



Research Article

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EXPLORING PLANT SPECIES FOR HAIR FALL PREVENTION AND HAIR GROWTH PROMOTION: A COMPREHENSIVE REVIEW

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ABSTRACT

Background- Mammals' hair has a purpose beyond its physiological function. Culturally, hair is a blank canvas on which one can express oneself and evoke previous and present fads. Today, significant hair loss might be caused by hormonal changes, genetics, a skin problem, or old age. Between 0.2 and 4% of the world's population has this disease, which often worsens physical and mental health. Recent research has focused on herbal hair growth remedies. Natural and alternative medicines are gaining popularity. **Methods-** Natural therapies, such as plants with therapeutic properties, are being studied to reduce hair loss and grow hair. A comprehensive analysis of plant species researched for hair loss and growth is provided. **Result-** The review uses traditional knowledge and scientific studies to describe how these plants work, their active components, and their advantages. To determine the efficacy and safety of these plant-based interventions, standardized research protocols, and clinical trials are needed due to differences in study methods, plant preparations, and individual responses. **Conclusion-** As interest in natural hair care grows, understanding the pros and cons of different plant species is crucial for establishing evidence-based hair fall prevention and growth solutions.

INTRODUCTION

Hair, an excellent and adaptable part of the human body, is essential in our lives, civilizations, and self-expression. Hair has become a canvas for personal style, cultural identity, and even a reflection of health, in addition to its utilitarian tasks of covering the scalp and regulating body temperature. Hair biology demonstrates the complicated workings of the human body [1]. Hair provides both defensive and sensory purposes, acting as an insulator against the weather and delivering tactile feedback. Understanding the stages of hair growth, from anagen (growing)

to catagen (transition) to telogen (resting), illustrates the dynamic nature of what appears to be a static feature [2]. Hair has acquired enormous cultural significance across nations and throughout history. It has been used to express individuality, religious commitment, and social position. Expensive hairstyles represented wealth and power in some communities, while hair played an important role in rites of passage and ceremonies in others [3]. Hair loss is a natural occurrence that happens every day. However, it cannot be the primary cause of hair loss. Every human hair strand goes through a genetic cycle of growth,

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stabilization, aging, and shedding. On average, the human scalp sheds 50-125 hairs daily, yet most of them grow back after the resting stage since the follicles are not damaged [4]. A person may experience excessive hair loss as a result of drug exposure, poor clinical health, pregnancy, pollution, stress, inactivity, insufficient sleep, malnutrition, etc. Additionally, some experts think that the hormones dihydrotestosterone, sulfonated dehydroepiandrosterone, and testosterone and its derivatives play a significant role in hair loss [5].

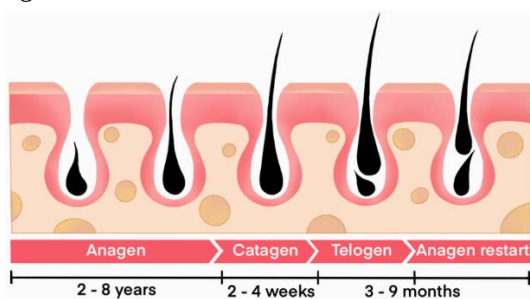


Fig 1: Hair growth cycle

Androgenetic alopecia (AGA) is a type of non-cicatricial or common baldness that affects both men and women at any age, from puberty to senescence. It is brought on by an excessive reaction of androgens. The development and differentiation of sebaceous glands, hair growth, the epidermal barrier's strength, and skin function aspects related to wound healing are the main effects of androgens [6]. AGA is diagnosed based on clinical symptoms and family history because it is primarily genetic in origin. The likelihood of having AGA is significantly higher in males with a family history of baldness than it is in men without such a history, according to evidence from family studies. Positive maternal family history may also enhance the likelihood of having AGA [7, 8, 9].

