loss naturally by their herbal ingredients, which have various effects like hair growth boosters, 5-alpha reductase inhibitors, and DHT blockers.

**Abbreviations:** DHT-dihydrotestosterone, AGA-androgenic alopecia, AA-alopecia areta, MAGA-male androgenic alopecia, MPB-Male-Pattern Baldness

**Key words:** Androgenic Alopecia, alopecia areata, dihydrotestosterone, 5-alpha-reductase, testosterone, dihydrotestosteron, betasitosterol

## INTRODUCTION

One of the essential body parts, hair, is produced by the ectoderm of the skin. It is regarded in addition to the protective function of the skin's accessory structure, sweat, sebum, and nail glands. They are also known as epidermal derivatives because, during embryonic development, they are derived from the epidermis.It is called "enhanced epithelium" and refers to hair. This page discusses hair follicles, which are the building blocks of hair. The average monthly growth of hair is between 15 and 30 mm, while each person has a different rate. For more than two millennia, alopecia has been recognized as a fundamental medical and cosmetic concern. An estimated 0.2% to 2% of humanity will be harmed by it, and it is expected to spread throughout the world. To cure hair loss, which is irreversible and has unfavorable side effects, there are many synthetic medications available. Alopecia is more successfully treated with the use of herbal therapies [1].

Hair looks much simpler than it actually is. They have a major influence on the appearance of men and women, but they also transmit sensory information and, as we all know, help to develop gender identity [2]. The follicle and the visible shaft are the two primary parts of hair. The follicle is a tunnel-like structure that emerges from the epidermis and continues into the dermis. Each of its several layers has a distinct function. The papilla, which is situated near the follicle's base, contains tiny blood veins called capillaries that are responsible for supplying the cells with nourishment.We refer to the innermost layer as the medulla, then the cortex, the middle layer, then the cuticle, the outermost layer.While the cortex comprises the majority of the hair shaft, the cuticle forms a densely packed

structure composed of overlapping scales that resemble shingles. Both the cortex and the medulla contain The pigment responsible for the color of hair. Hair development is caused by the follicles, which are located beneath the skin's surface.Blood vessels that are close to the follicles give them vital nutrition, which promotes hair growth. Hair loss may result from inadequate blood vessel feeding [3].

**[A] Every hair goes through three cycles of growth:**

1) Growth Phase (Anagen): This phase could last anywhere from two to eight years. On average, 80 percent of hair is in the anagen phase.

2) Catene (Regression): Following the recession phase, growth activity increases,and the hair moves on to the next stage. Regression lasts between 10 and 14 days.

3) Telogen: The hair enters a resting condition during this phase. This phase lasts between ninety and one hundred days. Fifty to one hundred hairs fall out per day on average. As a minimum of 100 hairs growing for each of the six ingredients Hair loss, or alopecia, is a disorder that might be temporary.[4][5].

**[B] HAIR LOSS**

Androgenetic alopecia (AGA), commonly referred to as male-pattern baldness (MPB), is one of the most prevalent underlying causes of hair loss.

1) It is thought that sensitivity to dihydrotestosterone (DHT), a male hormone that our bodies naturally produce, is the primary cause of androgenetic alopecia (AGA).

2) Dihydrotestosterone (DHT) is produced from testosterone by the enzymatic action of 5-alpha-reductase.

3) This process occurs in a number of body tissues, including the skin and liver. A portion of the produced DHT finally finds its way to the scalp and hair follicles after entering the bloodstream.DHT's binding to the follicle's androgen receptors modifies the normal hair development cycle of a sensitive hair follicle.[6].

**ALOPECIA**

Alopecia is a medical term for hair loss that encompasses a number of disorders that cause hair loss. Alopecia can be a sign of underlying health problems; however, it is not communicable and can be caused by a number of circumstances. An autoimmune disorder called alopecia areata is a common kind of alopecia.Nevertheless, not every type of alopecia is linked to an aberrant immune response. Some varieties of alopecia can also be caused by psychiatric disorders, including hair pulling, lifestyle choices, genetics, and environmental factors. Different types of alopecia can be treated with topical treatments, oral drugs, and even behavioral modifications to encourage hair growth.

While many types of alopecia can be avoided, others can impact anyone of any age, gender, race, or family history due to disturbances in the natural cycle of hair growth [7].

There are various types of hair loss, including androgenic, alopecia areata, cicatricial [8], persistent patchy, trichotillomania, traction [9], postpartum, lichen planopilaris [10], anagen effluvium, telogen effluvium, and central centrifugal cicatricial alopecia [11].

