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SHORT REVIEW

Treatment of Alopecia with New Approaches: An Updated Review

Sakshy Sharma[1*], Ganesh Prasad Mishra[1,2] and Sachin Kumar[3]

[1]Kharvel Subharti College of Pharmacy, Swami Vivekanand Subharti University, Subhartipuram, NH-58, Delhi-Haridwar Bypass Road, Meerut - 250005, Uttar Pradesh, India; parashar5sakshi@gmail.com

[2]Dr Prafulla Chandra Ray Subharti College of Pharmacy, Bijnor - 246721, Uttar Pradesh, India

[3]NKBR College of Pharmacy and Research Centre, Phaphunda, Meerut - 245206, Uttar Pradesh, India

Abstract

Alopecia is one of the main problems among people due to stress, heredity and environmental problems. We searched, focusing on treating Alopecia, in PubMed, Web of Science, EMBASE, Scopus, and Google Scholar to study in detail to understand the exact mechanism of hair loss. We found that herbal drugs have the potency to cure Alopecia with fewer or no side effects. The primary focus of this study is to address Alopecia, an unpredictable condition characterised by hair loss. This article compiles information about herbal remedies used for Alopecia. Various methods have been studied to treat Alopecia, including allopathic, ayurvedic, acupuncture, mesotherapy, hair transplantation, nutritional support, aromatherapy, and 5-α-reductase blockers. So, with the help of this review article, we conclude that 5α-Reductase inhibitors (5ARIs) block Dihydrotestosterone production from adrenal and gonadal sources. Our current approach is to provide information about the drugs targeting a subset of 5-alpha reductase inhibitors that play a significant role in hair loss due to their anti-androgenic effects.

Major Finding: Challenges exist in standardising the concentration of active compounds in herbal extracts. A potent androgen that is a primary cause of hair loss in androgenetic alopecia. By blocking this process, these herbal drugs help prevent hair follicle miniaturisation and hair loss.

Keywords: Alopecia, Androgenic, DHT Blockers, Herbs

Abbreviations: ARI- Alpha Reductase Inhibitors; DHT- Dihydrotestosterone; IGF- Insulin-like Growth Factor; FUE- Follicular Unit Extraction; FUT- Follicular Unit Transplantation; TECR- Trans-2,3-enoyl-CoA reductases

1. Introduction

Hair loss is a common issue affecting both men and women, influenced by various factors including genetics, medications, and other underlying causes. There are multiple types of allopathic drugs to treat hair loss, but they have many side effects[1]. Herbs are the starting material for any medication research. Herbal drugs help treat hair problems through various mechanisms. Today, approximately 80% of the population recommends herbal formulations due to their beneficial effects and fewer side effects compared to synthetic drugs[2]. Some herbal marketed preparations are oil, shampoo, gel, and emulsion with herbs such as Tulsi, Neem, Walnut, Bhringaraj, Sage, Brahmi, Banana, etc[3]. The natural system provides nutrition, antioxidants, proteins, terpenoids, and essential oils[3,4].

Modern medicine categorises this treatment into first, second, and third lines. First-line therapy features hormones such as corticosteroids, topical corticosteroids, prostaglandins, capsaicin, minoxidil, anthralin, immunotherapy, retinoids and their analogues.

The second line comprises sulfasalazine, photochemotherapy, fractional photography and excimer laser. The third line includes systemic corticosteroids, azathioprine, methotrexate, cyclosporine, and biologics.

*Author for correspondence

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The agent that can cure this state is inappropriate or completely preventive[5,6]. In *Ayurveda*, hair growth is understood to be related to bone tissue development. The same *dhatus* (tissues) responsible for bone formation are also involved in hair growth[7]. Natural medications such as juice, latex, or dried powder are utilised for hair loss[8,9].

It is a disputable issue, as there is no broad understanding of the fundamental factors that cause hair loss. Different components contributing to balding include hereditary predisposition, hormonal factors, and disease states, for example, typhoid, malaria, jaundice and the use of chemotherapy[10,11].

The distress of hair loss, a dermatologic condition stemming from genetic, hormonal, and disease-related factors (including typhoid, malaria, and jaundice), has spurred the development of herbal hair growth therapies[12].

The hair follicles have a natural hair growth cycle that begins with the anagen phase, followed by the catagen phase (hair fall) and concludes with the resting stage as the telogen phase (Figure 1)[13].