MATERIAL AND METHODS

A systematic literature search was conducted across scientific databases, including PubMed, Scopus, and Web of Science. The search terms included "Plant species helpful for the hair fall and hair growth managements and related variations. Relevant studies were identified, and data extraction was performed on the selected studies. Herbal components play a significant role in hair fall management and hair related diseases. Herbal treatments are becoming more and more popular as a result of their wide availability, therapeutic effectiveness, lack of side effects, affordability, and simplicity of preparation [10]. Hair tonics and hair grooming aids, mostly made using extracts of medicinal plants in oil bases, are the two main categories into

which hair care products are categorized. Most herbal hair care products, such as hair oils, serums, tonics, and conditioners, reverse dry scalp and condition dry hair while promoting optimal scalp moisture levels. They are packed with several vital nutrients that support the sebaceous gland's healthy function and encourage the growth of healthy hair [11]. Here are several natural herbal plant species found that have promising contributions in effectively controlling hair falls and hair growth promotion as below

1. *Bacopa monnieri* (L.) Wettst.

Bacopa monnieri, sometimes referred to as Brahmi or Water Hyssop, is a perennial herb from the *Scrophulariaceae* family. It is indigenous to wetlands and marshy regions in India, Southeast Asia, Australia, and North and South America. It possesses an extensive historical background in traditional medicine, namely in Ayurveda, where it is highly regarded as a helpful plant for augmenting cognitive function and memory [12]. *Bacopa monnieri* is an aquatic, fleshy herb that spreads horizontally and thrives in areas with limited water depth or damp soil. The plant possesses little, elongated foliage that exhibits a vibrant green hue and frequently displays a succulent texture [13]. The plant has the ability to generate little, white or pale blue flowers that consist of five petals. *Bacopa monnieri* comprises a range of biologically active substances, such as bacosides, alkaloids, saponins, and flavonoids. Alkaloids aid in the detoxification of hair follicles and enhance blood circulation in the scalp. Saponins deeply penetrate the scalp, effectively cleanse it, and enhance blood circulation [14].

2. *Tridax procumbens* (L.)

Tridax procumbens, often called coat buttons or tridax daisy, is a flowering plant belonging to the *Asteraceae* family. Originally indigenous to the American tropics, this plant has successfully established itself in several regions across the globe, including as Asia, Africa, and Australia. This plant is renowned for its little, daisy-like blossoms and is frequently seen as a nuisance in numerous areas owing to its adaptability to thrive in diverse environments. *Tridax procumbens* harbours a diverse range of bioactive chemicals, such as saponins, terpenes, flavonoids, tannins, carotenoids, and alkaloids. Flavonoids assist in the restoration of hair follicle damage. Alkaloids cleanse the hair follicles and enhance blood circulation. Tannins constrict the hair cuticles, resulting in a more polished and lustrous appearance [15].

3. *Nardostachys jatamansi* (D.Don) DC.

Nardostachys jatamansi, also referred to as "Jatamansi" or "Spikenard," is a perennial herbaceous plant classified under the *Valerianaceae* family. The plant is indigenous to the Himalayan region encompassing India, Nepal, Bhutan, and Tibet. This plant has historically been utilized for its therapeutic and fragrant characteristics. *Nardostachys jatamansi* is rich in diverse bioactive chemicals, such as sesquiterpenes, coumarins, alkaloids, lignans, and neolignans. Sesquiterpenes stimulate hair growth [16].

4. *Panax ginseng*

Panax ginseng, also referred to as Korean ginseng or Asian ginseng, is a perennial herbaceous plant belonging to the *Araliaceae* family. It is a well-known medicinal plant with a long history of usage in traditional Chinese medicine. Renowned for its inherent therapeutic properties, it is frequently employed as a botanical treatment. *Panax ginseng* is composed of a diverse range of bioactive substances such as Ginsenosides, ginseng oils, sesquiterpenes, saponins, polyacetylenes, polysaccharides, peptidoglycans, steroid, choline, vitamins B, C, E, unsaturated fat, starches, and amino acids. Ginseng oils stimulate hair growth. Saponins infiltrate and purify the scalp, stimulating blood circulation. Sesquiterpenes additionally stimulate the growth of hair [17].

5. *Emblica officinalis* Gaertn.