**ALOPECIA AREATA**

Anagen hair follicles are affected by the complex, immune-mediated, genetic disorder known as alopecia areata. Three main clinical manifestations are associated with alopecia areata, a persistent, recurring disorder that results in non-scarring hair loss. Alopecia areata affects persons of all ages and races, whether they are male or female, children or adults. In any hair-bearing region, in restricted alopecia areata, non-scarring hair loss is characterized by round or oval patches. All body hair loss (alopecia universalis) or all scalp hair loss (alopecia totalis) may result from this, while many people may exhibit patchy to complete body hair loss.

Up to 50% of patients with limited disease are thought to have a life expectancy of less than a year and may achieve spontaneous hair regeneration, meaning that not all patients may need treatment [12]. Alopecia areata currently has no known cure, nor is there a well-recognized therapy that can put patients in remission and keep them there [13]. For this disease, there are numerous therapy options, and the patient's age, disease activity, duration, and severity are often taken into consideration.

**ANDROGENIC ALOPECIA**

Alopecia androgenica is the most prevalent kind of progressive hair loss, also designated as female-pattern alopecia or male-pattern alopecia Both hormonal and genetic factors have an impact on it. Through its effects on the scalp's hair follicles, the hormone dihydrotestosterone (DHT) is a key player in this disorder. When DHT is administered to people who are genetically prone to androgenetic alopecia, the hair follicles undergo a change that makes the hairs grow lighter, shorter, and smaller. The follicles that are impacted eventually shrivel to the point that hair creation stops.Approximately half of men will develop male-alopecia baldness by the time they are 50 years old, and it usually begins during or after adolescence.

A receding hairline Is the first sign, after which the hair on the head and temples starts to thin,which can ultimately lead to partial or total baldness. Loss of hair on the crown of the head is the main symptom of female-pattern baldness, which may become more apparent in women following menopause. It's crucial to remember that there are different kinds of progressive hair loss in addition to the most prevalent type, androgenetic alopecia. The disorder known as alopecia areata (AA) is typified by patchy hair loss and believed to have an autoimmune component, is one example. Appropriate management and therapy for different types of hair loss depend on a thorough understanding and diagnosis of the condition[14].

**SYMPTOMS:**Depending on the reason, hair loss can manifest itself in a variety of ways. It may affect just the scalp or the entire body, and it may occur suddenly or gradually. Indicators and indications of hair loss may also include:

- The predominant kind of hair loss that happens to individuals as they become older is called "gradual thinning on top of the head." For guys, hair loss usually begins at the hairline on the forehead. It is common for women to spread out a section of their hair. The receding hairline, also referred to as fibrosing alopecia frontal, is a pattern of Specifically, hair loss becoming more common in older women.
- Patchy or Round Bald Spots on the eyebrows, beard, or scalp, some persons have round or spotty bald spots. Prior to hair loss, the skin may be unpleasant and irritating.
- Unexpected Hair Loss: Surprise, whether either psychologically or physically, might result in hair to fall out. A tiny bit of hair may still fall out even after brushing, bathing, or gently pulling your hair. Redness, swelling, damaged hair, and occasionally discharge might accompany it[15].

**CAUSES:**

- Reasons for Alopecia Both circulating androgens and the gene linked to hair loss needs to be there for either a design to appear in either a male or female
- This gene is inherited in a polygenic or multifactorial manner. Androgens like testosterone and dihydrotestosterone (DHT) are examples of male hormones, are the primary initiating factor. The enzyme 5alpha reductase converts testosterone into DHT. Has been shown to have an impact on hair follicles that are genetically vulnerable to its effects.
- This causes the follicles to shrivel or miniaturize, which results in hair loss. As a result, the hair gradually gets finer and shorter.
- Hair growth may be entirely stopped by genetically programmed follicles as people age[16].

How to Reverse Hair Miniaturization:

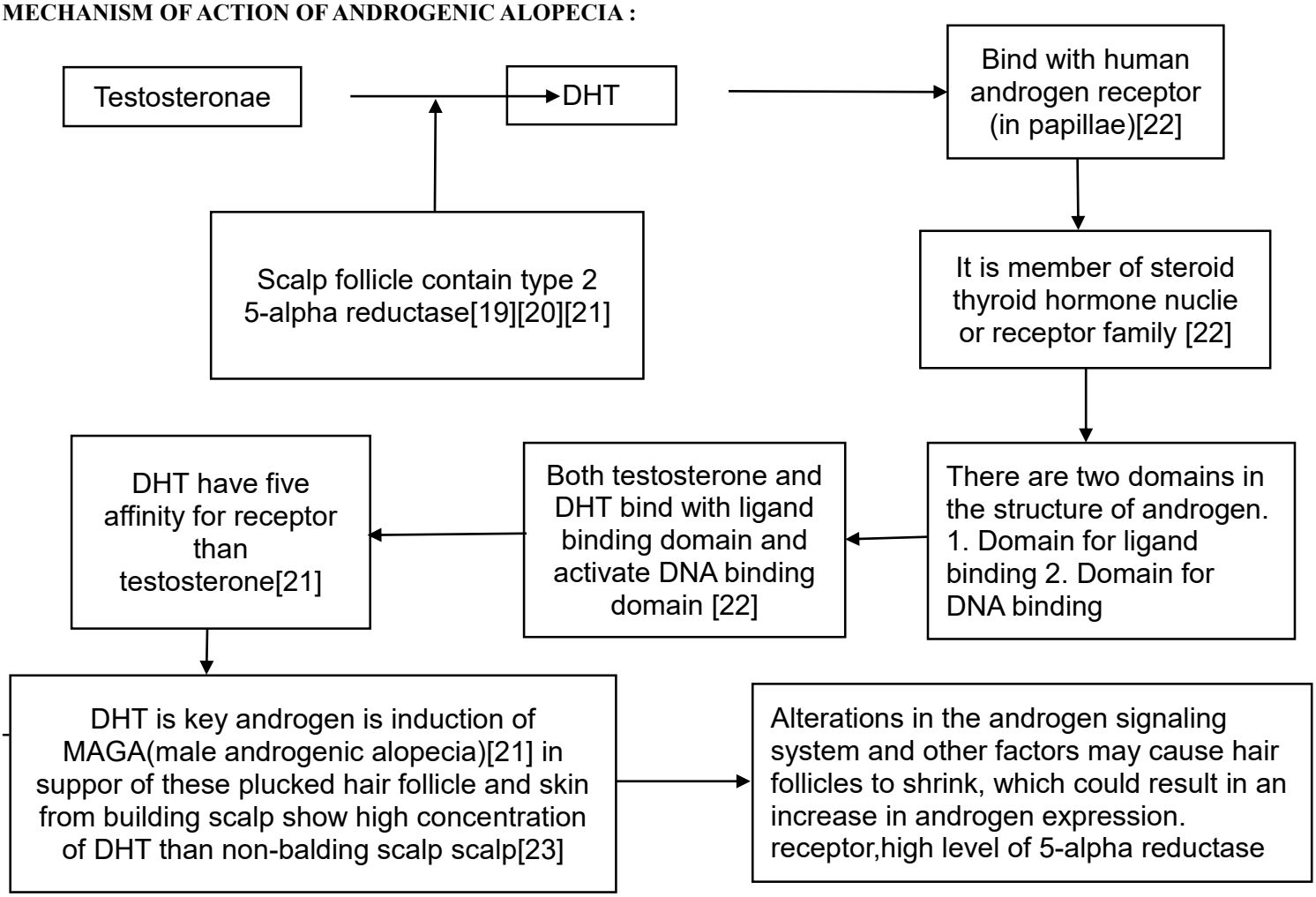
- Use Essential Oils
- Reduce DHT on the Scalp
- Improve Circulation and Nutrient Delivery
- Quit Using Chemical-Laden Hair Products

**FACTORS:** The following factors are usually linked to hair loss:

- Hereditary Family History: A genetic disease that presents as aging is the most frequent cause of hair loss. This condition is referred to as male hormonal alopecia, male pattern baldness, and female pattern baldness. Males often have receding hairlines and bald patches, while females experience thinning hair above the head. It usually occurs gradually and in predictable patterns.
- Hormonal Changes and Medical problems: Temporary or permanent hair loss can result from a variety of medical problems, including thyroid disorders, menopause, pregnancy, and childbirth-related hormonal changes. Alopecia areata, which affects the immune system and results in patchy hair loss, trichotillomania, a disorder characterized by excessive hair pulling, and ringworm infections of the scalp are examples of medical problems.
- Drugs and Supplements: Some drugs, including those for cancer, arthritis, depression, heart issues, gout, and high blood pressure, can cause hair loss as a side effect.Radiation therapy may cause hair to regrow more slowly than it did before.Months after going through a physical or mental trauma, many people experience the very upsetting phenomena of hair thinning. This kind results in transient hair loss.