Hormones play a crucial role in the development of hair on the human body. They change the body according to the seasons, age, and sex development in an individual's body. IGF is a growth hormone that affects the epithelial interactions, growing time, and dermal papilla size, melanocyte and keratinocyte activity, etc[14]. Hormones always coordinate the development of hair in the human body under changes in age, developmental stage and environmental changes[15]. The regulators of hair growth include hormones such as androgens, nutritional requirements, and thyroid function, which are the three essential aspects of hair growth. During pregnancy, numerous changes occur in the female body, and certain hormones, known as pregnancy hormones, impact hair growth. Androgens act as intracellular receptors in the dermal papilla cells of the hair follicle. These receptors are usually found in hair follicles of the dermal papilla cells. They are activated by the binding of androgens, such as testosterone and convert to dihydrotestosterone. The importance of understanding how androgens, which are male hormones, affect hair growth can be illustrated by looking at individuals with a condition known as testicular feminisation. These individuals are genetically male but appear female because their bodies do not respond to androgens due to a lack of working androgen receptors. As a result, they do not develop any of the typical hair growth patterns associated with androgens, such as body hair in the armpits and pubic area. This highlights the role of androgens in human hair growth. Recent research has shown that androgen receptors are mainly found in a specific part of hair follicles called the dermal papillae, which helps explain how these hormones influence hair development[16].

In the present study, various therapies for hair loss, along with the responsible factors and their management, are explored, including both traditional remedies and modern treatments. Through our analysis of phytoconstituents of plants and their mechanisms, we've gained a clear picture of how these treatments work. Our review of literature from databases such as PubMed, Scopus, Web of Science, NIH, EMBASE, and Google Scholar reveals that many herbal therapies not only mask symptoms but also target the root causes of alopecia, offering a holistic and layered approach to management with fewer or no side effects.

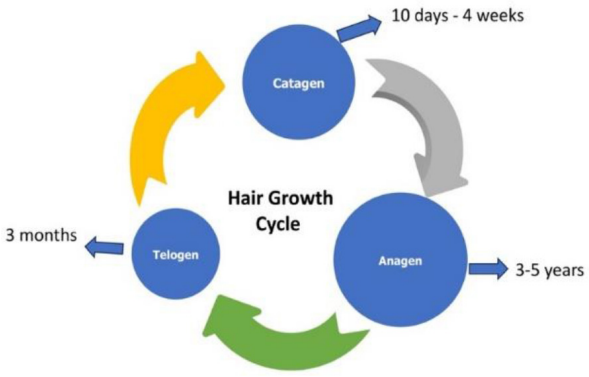


Figure 1. Hair growth cycle.

2. Treatment of Alopecia

Hair loss, or alopecia, can be patchy or all over (diffuse) and can arise from a variety of reasons, including lack of key nutrients like zinc, iron, biotin, and various vitamins. Hormone imbalance can also contribute to hair loss, as seen in both common forms of male and female baldness. In some cases, the body's defence system goes awry, mistakenly targeting hair follicles in an autoimmune attack. Furthermore, medical interventions such as chemotherapy and radiation

therapy are well-known to cause hair loss, as can certain medications used to treat arthritis, heart issues, and cancer. Even common ailments, such as scalp infections, particularly caused by fungi, can lead to hair loss if not treated promptly. The environment you're in and the habits you form also play a part in the overall health of your hair.

Table 1. Synthetic drugs used in alopecia and their side effects

Drugs	Side effects
Minoxidil	It is expensive, and excessive fluid retention
Finasteride	Expensive, use regularly, only for men
Zinc	Expensive, use continuously
Ketoconazoic (Nizoral)	Skin irritation
Copper Chloride	Skin, eye, and respiratory irritation

2.1 Use of Synthetic Drugs in Alopecia

The large variety of treatment options available and the need for more standardisation among existing studies complicate treatment selection even further. Determining the best treatment options is difficult because standardised grading techniques have yet to be consistently implemented.

Since the oral drug is a convenient option, many doctors, based on the medical perspective, cannot default on this treatment option and bias other additions, invasive or alternative treatment methods, which can be more effective and more suitable for the specific patient subset[17].