Emblica officinalis, commonly referred to as Indian gooseberry or amla, is a fruit-bearing tree that originates from India and other regions of South Asia. It belongs to the *Phyllanthaceae* family. *Emblica officinalis* comprises a range of bioactive constituents, such as vitamin C, Gallic acid, ellagic acid, tannins, flavonoids, and polyphenols. Gallic acid exhibits antioxidant effects. Ellagic acid is utilised in the treatment of typical hair loss. Tannins constrict the hair cuticles, resulting in hair that is smoother and more lustrous. Flavonoids help the process of repairing and regrowing hair follicles [18].

6. *Centella asiatica* (L.) Urb.

Centella asiatica, also referred to as Gotu Kola, is a little herbaceous plant belonging to the *Apiaceae* family. This species is indigenous to Asian wetlands and is frequently encountered in nations such as India, Sri Lanka, and Southeast Asia. This plant has a rich historical background in both Ayurvedic and

traditional Chinese medicine. *Centella asiatica* comprises a range of bioactive substances, such as triterpenoid saponins, flavonoids, alkaloids, tannins, and essential oils. Triterpenoid saponins have the potential to enhance hair and scalp health by moisturising and nourishing the hair. Flavonoids help the process of repairing and regenerating hair follicles. Tannins constrict hair cuticles, resulting in hair that is smoother and more lustrous [19].

7. *Aloe barbadensis* Mill.

Aloe barbadensis Mill., also referred to as Aloe Vera, is a succulent plant species from the *Asphodelaceae* family. It is extensively grown for its therapeutic and cosmetic applications. This particular Aloe plant is classified among a group of more than 500 species. However, it stands out as the most renowned and intensively researched due to its numerous health advantages. *Aloe barbadensis* Mill comprises a diverse range of bioactive constituents, including as polysaccharides, anthraquinones, enzymes, flavonoids, vitamins and minerals, amino acids, plant sterols, polyphenols, and carotenoids. Flavonoids help the process of repairing and regenerating hair follicles. Polyphenols possess antioxidative effects. Minerals promote the growth and well-being of hair [20].

8. *Ocimum sanctum* L.

Ocimum sanctum, also referred to as Holy Basil or Tulsi, is a type of basil that belongs to the *Lamiaceae* family. It is indigenous to Southeast Asia. The plant holds great reverence in Hindu culture and is renowned for its medicinal and fragrant attributes. *Ocimum sanctum* is rich in a variety of bioactive components such as phenolics, flavonoids, terpenoids, fatty acid derivatives, and essential oils. Phenolics are employed in the treatment of alopecia areata (AA). Flavonoids help the process of repairing and regrowing hair follicles. Essential oils effectively restore damage to both the hair scalp and shaft. Terpenoids promote the growth of hair follicles [21].

9. *Cuscuta reflexa* Roxb.

Cuscuta reflexa Roxb. is a parasitic angiosperm of the family *Convolvulaceae*, usually referred to as gigantic dodder or amar bel. This plant exhibits slender, yellow to orange stems that are devoid of chlorophyll, rendering it completely reliant on its host plants for sustenance. *Cuscuta reflexa* exhibits a broad geographical distribution, spanning tropical and subtropical

areas, encompassing places in Asia, Africa, and Australia. *Cuscuta reflexa* Roxb. is rich in a variety of bioactive substances such as flavonoids, alkaloids, saponins, steroids, and polysaccharides. Flavonoids help the process of repairing and regrowing hair follicles. Alkaloids cleanse the hair follicles and enhance blood circulation. Saponins permeate the scalp, purify, and enhance blood circulation. Polysaccharides promote the process of hair renewal and enhance its strength [22].

10. *Eclipta prostrata* L.

Eclipta prostrata L., also referred to as False Daisy, is a therapeutic botanical specimen classified within the *Asteraceae* family. This herbaceous plant exhibits a creeping or prostrate growth habit, with branches that extend horizontally along the ground. This species is indigenous to tropical and subtropical areas and has a broad distribution throughout Asia, encompassing India, China, and Southeast Asia. *Eclipta prostrata* L. is rich in a diverse range of bioactive substances such as alkaloids, coumestans, flavonoids, polyacetylenes, triterpenes, and thiopenes. Alkaloids cleanse the hair follicles and enhance blood circulation. Coumestans, by virtue of their estrogenic properties, stimulate the growth of hair. Flavonoids help the process of repairing and regrowing hair follicles [23].