- Treatments and hairstyles: Traction alopecia is a type of hair loss that can be brought on by overdoing hairstyles and pulling braids. Hair loss can also result with curling and hot oil treatments. If scarring develops, hair loss could not be reversible.[17][18

**MECHANISM OF ACTION OF ANDROGENIC ALOPECIA :**




**Diagramatic representation of Mechanism of causing androgenic alopecia**

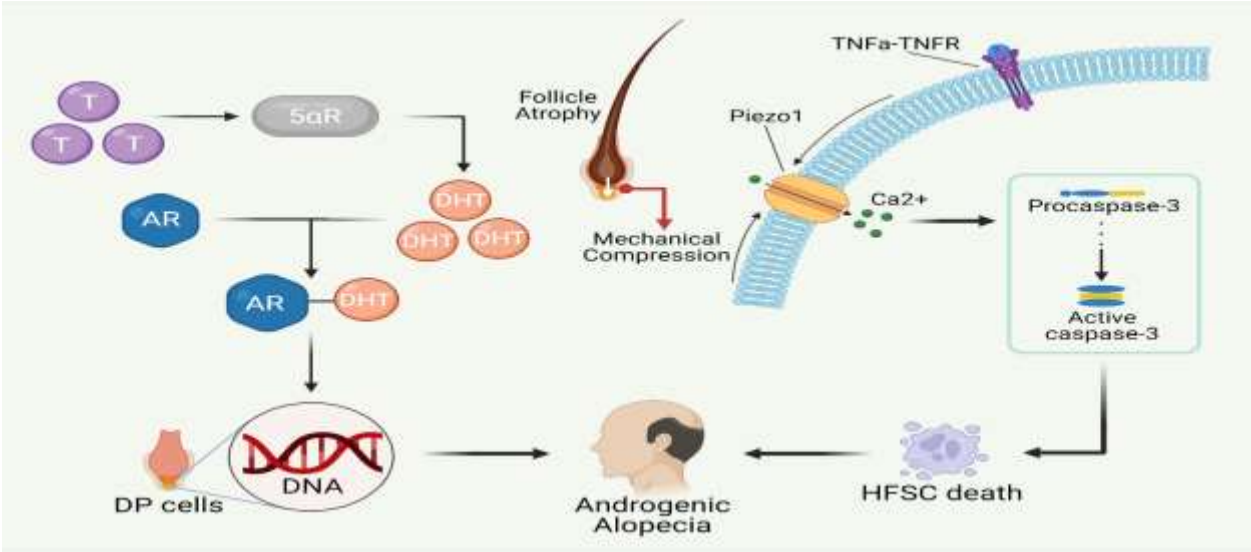



*Figure 1Fig no.:01 Diagrammatic representation of causing androgenic alopecia*

**HERBS USE IN ANDROGENIC ALOPECIA: Herbal** compounds and their effects on alopecia: Alopecia can be treated, and the risk of hair loss decreased naturally with the use of certain herbal ingredients, such as DHT blockers, 5-alpha reductase inhibitors, and hair growth enhancers. Other natural herbal remedies include DHT blockers like saw palmetto, pumpkin seeds, and green tea's 5-alpha reductase inhibitor.

**1) Aloe Vera, or Aloe Barbadensis:**

▪ **Chemical components:**aloenin, barbaloin, and aloe-emodin.

▪ **Mechanism of action:** ratinol , ascorbic acid and tocopherol found in aloe vera help to repair and fortify hair strands. Healthy cell growth is encouraged by these three vitamins.aid in cell renewal, and give hair a glossy finish. Aloe vera gel also contains vitamin B9 and cyanocobalamin. These two products can help you stop hair loss.

▪**Uses:** The primary ingredient in aloe vera that promotes hair growth in alopecia is aloenin[24].

**2) PhyllanthusEmblica (Amla)**

▪ **Chemical Components:** Gallic Acid, Ellagic Acid, and Ascorbic Acid (Vitamin C).

▪ **Mechanism of action:** Amla's antifungal qualities aid in promoting scalp health and preventing dandruff and other fungal infections. A strong inhibitor of 5-alpha reductase is amla.

▪ **Uses:**Both men and women can benefit from using amla to treat baldness and hair loss. Amla keeps dandruff at bay.Enhances the condition of the scalp, and purifies the blood[25][4].

**3) Allium Cepa (Onion)**

▪ **Chemical components:** Allium Cepa (onion) include allyl propyl and diallyl disulfides, which are present in allicin, amino acids, and essential oil (0.06–0.1%).