Treating androgenetic alopecia is still a complex issue. Selecting the appropriate treatment requires ethical, evidence-based therapy, along with consideration of the individual patient's condition, adherence to treatment, financial benefits, and hair loss severity. These factors should guide treatment

Table 2. Plants mentioned in *Charak Samhita* and *Shandrdhar Samhita Grantha* for hair loss treatment

S. No.	Common name	Botanical name	Family	Part used	Phytoconstituents
1	*Bhringraj*	*Wedelia species*	*Asteraceae*	Leaves	Flavonoid, Alkaloid, Glycoside
2	*Tulsi*	*Ocimum sanctum*	*Lamilaceae*	Leaves	Phenolics, Flavonoids
3	*Liquorice*	*Glycyrrhiza glabra*	*Leguminosae*	Root	Flavonoid, Glycoside
4	*Rose-bay*	*Nerium oleander*	*Apocynaceae*	Flower, Bark	Alkaloid, Glycoside
5	*Jasmine*	*Trachelospermum lucidum*	*Apocynaceae*	Flower, Leaves	Lignans, Flavonoids, Triterpenoids, Saponins
6	*Makoy*	*Solanum nigrum*	*Solanaceae*	Berries	Alkaloid, Flavonoid,
7	*Devdaru*	*Cedrus Deodara*	*Pinaceae*	Leaves	Lignan, Flavonoid, Glycoside
8	*Bahede*	*Terminalia bellerica*	*Combretaceae*	Fruits	Tannins, Flavonoids,
9	*Harad*	*Terminalia chebula* Retz.	*Combretaceae*	Fruits	Phenolic, Flavonoids, Carbohydrates
10	*Manjistha*	*Rubia cardifolia* L.	*Rubiaceae*	Leaves	Glycosides, Saponins, Phenols, Flavonoids
11	*Bhilwa*	*Semecarpus anacardium*	*Anacardiaceae*	Nuts	Flavonoid, Glycoside, Minerals
12	*Lodh*	*Symplocos racemosa*	*Symplocaceae*	Aerial Parts	Alkaloid, Flavonoid,
13	*Mallika*	*Jasminum officinale*	*Oleaceae*	Leaves	Alkaloids, Flavonoids, Coumarins, Tannins
14	*Babchi*	*Psoralea corylifolia* L.	*Fabaceae*	Seed	Coumarins, Flavonoids, Essential Oils
15	*Sahchar*	*Calacanthus grandiflorus*	*Acanthaceae*	Leaves	Phenolics, Glycosides, Terpenes, Steroids, Fatty Acids
16	*kumbher*	*Gmelina arborea* Roxb.	*Lamiaceae*	Fruits	Lignans, Flavonoids, Iridoid Glycosides
17	*Arjuna*	*Terminalia arjuna* (Roxb.)	*Combretaceae*	Bark	Flavonoid, Glycoside, Minerals
18	*Kateri*	*Solanum xanthocarpum*	*Solanaceae*	Leaves	Alkaloids, Phenolics, Flavonoids, Carbohydrates,
19	*Patol*	*Trichosanthus* species	*Cucurbitaceae*	Fruits, Leaves	Vitamins, Tannins, Saponins, Alkaloids

choices, ensuring that potential economic advantages for the patient do not influence decisions and that their health and well-being are the top priority. There are so many other drugs available on the market. Still, they are manufactured not only for treating alopecia but also for the medicinal cure of different diseases, such as anti-epileptic drugs, antihypertensives, and topical corticosteroids[17,18].

2.2 *Ayurveda* Treatment

In *Ayurveda*, alopecia is correlated with *Indralupta*, as mentioned in the texts. Patchy hair loss in the human body is known as *Indralupta*, caused by irregular dietary habits, air pollution, and an unclean body. According to the philosophy of *Ayurveda*, the human body is a combination of three different compositions: *Vata, Pitta,* and *Kapha*. When *Vata* and *Pitta* are dominant, they block the hair follicles, leading to hair loss[19]. The discussion of Alopecia in *Ayurveda* clears the history of Alopecia, stating that it is not a disease of the new generation. Still, it is as old as our human civilisation. Not only does *Ayurveda* depict the picture of Alopecia, but together with Allopathic and Homoeopathic, all three combine to give us a clear presentation of the disease[19,20].