11. *Nyctanthes arbor-tristis* L.

Nyctanthes arbor-tristis L., commonly known as the "Night-flowering Jasmine" or "Parijat," is a small to medium-sized deciduous tree belonging to the *Oleaceae* family. Native to Southeast Asia, particularly India, Bangladesh, and Myanmar, this plant is renowned for its fragrant, white, and orange flowers that bloom at night and fall off by the morning, creating a captivating and ephemeral spectacle. *Nyctanthes arbor-tristis* L. contains various bioactive compounds including Flavonoids, glycoside, essential oils, tannic acid, carotene, benzoic acid. Flavonoids aid in hair follicle repair and regrowth. Glycosides aid in hair regrowth and reduce the time for hair growth completion. Essential oils repair hair scalp and shaft damage. Tannic acid has antioxidant and anti-inflammatory properties that benefit hair health. Carotene and vitamins effectively reduce hair loss and increase hair growth [24].

12. *Trigonella foenum-graecum* L.

Trigonella foenum-graecum L., commonly known as fenugreek, is an annual herb belonging to the *Fabaceae* family. This

versatile plant is native to the Mediterranean region, including southern Europe, western Asia, and northern Africa. Fenugreek is well-adapted to a variety of habitats, thriving in both semi-arid and arid conditions. It often grows in cultivated fields, along roadsides, and in disturbed areas. *Trigonella foenum-graecum* L. contains various bioactive compounds including Alkaloids, flavonoids, saponins, fibers, proteins, vitamins (A, B, C), minerals (calcium, phosphorus, iron). Alkaloids detoxify the hair follicles and promote blood circulation. Flavonoids aid in hair follicle repair and regrowth. Saponins penetrate the scalp, cleanse, and promote blood circulation. Proteins, vitamins, and minerals nourish hair follicles and promote healthy growth [25].

13. *Hibiscus rosa-sinensis* L.

Hibiscus rosa-sinensis L., commonly known as the Chinese hibiscus or shoe flower, is a vibrant and ornamental flowering plant that belongs to the *Malvaceae* family. Native to East Asia, specifically China, Taiwan, and Malaysia, this tropical evergreen shrub has found widespread cultivation in various tropical and subtropical regions around the world. *Hibiscus rosa-sinensis* L. contains various bioactive compounds including Flavonoids, glycosides, mucilage, anthocyanins, vitamins (A, C), minerals (calcium, phosphorus, iron). Flavonoids aid in hair follicle repair and regrowth. Anthocyanins and vitamins promote hair growth. Mucilage acts as a natural hair conditioner, promoting hair health and shine [26].

14. *Mangifera indica* L.

Mangifera indica L., commonly known as the mango tree, is a species of flowering plant belonging to the *Anacardiaceae* family. Native to South Asia, specifically the Indian subcontinent, the mango tree has been cultivated and naturalized in various tropical and subtropical regions around the world. It is renowned for its delicious and aromatic fruits, which are one of the most popular and widely consumed tropical fruits globally. *Mangifera indica* L. contains various bioactive compounds including Flavonoids, phenolic compounds, vitamins (A, C, E), minerals (calcium, phosphorus, iron). Flavonoids aid in hair follicle repair and regrowth. Vitamins and minerals nourish hair follicles and promote healthy growth [27].

15. *Lawsonia inermis* L.

Lawsonia inermis L., sometimes referred to as henna and classified under the family *Lythraceae*, is a flowering plant that

possesses cultural, cosmetic, and medical importance. *Lawsonia inermis* is indigenous to northern Africa, western and southern Asia, and northern Australasia. It flourishes in arid and semi-arid areas with soils that have good drainage. Henna is highly esteemed for its foliage, which, when desiccated and pulverised, yields a natural pigment with a reddish-brown tint. *Lawsonia inermis* L. is rich in bioactive components such as Lawsone, mannitol, tannins, gallic acid, glucose, and proteins. Lawsone possesses antibacterial qualities that help enhance the health of the scalp. Proteins provide essential nutrients to the hair and stimulate the process of hair development. Tannins constrict the hair cuticles, resulting in a more polished and lustrous appearance of the hair [28].