▪ **Mechanism of action:** Zinc aids in the production of essential scalp oil and guards against dandruff-induced hair loss. The oxygen that the body's red blood cells receive is influenced by iron. It is necessary for healthy hair growth and maintenance.

▪ **Applications:** Onions' sulfur helps to strengthen and thicken hair, which prevents hair loss and promotes the growth of new hair. Collagen promotes the development of healthy skin cells and hair growth. [4][24].

**4) Allium Sativam (Garlic)**

▪ **Chemical components:** Allicin, amino acids, and essential oil (0.06–0.1%) contain allyl propyl and diallyl disulfides, among other chemical constituents.

▪**Mechanism of Action:** Garlic's antibacterial qualities help to eradicate bacteria and germs that harm the scalp and further impede hair growth. As everyone knows, raw garlic is high In vitamin C and supports healthy hair. Additionally, it increases the growth of hair by stimulating the creation of collagen.

▪ **Uses:** Raw garlic is a great source of vitamins and minerals that promote healthy hair, including vitamin B-6, vitamin C, manganese, and selenium. [26][27][28].

**5) Eclipta alba (Bhringraj)**

▪**Chemical Components:** Daucosterol and Wedelolactone.

▪ **Mechanism of Action:**EcliptaAlbamethanol extract increases hair growth by encouraging hair follicles' anagen while they are in the telogen (resting) phase.

▪ **Uses:** It promotes hair follicles to grow more hair by feeding the hair follicles and scalp. The vitamin E-rich herb known as the fake daisy plant fortifies the hair strands and nourishes the scalp. Hydrates the skin, giving it a healthy, glossy appearance[4][24].

**6) Pumpkin Seed (Cucurbita maxima Plant)**

▪**Chemical components:**Proteins, carbohydrates, lipids, alkaloids, flavonoids, fibers, saponins, steroidal saponins, vitamins, minerals, and nitrogen compounds are the main chemical components of fenugreek seeds. These components can be further divided into volatile and non-volatile categories.

▪ **Mechanism of Action:** Fenugreek contains a number of plant components that can interact with the hormone DHT (dihydrotestosterone). DHT's adhesion to hair follicles eventually causes hair loss. Fenugreek can reduce the ability of DHT to bind to hair follicles.

▪ **Uses:** Packed with proteins and amino acids, fenugreek helps repair damaged hair shafts from heat styling, color treatments, dryness, chemicals, and UV rays. Promotes the development of thicker hair and the integration of the cuticle into the hair shaft [24][25].

**7) Ocimum sanctum (tulsi)**

▪ **Chemical Constituents:** Approximately 70% eugenol, 20% methyl ether, and carvacrol are among the chemical constituents. Additionally, it includes caryophyllene. Alkaloids, glycosides, saponins, tannins, high levels of vitamin C, and trace amounts of citric, tartaric, and maleic acids have also been linked to the plant.

▪**Mechanism of action:**Tulsi is that it has positive benefits on hair, strengthening the roots and revitalizing the hair follicles to prevent hair loss. This herbal remedy keeps the scalp cool and improves blood flow to it.

▪**Uses:** Tulsi is utilized for increase hair density and prevent hair loss and thinning. Tulsi's anti-inflammatory components are believed to cause irritation to the scalp. [24].

**8) Pumpkin Seed (Cucurbita maxima Plant)**

▪ **Synonym:**Curcubitapepo, pepita

▪ **Chemical constituent :**The lipid fraction of pumpkin seed oil is primarily composed of triacylglycerols (94.5%), with free fatty acids, monoacylglycerols, and diacylglycerols also present. The non-glycerol fraction is made up of carotenoids, phospholipids, and sterols. Squalene[29], a hydrocarbon with potent antioxidant qualities, is a significant part of the lipid fraction of pumpkin seed oil[30]; tocopherols, triterpene alcohols, squalene, chlorophylls, and carotenoids make up 0.89% of its percentage content. Desmosterol, campesterol, stigmasterol, β-sitosterol, spinasterol, fatty acids, squalene, and zinc are some of the phytosterols found in pumpkin seed oil[31][32]. The tocopherols α-, β-, γ-, and δ-tocopherol, are also included in this oil's structure. These tocopherols contain vitamin E, which has antioxidant qualities[33].

▪ **Mechanism of action:** Because Linositol and b-sitosterol block 5α-reductase as well as lower activity of IL-6, pumpkin seed oil is thought to help prevent hair loss[34].

▪ **Uses:** antioxidant, anti-inflammatory, and antimicrobial[6].