Charak Samhita[21] and *Sharangdhar Samhita Grantha*[22] comprise some natural drugs used for the treatment of hair loss (*khalitya*) and baldness (*Indrulupta*) alone or in combination by Charak in the *Ayurvedic* system of medicine.

2.3 Acupuncture

Acupuncture is not a modern concept; it's an ancient technique used to cure skin diseases on the face, hair, and body. In the traditional Chinese system, acupuncture depends on qi, which indicates an energy-giving life force that flows through the body. When qi is blocked, a person may become sick. Acupuncture therapy helps maintain an energy flow by releasing those roadblocks. During acupuncture therapy, a practitioner stimulates specific points on the body with sharp needles.

Acupuncture's influence on alopecia may engage various mechanisms tailored to the specific type of the condition, primarily concentrating on mitigating inflammation through two distinct pathways. Acupuncture can also effectively treat Androgenic Alopecia by reducing testosterone. Androgens combine with receptors in the skin papilloma to control the hair growth cycle, where testosterone turns into a more potent DHT after a 5α-reductase enzyme reaction. In this technique, tiny needles are inserted into the body points to improve blood circulation and clear the acne spots[23]. Alopecia can be treated by diminishing the ill effects of T cells on the hair roots and helping to stimulate the follicles of the hair. With the help of acupuncture, there is a considerable level of improvement in the disease[24]. In general, acupuncture is a well-tolerated alternative system of medicine. Some individuals may experience some side effects, such as allergic reactions to the needles or any products used during the acupuncture session[23].

2.4 Mesotherapy

Dr. Michel Pistor, a French physician, introduced the Mesotherapy technique to asthma patients. The term mesotherapy was coined in 1976, and it includes superficial injections of Procaine to patients. Mesotherapy was initially used in Europe as an alternative method of utilising cutaneous injections containing individual or a mixture of substances for the treatment of local medical and cosmetic problems[25,26].

A treatment that biologically activates hair cells through small, painless, and subcutaneous injections. It changes the contraction of the hair follicles and increases the thickness and growth of the hair. Mesotherapy is a treatment that involves microinjecting medications and/or micronutrients into the middle layer of the skin. Mesotherapy reduces systemic side effects, delivering drugs directly to the hair follicles and increasing local bioavailability by reducing systemic effects. The compounds used in intermediate therapy can help prevent hair loss by nourishing the scalp and increasing the thickness and growth of the hair. It contributes to regeneration and encourages hair growth. It is an advantageous option that is not dangerous for the patient.

Local side effects and reactions can develop from mesotherapy. It mainly reduces cellulite, ageing, skin and hair loss. Primarily, it has been the centre of the cosmetic industry, particularly in hair and skin clinics. It is an amalgamation of *Ayurveda*, Homoeopathic and Allopathic treatments. Although it is costly, the results are not encouraging[25,26].

2.5 Cosmetic Aids

Cosmetic aids can be used alone if the medical or surgical treatment is not indicated, ineffective or not desired by the patients or even as an adjuvant therapy to hide thinning or baldness. Wigs, hair pieces, and extensions available nowadays are more natural, weigh less, and can be customised according to the patient's head[27]. A variety of cosmetic interventions are frequently employed to mitigate the visible effects of alopecia. These include the application of keratinaceous hair-building fibres, available in a spectrum of natural hues; the use of scalp thickening sprays; the application of alopecia masking lotions; and the utilisation of topical shading agents. Pigmented powders, creams, and many hair sprays assist in camouflaging hair loss[28].

2.6 Surgical Hair Restoration

Hair restoration surgery has evolved a few years. Surgical Hair Restoration. Considered the standard treatment for permanent hair restoration for hair loss, this procedure involves transplanting hair follicles from a zone of permanent growth to the bald or thinning areas. It can be implemented via the Follicular Unit Extraction (FUE) or FUT method. While results take over 6 months to manifest fully, transplanted hairs continue growing for life. Different people have so many options, such as punch transplant, flaps, scalp-reduction, and artificial hair, that have been tried and either rejected or found unsatisfactory and discarded in favour of hair transplantation[29]. The scalp is resistant to hair loss in androgenetic baldness, and it is expected that hair transplantation from these sites to the area of Alopecia could grow for the remainder of the patient's life[30].