16. *Rosmarinus officinalis* L.

Rosmarinus officinalis L., also referred to as rosemary, is an aromatic and adaptable perennial shrub that belongs to the *Lamiaceae* botanical family. This herbaceous plant is indigenous to the Mediterranean region, flourishing in well-drained, sunlit settings with sandy or stony soils. Rosemary is distinguished by its slender foliage that emits a unique scent reminiscent of pine when compressed. The upper surface of the leaves is a rich green colour, while the underside is silver-gray, creating a visually appealing contrast. *Rosmarinus officinalis* L. is a plant that includes a variety of bioactive chemicals, such as Rosmarinic acid, essential oils (such as cineole and camphor), and flavonoids. Rosmarinic acid promotes hair development and aids in the prevention of hair loss. Essential oils enhance scalp health and stimulate blood circulation, hence promoting hair growth. Flavonoids help the process of repairing and regrowing hair follicles [29].

17. *Amaranthus spinosus* L.

Amaranthus spinosus L. is a flowering plant in the *Amaranthaceae* family, commonly referred to as spiny amaranth. This perennial herbaceous plant is distinguished by its erect growth style and unique bristly, thorny characteristics along the stems and leaves, which confer its popular name. *Amaranthus spinosus* L. is rich in bioactive components such as Squalene, alpha-tocopherol, flavonoids, betacyanins, and minerals like calcium, iron, and zinc. Squalene and alpha-tocopherol possess antioxidant qualities that contribute to the enhancement of hair health. Flavonoids help the process of repairing and regrowing hair follicles. Minerals provide essential

nutrients to hair follicles, supporting robust and vigorous development [30].

18. *Sesamum indicum* L.

Sesamum indicum L., also referred to as sesame, is a yearly blooming plant classified under the *Pedaliaceae* family. Originally indigenous to Africa, this adaptable plant is currently farmed in many tropical and subtropical climates across the globe. Sesame is highly prized for its seeds that are abundant in oil and are frequently utilised in culinary applications due to their nutritional advantages. *Sesamum indicum* L. is rich in bioactive components such as Sesamin, sesamol, vitamins (B, E), and minerals (calcium, magnesium, iron, zinc). Sesamin and sesamol enhance hair growth by providing nourishment to the hair follicles. Vitamins and minerals contribute to the overall well-being and development of hair [31].

19. *Psidium guajava* L.

Psidium guajava L., also referred to as guava, is a tropical fruit tree that falls within the *Myrtaceae* family. Originally indigenous to Central America, it has subsequently disseminated to diverse tropical and subtropical locations across the globe. This perennial shrub or little tree is renowned for its fragrant foliage, white blossoms, and spherical or elliptical fruits. *Psidium guajava* L. is rich in bioactive substances such as flavonoids, phenolic compounds, essential oils, vitamins (A, C, B), and minerals (calcium, phosphorus, iron). Flavonoids help the process of repairing and regrowing hair follicles. Essential oils enhance the condition of the scalp and promote the growth of hair. Vitamins and minerals provide essential nutrients to hair follicles, supporting their health and stimulating development [32].

20. *Azadirachta indica*

Azadirachta indica, sometimes referred to as Neem and classified under the *Meliaceae* family, is a resilient and adaptable tree that thrives in diverse environments. Endemic to the Indian subcontinent, it is distributed across nations including India, Bangladesh, Sri Lanka, and Pakistan. Neem trees have successfully acclimated to diverse environmental circumstances, flourishing in both dry and partially dry locations. They commonly inhabit tropical and subtropical regions characterised by a wide temperature range, from hot to somewhat cool. *Azadirachta indica* comprises a diverse range of bioactive

substances such as Nimbin, nimbidin, azadirachtin, flavonoids, fatty acids, vitamin E, and minerals such as sulphur, iron, and zinc. Nimbidin and nimbin possess antifungal and antibacterial activities that facilitate the maintenance of a healthy scalp. Azadirachtin stimulates hair follicles, hence promoting hair growth. Flavonoids help the process of repairing and regrowing hair follicles. Vitamin E and minerals promote optimal hair well-being [33].