**9) Rosemary (Rosmarinusofficinalis)**

▪ **Chemical constituents :** α pinene, 1,8-cineole, camphor, rosmarinic acid, carnosic acid, as well as borneol are the primary chemical elements of rosemary extract.

▪ **Mechanism of action:** Rosmarinusofficinalis is perfect for therapeutic purposes because of its strong anti-inflammatory properties. A number of bioactive substances that help to inhibit the inflammatory cascade, such as carnosic, ursolic, oleanolic, and micromeric acids[35]. By inhibiting nuclear factor kB (control DNA transcription) and reducing lipopolysaccharide (LPS)-stimulated nitric oxide generation, carnosol helps to decrease inflammation[36]. Additionally, it has been demonstrated that Rosmarinusofficinalis inhibits 91.8% of the development of free radicals, 71.8% of the synthesis of nitric oxide, and 82% of platelet aggregation, so demonstrating its anti-inflammatory and antioxidant qualities[37]. According to one study, 12-methoxycarnosic acid is principally responsible for the strong antiandrogenic activity[38].

▪ **Use:** antidandruff, graying of hairs, promote hair loss, helps to increase hair regrowth.

**10) Moringa (Moringaoleifera) seed oil :**

It is an edible oil that has anti-aging, emollient, skin-lightening, haircare, and antioxidant properties[39].

▪ **Chemical constituent :**Lauric and linoleic acids are two fatty acid constituents that may have anti-alopecia properties[40].The chemical known as β-sitosterol is found in moringa seeds[41].Dihydrotestosterone is blocked by the β-sitosterol molecule on hair follicle androgen receptors[42].Numerous research has been done to isolate and determine the component in moringa seed oil; yet, little is known about the oil's possible activities. Thus, this review paper's objective was to examine the capability of the active ingredients in oils from moringa seeds and grow the plant as a remedy for alopecia.

▪ **Mechanism of action :**By blocking the 5 α-reductase enzyme, which can change the hormone testosterone into DHT[43], the β-sitosterol molecule acts as an antialopeciaagent.The primary cause of hair loss is DHT; it attaches itself to certain androgen receptors on hair follicles. This causes the hair follicles to constrict, which makes the hair gradually thinner, more brittle, and more likely to fall out as a result of damage to the hair follicles and roots or miniaturization[44]. Linoleic acid and lauric acid, two fatty acids that are present in moringa seed oil, have the ability to support hair nutrition, reduce the rate of hair loss, speed up hair development, protect hair, take care of hair, and promote hair growth. By blocking the enzyme 5 α-reductase, hair growth can be stimulated[30][45].

## CONCLUSION

An autoimmune condition called alopecia is especially prevalent in urban areas due to environmental issues and lifestyle changes. It can be caused by excessive use of allopathic drugs, chemotherapy treatments, and family history. Many physicians recommend herbal medicine, with 80% suggesting it as a safe alternative. Herbal drugs like aloe vera, amla, onion, garlic, bhringraj, tea, fenugreek, coconut, almond, and tulsi are effective in treating alopecia and hair loss. These herbs provide a comprehensive approach to hair care by encouraging healthy hair development by utilizing the medicinal potential of herbal components. For those who are losing their hair, it offers a potential effectiveness. With reduced adverse effects and enhanced safety and effectiveness, these formulations provide the advantages of herbal components. To create the ideal composition for promoting hair development, the combination was carefully chosen.