2.7 Hair Transplantation

Norman Orentreich, a New York dermatologist, was considered the "Father of modern hair transplantation." It is defined as maintaining the integrity and characteristics of transposed grafted skin, which depends on the recipient site[31]. In this technique, fully thickened grafts of 2-4 mm plugs are punched out by a hair transplant punch from the donor occipital area and later inserted into the holes made by the same punch in the bald area of the recipient site. This technique is introduced, but it does not give a natural look[32].

2.8 Nutritional Support

Minerals are essential elements for overall health. Mineral deficiency impairs the ability to regulate blood circulation, which can hinder healthy hair growth.

Table 3. Plants used for aromatherapy and hair loss treatment

S. No.	Botanical name	Common name	Chemical constituents	Mechanism of action	References
1	*Simmondsia chinensis*	Jojoba Oil	Palmitic Acid, Lignoceric Acid	Improve skin hydration and natural sebum in the skin.	38,39
2	*Persia americana*	Avacado	Isoflavonoid, Terpenoids	5-α reductase type 1 inhibitor and Sebum secretion Inhibitor	40,41
3	*Rosmarinus officinalis*	Rosemary	Volatile Oil, Rosmarinic Acid	5-α reductase inhibitor	42,43
4	*Calendula officinalis*	Scotch marigold	Volatile oil, Flavonoids	Smoothing effect	44
5	*Centella asiatica*	Mandukparni	Essential Oil	Whole plant for hair growth and maintenance	45,46
6	*Cocos nucifera*	Nariyal	Alkaloids, Essential Oil	Aromopathy	39,45
7	*Salvia officinalis*	Sage Oil	Essential Oil	Aromopathy, 5-α reductase inhibitor	45
8	*Phyllanthus embelica*	*Amla Henna*	Vitamin C	Oil is used in hair growth	39,47
9	*Ocimum sanctum*	*Basil*	Essential Oil, Vitamin K	Revitalising hair follicles	45
10	*Thujae occidentalis* Semen	Arbor vitae	Essential Oil, Flavonoids	5-α reductase inhibitor	48
11	*Arnica montana*	*Arnica*	Terpenoids	Flower extract is used in hair tonic material	49

Minerals also regulate thyroid hormones, which can help prevent dry hair and hair loss. Calcium, copper, chromium, iodine, zinc, and magnesium are necessary for maintaining healthy hair growth[33].

Mineral supplement: B vitamins, Vitamin A, Vitamin E, Coenzyme, etc.

Food sources: Yoghurt and soya, dark green vegetables, carrots, whole grain products, essential fatty acids, nuts and seeds. Many other foods can help prevent hair loss and promote hair growth, including fruits, eggs, spinach, and broccoli[34,35].

2.9 Aromatherapy

Aromatherapy is a technique in which essential oils are applied to the scalp to reduce stress. In severe cases of Alopecia, essential oils can help increase blood circulation and relieve stress levels. The best use of aromatherapy is that the oils are rich in antioxidants and have no side effects on the scalp. This treatment utilises potent botanical essences sourced from the blossoms, foliage, wood, and subterranean parts of diverse flora, including mountain tobacco, *Cedar brevifolia*, lavender, holy basil, pernambuco, rosemary, thyme, jojoba, almond, and coconut oils are used for this therapy[36]. It is an ancient concept practised by our ancestors, as it helps nerve stimulation and makes the body and hair glow[37].

2.10 DHT Blockers

Testosterone is the primary hormone responsible for the development of masculine characteristics in men. It plays a crucial role in the development of hormonal changes during puberty, such as muscle growth, facial hair growth, and deepening of the voice. The gonads are typically responsible for producing testosterone. However, after the adult stage, testosterone's role changes, and it gets converted into DHT. Dihydrotestosterone (DHT) exhibits a greater binding affinity for prostatic