21. *Althaea officinalis* L.

Althaea officinalis L., sometimes referred to as marshmallow, is a perennial herbaceous plant classified under the *Malvaceae* family. This plant is indigenous to Europe, Western Asia, and North Africa. It flourishes in diverse environments, displaying a specific preference for moist and swampy regions. *Althaea officinalis* L is typically found on the periphery of marshes, riverbanks, and other wetlands, which serve as its native habitat. *Althaea officinalis* L is rich in a variety of bioactive components such as polysaccharides, flavonoids, mucilage, tannins, and phenolic acids. Polysaccharides and mucilage enhance the condition and nourishment of the hair, so promoting its health and imparting a glossy appearance. Flavonoids help the process of repairing and regenerating hair follicles. Tannins constrict the hair cuticles, resulting in a more polished and lustrous appearance [34].

22. *Citrus limon* (L.) Osbeck

Citrus limon (L.) Osbeck, also referred to as lemon and classified under the *Rutaceae* family, is a compact evergreen tree indigenous to Asia. The lemon tree is grown for its vibrant yellow, ellipsoidal fruit, which is utilised for both culinary and medicinal applications. *Citrus limon* flourishes in subtropical and tropical areas, preferring well-drained soils with a pH that ranges from slightly acidic to neutral. These trees necessitate a tropical climate, characterised by temperatures that fall within the range of 77°F to 86°F (25°C to 30°C), and are vulnerable to frost. Sufficient sunlight is essential for proper growth, and they typically inhabit regions that offer unrestricted exposure to direct sunlight. *Citrus limon* (L.) Osbeck is rich in a variety of bioactive components such as Limonene, citric acid, flavonoids, vitamins C, minerals (calcium, phosphorus). Limonene enhances the activity of hair follicles and facilitates the growth of hair. Flavonoids help the process of repairing and regrowing hair

follicles. Vitamins and minerals provide essential nutrients to hair follicles, stimulating robust growth [35].

23. *Acalypha indica* L.

Acalypha indica L. is a tropical and subtropical plant species belonging to the *Euphorbiaceae* family, popularly referred to as Indian copperleaf or Indian nettle. This herbaceous plant is indigenous to Southeast Asia and can be observed in several environments, encompassing open fields, grasslands, waste regions, and disturbed places. *Acalypha indica* exhibits a high degree of adaptability to several environmental circumstances and is capable of flourishing in both humid and arid soils. *Acalypha indica* L is rich in several bioactive substances such as alkaloids, flavonoids, tannins, saponins, and phenols. Alkaloids cleanse the hair follicles and enhance blood circulation. Flavonoids help the process of repairing and regrowing hair follicles. Tannins constrict the hair cuticles, resulting in a more polished and lustrous appearance of the hair [36].

RESULT

The systematic review intended to analyse plant species known for their effective hair care properties by conducting a thorough examination of the existing literature. After conducting a comprehensive search of electronic databases, 23 plant species research were found that satisfied the inclusion requirements. The review analysed studies conducted from 1991 to 2023 on various plant species and their hair care practices. Among the plant species investigated Brahmi (*Bacopa monnieri*), coat buttons (*Tridax procumbens*), Jatamansi (*Nardostachys jatamansi*), Asian ginseng (*Panax ginseng*), Indian gooseberry (*Embllica officinalis*), Gotu kola (*Centella asiatica* (L.) Urb), Aloe Vera (*Aloe barbadensis* Mill), Tulsi (*Ocimum sanctum* L), Giant dodder (*Cuscuta reflexa* Roxb), False daisy (*Eclipta prostrata* L), Night-flowering Jasmine (*Nyctanthes arbor-tristis* L), Fenugreek (*Trigonella foenum-graecum* L), Hibiscus (*Hibiscus rosa-sinensis* L), Mango (*Mangifera indica* L), Henna (*Lawsonia inermis* L), Rosemary (*Rosmarinus officinalis* L), Amaranth (*Amaranthus spinosus* L), Sesame (*Sesamum indicum* L.), Guava (*Psidium guajava* L), Neem (*Azadirachta indica*), Marshmallow (*Althaea officinalis* L), Lemon (*Citrus limon* (L.) Osbeck), Indian nettle (*Acalypha indica* L) were the studied plants. The plants have been extensively researched, and their bioactive compounds have been proven to greatly enhance hair development, repair and rejuvenate hair follicles, supply nutrients, and enhance scalp health.