## References

1. Tathe M, Wani S, M.Murkute P. A REVIEW: HERBAL THERAPY USED IN HAIR LOSS . Pharmaceutical Resonance 2020 . 2020;3(1):44–50.
2. .J B. PROHAIR [Internet]. PROHAIR. 2017 [cited 2024 Dec 23]. Available from: https://prohairklinika.hu/En/About-Hair
3. United States Trichology Institute | Expert Hair Loss & Scalp Health Education [Internet]. Ustrichology.org. 2024. Available from: https://ustrichology.org
4. .Shivam A. Bartere, Lochana L. Malode, Gunjan P. Malode, Minakshee G. Nimbalwar, Chaitanya A. Gulhane, Jagdish V. Manwar, et al. Exploring the potential of herbal drugs for the treatment of hair loss. GSC Biological and Pharmaceutical Sciences. 2021 Aug 30;16(2):212–23.
5. Rambwawasvika H. Alopecia types, Current and Future Treatment. Journal of Dermatology & Cosmetology. 2021;5(4):93–9.
6. Dhariwala MY, Ravikumar P. An overview of herbal alternatives in androgenetic alopecia. Journal of Cosmetic Dermatology. 2019 Apr 13;18(4).
7. Qi J, Garza LA. An Overview of Alopecias. Cold Spring Harbor Perspectives in Medicine [Internet]. 2014 Mar 1 [cited 2019 Oct 18];4(3):a013615–5. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3935391/
8. Rongioletti F, Christana K. Cicatricial (Scarring) Alopecias. American Journal of Clinical Dermatology. 2012 Aug;13(4):247–60.
9. Kluger N, Cavelier-Balloy B, Assouly P. Les alopécies par traction. Réponses au pré-test. Annales de Dermatologie et de Vénéréologie. 2013 Apr;140(4):315.
10. Rathi V, Rathi JC, SengodanTamizharasi. Development and Evaluation of Polyherbal Formulations for Hair Growth Potential. Pharmacognosy Research. 2009 Jul 1;1(4):234.
11. Summers P, Kyei A, Bergfeld W. Central Centrifugal Cicatricial Alopecia – an Approach to Diagnosis and Management. International Journal of Dermatology. 2011 Nov 21;50(12):1457–64.
12. Messenger AG, McKillop J, Farrant P, McDonagh AJ, Sladden M. British Association of Dermatologists' guidelines for the management of alopecia areata 2012. British Journal of Dermatology [Internet]. 2012 Apr 23 [cited 2019 Oct 29];166(5):916–26. Available from: https://www.bad.org.uk/library-media%5Cdocuments%5CAlopecia_areata_guidelines_2012.pdf
13. Delamere FM, Sladden MJ, Dobbins HM, Leonardi-Bee J. Interventions for alopecia areata. Cochrane Database of Systematic Reviews. 2008 Apr 23;(2).
14. Home | GSK [Internet]. Stiefel.com. 2023 [cited 2024 Dec 31]. Available from: http://www.stiefel.com/About-Male-Androgenetic-Alopecia.Html