Table 4. Plants used as DHT blockers

Sl. No.	Botanical name	Common name	Chemical constituents	Mechanism of action	References
1	*Bacopa monnieri* Linn	Brahmi	Alkaloids	Activate proteins	51,52
2	*Acacia concinna*	Shikakai	Terpenoids	Used as a hair cleanser	53
3	*Nardostachys jatamansi*	Jatamansi	Nardal, Jatamansic Acid	Prolongation of the anagen phase	54,55
4	*Trigonella foenum graecum*	Fenugreek	Alkaloids, Polyphenol	5-α reductase inhibitor	56
5	*Allium cepa*	Onion	Terpenoids	5-α reductase inhibitor	47,57
6	*Hibiscus rosa-sinensis* Linn	Gurhal	Polyphenol	5-α reductase inhibitor	58,59
7	*Betula pendula*	Birch	Polyphenol	Extract of leaves used as an anti-dandruff.	60
8	*Polyporus umbellatus*	Umbrella Polypore.	Polysaccharides and Sterol	Stimulate the regrowth of hair	45,61
9	*Brassica* spp.	Mustard	Tannin and Flavonoids	Prevent the testosterone-induced inhibition of (DP) cells.	62
10	*Camellia sinensis*	Green Tea	Catechins Epicatechins	5-α reductase inhibitor	45,63
11	*Boehmeria nipononivea*	Ramie		5-α reductase inhibitor	64
12	*Calendula officinalis*	Marigold	Flavonoids	Used for a smoothing effect	65
13	*Buxus wallichiana*	Papri	Alkaloids	5-α reductase inhibitor	45,66
14	*Capsicum annum*	Pepper	Isoflavones	Nerve stimulants	47,67
15	*Ginkgo biloba*	Maidenhair-tree	Polyphenol	Improve inflammatory response.	45,68
16	*Citrullus colocynthis*	Indrayan	Glycosides	Hair follicles in the anagenic phase	39,45,47
17	*Panax ginseng*	Korean ginseng	Glycosides, Flavonoids	Antiapoptotic effects	39,69,70
18	*Eclipta alba*	Bringraj	Glycosides	Anagen phase enlargement	47,69,71

androgen receptors than testosterone. 5α-reductase, existing as two isoenzymes, is responsible for DHT synthesis. The Type II isoenzyme, predominantly found in prostate tissue, seminal vesicles, epididymides, hair follicles, and the liver, contributes approximately two-thirds of circulating DHT.

Once we understand the established role of DHT in hair loss, we should use herbs with noticeable 5-α-reductase blocking activity for treating Alopecia, especially androgenetic alopecia. Some herbs have proven DHT-blocking activity and have the potential to inhibit 5-α-Reductase, such as Green Tea (*Camellia sinensis*), Dodder seed (*Cuscuta reflexa)*, and *Panax ginseng*, among others[50].

3. Summary

Natural drugs have been used for centuries to promote hair growth and health in various formulations. This review has explored the methods and efficacy of multiple

Table 5. Plants used as DHT blockers

Sl. No.	Botanical name	Common name	Chemical constituents	Mechanism of action	References
1	*Lawsonia inermis*	*Bringraj*	Flavonoids, Terpenoids	Inactive telogen phase to active anagen phase	72,73
2	*Lawsonia inermis*	*Bringraj*	Flavonoids, Terpenoids	Inactive telogen phase to active anagen phase	72,73
3	*Lygodii spora*	Climbing fern	Oleic, Linolenic And Palmitic Acids	5-α reductase inhibitor	45,74
4	*Cuscuta reflexa*	*Akashbel*	Flavonoids, Steroids	5-α reductase inhibitor	45,69
5	*Polygonium multiflorum Thumb*	**Tuber fleece flower**	Flavonoids, Glycosides	5-α reductase inhibitor	47,69,75
6	*Tridax procumbens*	*Ghamra*	Alkaloids, Flavonoids	Enhanced microcirculation around hair follicles.	45,76
7	*Pueraria thunbergiana*	*Kudzu*	Alkaloids, Flavonoids	5-α reductase inhibitor	69,77,78
8	*Asiasari radix*	*Maek*	Terpenoids, Flavonoids, Glycosides	Induction of the anagen phase	47,69,79
9	*Punica granatum*	Pomegranate	Polyphenols, Vitamins, Flavonoids, Tannins and Iron,	Transition from the telogen to the anagen phase.	69,80
10	*Acanthopanax koreanum*	Acanthopanax root bark	Acanthoic Acid Acankoreoside J, Lupine-Triterpene.	Regulating the hair cycle	69,81
11	*Coffea arabica*	Coffee	Caffeine, Sterols, Diterpenes	Prolongation of the anagen phase	69,81
12	*Crataegus pinnatifida*	Mountain hawthorn	Terpenoids, Quercetin and Steroids,	Induce the anagen phase	69,82,83
13	*Carthamus tinctorius*	Safflower	Flavonoids, Oleic and Linoleic Acids,	5-α reductase inhibitor	84,85
14	*Malus pumila*	Apple	Procyanidin B2, Phytosterols, Vitamins	Increase in keratin production	69,86,87
15	*Juglans regia* L	Walnut	Alkaloids, Flavonoids, and Polyphenols	Increases blood circulation and oxygen supply	39,88,89
16	*Cicer areitinum*	Chickpeas	Alkaloids, Flavonoids, and Steroids	Fast hair growth initiation and completion time	90
17	*Moringa oleifera*	**Sahjan**	Flavonoid, quercetin, vitamin C and vitamin A	Inhibit 5-alpha reductase enzymes	91–93
18	*Musa acuminata*	Banana flower	Proanthocyanidin	Inhibit DHT production	94,95