The investigations showed that these plants displayed different processes that promoted hair development. The 23 plant species mentioned in this study have shown significant benefits for preventing hair loss and promoting hair growth. For example, Brahmi contains a variety of biologically active compounds that aid in detoxifying hair follicles and improving blood circulation in the scalp. Coat buttons help repair hair follicle damage, cleanse the follicles, and improve blood circulation. Jatamansi has a variety of bioactive compounds that promote hair development. Asian ginseng contains a variety of bioactive compounds that can penetrate and cleanse the scalp, promoting increased blood flow. Indian gooseberry, also known as amla, contains ellagic acid which is used in treating common hair loss.

Gotu Kola improves hair and scalp health by hydrating and providing nutrients to the hair. Aloe Vera contains nutrients that support hair development and health. Tulsi contains essential oils that can effectively repair damage to both the scalp and hair shaft. The systematic study offers thorough evidence that supports the use of plant species in hair care treatment. The results emphasised the nutritional significance and bioactive components of plant species in the region, as presented in table 1. The assessment also indicates the necessity for additional research on plant species for their hair care management.

Table 1. Nutritional Value and Active Constituents of Selected Plant Species

SNo.	Plant Spices	Nutritional Value	Active constituent	Ref
1	<i>Bacopa monnieri</i> (Brahmi)	Moisture, Energy, Phosphorus, Calcium, Ash, Protein, Nicotinic acid, Fats, Carbohydrates, Iron, Crude Fiber, Ascorbic Acid, Nicotinic acid.	Bacosides-A, Bacosides-B, Alkaloids, and Alavonoids	37
2	<i>Tridax procumbens</i> (coat buttons)	Protein, Crude Fiber, Carbohydrates, Ascorbic Acid	Procumbenetin (Flavanoid), Saponins, Terpenes, Tannins, Betacarotene (Carotenoids), Akuamidine and Voacangine (Alkaloid)	38
3	<i>Nardostachys jatamansi</i> (Jatamansi)	-	Jatamansone (sesquiterpene), Coumarins, alkaloids, lignans, and neolignans	39
4	<i>Panax ginseng</i> (Asian ginseng)	Calories, Carbohydrates, Protein Fiber, Fat: vitamin C, vitamin B6, vitamin A, Minerals, Phytonutrients	Ginsenosides, ginseng oils, sesquiterpenes, saponins, polyacetylenes, polysaccharides, peptidoglycans, steroid, choline, vitamins B, C, E, unsaturated fat, starches, and amino acids	40
5	<i>Emblica officinalis</i> (Indian gooseberry)	vitamin C, vitamin B1, vitamin B2, vitamin B3, vitamin B5, vitamin E, Fiber, Minerals, Amino Acids, Carbohydrates, Water	vitamin C, Gallic acid, ellagic acid, tannins, flavonoids, polyphenols	41
6	<i>Centella asiatica</i> (L.) <i>Urb</i> (Gotu kola)	Vitamin C, Calcium, Potassium, Dietary Fiber, Protein, Energy, Carbohydrates, Fats	asiaticosides and madecassosides (triterpenoid saponins), flavonoids, alkaloids, tannins, and essential oils	42
7	<i>Aloe barbadensis</i> Mill. (Aloe Vera)	Water, Vitamin A, Vitamin C, Vitamin E, Vitamin B1, Vitamin B2, Vitamin B3, Vitamin B6, Minerals	Polysaccharides, Aloin and Emodin (Anthraquinones), Amylase and Lipase (Enzymes), Flavonoids, Amino Acids, Campesterol and Beta-Sitosterol (Plant Sterols), Polyphenols, Carotenoids	43
8	<i>Ocimum sanctum</i> L. (Tulsi)	vitamin A, vitamin C, and vitamin K, calcium, phosphorus, iron, and potassium,	Eugenol (Phenol), Ocimumosides A and B (Saponins), Ursolic acid, Rosmarinic acid, essential oils, flavonoids.	44