15. Hair loss – Symptoms and causes [Internet]. Mayo Clinic. 2024 [cited 2024 Dec 23]. Available from: https://www.mayoclinic.org/diseases-conditions/hair-loss/symptoms-causes/syc-20372926.
16. Male vs. Female Pattern Baldness | Hair Transplant Learning Center [Internet]. Wolf Medical. 2002 [cited 2022 Apr 21]. Available from: https://www.wolfhair.com/learning-center/hair-loss-why/articles-by-dr-wolf/male-vs-female-pattern-hair-loss/
17. S S, Gardner. WebMD – Better information. Better health. [Internet]. WebMD. 2022. Available from: http://www.webmd.com.
18. Amin SS, Sachdeva S. Alopecia areata: A review. Journal of the Saudi Society of Dermatology & Dermatologic Surgery [Internet]. 2013 Jul 1 [cited 2020 Feb 22];17(2):37–45. Available from: https://www.sciencedirect.com/science/article/pii/S2210836X13000237
19. Jenkins E, Andersson S, Imperato-McGinley J, Wilson JD, Russell DH. Genetic and pharmacological evidence for more than one human steroid 5 alpha-reductase. JCI the Journal of Clinical Investigation . 1992 Jan 1;89(1):293–300.
20. EICHELER W, DREHER M, HOFFMANN R, HAPPLE R, AUMULLER G. Immunohistochemical evidence for differential distribution of 5α-reductase isoenzymes in human skin. British Journal of Dermatology. 1995 Sep;133(3):371–6.
21. Kaufman KD. Androgens and alopecia. Molecular and cellular endocrinology. 2002 Dec 30;198(1-2):89-95.
22. Jänne OA, Palvimo JJ, Kallio P, Mehto M. Androgen Receptor and Mechanism of Androgen Action. Annals of Medicine. 1993 Jan;25(1):83–9.
23. SCHWEIKERT HU, WILSON JD. Regulation of Human Hair Growth by Steroid Hormones. I. Testosterone Metabolism in Isolated Hairs. The Journal of Clinical Endocrinology & Metabolism [Internet]. 1974 May;38(5):811–9. Available from: https://zero.sci-hub.se/3948/8c934b2b1d2fddb83c8d1c191349fbb6/schweikert1974.pdf
24. Pushpendra Kumar Jain, Das D. THE WONDER OF HERBS TO TREAT–ALOPECIA. Berkalailmukedokteran/Journal of the medical sciences. 2016 Oct 1;4(5):5–10.
25. AfsarDrZeeshan. Essential of Herbal drug. PV Publication;
26. Arunachalam DG, Christi I, Dr. Prashant Kumar. Herbal Drug Technology (English Edition). Lucknow: Thakur Publication Private Limited; 2021.
27. NneamakaEzekwe, King M, Hollinger JC. The Use of Natural Ingredients in the Treatment of Alopecias with an Emphasis on Central Centrifugal Cicatricial Alopecia: a Systematic Review. The Journal of Clinical and Aesthetic, 2020: 23. 2020 Aug 1;13(8):23–7.
28. Hosking AM, Juhasz M, Atanaskova Mesinkovska N. Complementary and Alternative Treatments for Alopecia: A Comprehensive Review. Skin Appendage Disorders. 2018 Aug 21;5(2):72–89.
29. Antoniewska A, Adamska A, Rutkowska J, Zielińska M. Olej z nasiondynijakoźródłocennychskładników w diecieczłowieka. ProblemyHigieny I Epidemiologii. 2017;98(1):17-22.
30. Obiedzinska A, Waszkiewicz-Robak B. Oleje tłoczone na zimno jako żywność funkcjonalna. Żywność Nauka Technologia Jakość. 2012;19(1).
31. Ramak P, Mahboubi M. The beneficial effects of pumpkin (Cucurbita pepo L.) seed oil for health condition of men. Food Reviews International. 2019 Feb 17;35(2):166-76.
32. Linkowska M, Matlawska I. Rolaziol w schorzeniachowlosionejskoryglowy. HerbaPolonica. 2007;53(2):114-5.
33. Zielińska A, Nowak I. Tokoferole I tokotrienolejakowitamina E. Chemik. 2014;68(7):585-91.
34. Promise Ufomadu. Complementary and alternative supplements: a review of dermatologic effectiveness for androgenetic alopecia. Baylor University Medical Center Proceedings. 2023 Sep 29;37(1):111–7.
35. Reuter J, Jocher A, Stephan von Hornstein, Jürgen Schulte Mönting, Schempp CM. Sage Extract Rich in Phenolic Diterpenes Inhibits Ultraviolet-Induced Erythema in Vivo. Planta Medica. 2007 Sep 1;73(11):1190–1.
36. Lo AH, Liang YC, Lin-Shiau SY, Ho CT, Lin JK. Carnosol, an antioxidant in rosemary, suppresses inducible nitric oxide synthase through down-regulating nuclear factor-κB in mouse macrophages. Carcinogenesis. 2002 Jun;23(6):983–91.
37. Yimam M, Lee YC, Jiao P, Hong M, Brownell L, Jia Q. A standardized composition comprised of extracts from Rosmarinusofficinalis, Annona squamosa and Zanthoxylumclava-herculis for cellulite. Pharmacognosy Research. 2017;9(4):319.
38. Murata K, Noguchi K, Kondo M, Onishi M, Watanabe N, Okamura K, et al. Promotion of Hair Growth byRosmarinusofficinalisLeaf Extract. Phytotherapy Research. 2012 Apr 20;27(2):212–7.
39. Dzakwan M, W P, D E. NANOENKAPSULASI MINYAK BIJI KELOR. JurnalIlmiahFarmasiFarmasyifa. 2019 Jul 30;2(2):84–92.
40. Muhammud A, Amin AR, Bakar RA, Jaafar R. The effectiveness of coconut oil mixed with herbs to promote hair growth. International Journal of Ethics in Engineering & Management Education. 2014;1(3):27-30.
41. Fahey JW. Moringaoleifera: a review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. Part 1. Trees for life Journal. 2005 Dec 1;1(5):1-5.
42. Cabeza M, Bratoef E, Heuze I, Ramírez E, Sánchez M, Flores E. Effect of beta-sitosterol as inhibitor of 5alpha-reductase in hamster prostate. InProceedings-Western Pharmacology Society 2003 Jan 1 (Vol. 46, pp. 153-155). [Western Pharmacology Society]; 1998.
43. Gupta AK, Talukder M, Bamimore MA. Natural products for male androgenetic alopecia. Dermatologic Therapy. 2022 Apr;35(4):e15323.
44. Ho BS, Vaz C, Ramasamy S, Chew EG, Mohamed JS, Jaffar H, Hillmer A, Tanavde V, Bigliardi-Qi M, Bigliardi PL. Progressive expression of PPARGC1α is associated with hair miniaturization in androgenetic alopecia. Scientific reports. 2019 Jun 19;9(1):8771.

45. Kaushik R, Gupta D, Yadav R. Alopecia: herbal remedies. International journal of pharmaceutical sciences and research. 2011 Jul 1;2(7):1631.