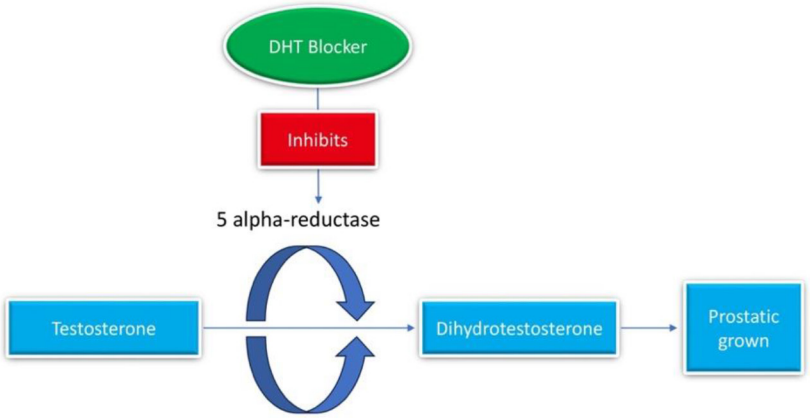


Figure 2. Mechanism of action of DHT blocker.

therapies, including Ayurvedic, hair transplantation, acupuncture, mesotherapy, aromatherapy, and surgical hair restoration. The study states that herbal drugs prolong the anagen phase by activating protein, providing nutritional support, cleansing, and preventing the testosterone-induced inhibition of (DP) cells as a 5α reductase inhibitor.

The 5-alpha reductases (5α-Rs) are a group of enzymes present in various organs and tissues[96]. The 5α-Reductase family consists of five enzymes, including three main isotypes (5α-R 1, 2, and 3) associated with steroidogenesis and two other trans-2,3-enoyl-CoA reductases (TECR and TECR-like)[97]. DHT demonstrates a higher potency in binding to the androgen receptor than testosterone[98]. DHT demonstrates a higher potency in binding to the androgen receptor than testosterone. 5 Alpha Reductase Inhibitors work by inhibiting 5α-reductase, thereby curtailing DHT synthesis. The enzyme 5-alpha reductase facilitates the transformation of testosterone into dihydrotestosterone (DHT)in the presence of NADPH. This conversion influences several processes, notably prostate enlargement, the development of acne, increased facial hair growth, and male pattern baldness. The 5-alpha reductase inhibitors work by reducing the activity of this enzyme. This review suggests that these herbs may have potential in promoting hair growth and treating various forms of hair loss. Figure 2[99,100].

4. Conclusion

In this article, information has been collected on the herbal drugs used for alopecia to understand the exact mechanism of action and the compounds responsible for their activity. The audit may provide a case for typical solutions to the troubling and upsetting issue of balding in the workplace. Our current approach utilises drugs targeting a subset of 5-alpha reductase inhibitors that play a significant role due to their anti-androgenic effects and favourable safety and efficacy profiles. In Alopecia, male and female-pattern baldness are effects of androgenic receptor activation; therefore, reducing levels of DHT also reduces hair loss in both. The results have improved because researchers now have a better understanding of the factors controlling hair follicles. Continuous clinical and basic research can further improve our understanding of this widespread disorder.

5. Author Contribution

SS: Conceived the idea, collected literature, and wrote the first draft; GPM: Critically reviewed the manuscript; SK: Sketched compelling and informative diagrams. All authors have read and agreed to the published version of the manuscript.

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