SNo.	Plant Spices	Nutritional Value	Active constituent	Ref
9	<i>Cuscuta reflexa</i> Roxb (Giant dodder)	Dodder has no nutritional value, as it relies on its host for nutrition.	kaempferol, quercetin, and rutin (Flavanoids), alkaloids, saponins, steroids, polysaccharides	45
10	<i>Eclipta prostrata</i> L (False daisy)	vitamins and minerals, wedelolactone, dimethyl wedelolactone, eclalbatin	Alkaloids, coumestans, flavonoids, polyacetylenes, triterpenes, thiopenes	46
11	<i>Ysthanthes arbor-tristis</i> L (Night-flowering Jasmine)	-	Hesperidin and Quercetin (Flavonoids), glycoside, essential oils, tannic acid, carotene, benzoic acid	47
12	<i>Trigonella foenum-graecum</i> L (Fenugreek)	Calories, Protein, Fats, Carbohydrates, Minerals, Vitamins	diosgenin, yamogenin, tigogenin, and neotigogenin (Saponins), vitexin, isovitexin, and quercetin (Flavanoids), Alkaloids, fibers, proteins, vitamins (A, B, C), minerals (calcium, phosphorus, iron)	48
13	<i>Hibiscus rosa-sinensis</i> L (Chinese hibiscus)	calcium, phosphorus, iron, vitamins A, vitamin C	Flavonoids, glycosides, mucilage, anthocyanins,	49
14	<i>Mangifera indica</i> L. (Mango)	Calories, Carbohydrates, Dietary Fiber, vitamins A, vitamins C, vitamins E, calcium, phosphorus, iron, Potassium, Magnesium	Quercetin (Flavonoids), gallic acid, catechins, and epicatechins (phenolic compounds), stearic acid, oleic acid, and linoleic acid (Fatty Acids)	50
15	<i>Lawsonia inermis</i> L (Henna)	Protein, Fiber, vitamin A, vitamin C, calcium, magnesium, phosphorus, and potassium	Lawson, mannitol, tannins, gallic acid, glucose, proteins	51
16	<i>Rosmarinus officinalis</i> L (rosemary)	Vitamin C, iron, calcium, potassium, Dietary Fiber. Essential Oils	Rosmarinic acid, cineole, camphor (essential oils), Apigenin, luteolin, diosmin (flavonoids), Betulinic acid, oleanolic acid (Triterpenes)	52
17	<i>Amaranthus spinosus</i> L (spiny amaranth)	Protein, vitamin A, vitamin C, folate, calcium, iron, phosphorus, potassium, dietary fiber	Saponins, Flavonoids, Triterpenoids, Phytosterols, Alkaloids	53
18	<i>Sesamum indicum</i> L. (sesame)	Calories, Protein, Fat, Carbohydrates, Vitamins, Minerals	Sesamin, sesamol, Sesamol, Protein, Fatty Acids, Fibers	54
19	<i>Psidium guajava</i> L. (Guava)	Water Content, Calories, Carbohydrates, Protein, Dietary Fiber, Fats, Vitamins A, Vitamins C, Vitamins K, Vitamins B9, Potassium, Copper, manganese, magnesium	quercetin, catechin, epicatechin (Flavanoids), Dietary Fiber, Tannins, Essential oils, Alkaloids	55
20	<i>Azadirachta indica</i> (Neem)	Protein, Fiber, vitamin C, vitamin A, vitamin B3, vitamin B1, calcium, magnesium, potassium, iron	oleic acid, linoleic acid, palmitic acid (fatty acids), Nimbin, nimbidin, azadirachtin, Quercetin (Flavanoids)	56
21	<i>Althaea officinalis</i> L. (Marshmallow)	Dietary Fiber, Vitamins, Minerals, Calories	Mucilage, Polysaccharides, flavonoids, tannins, and phenolic acids	57
22	<i>Citrus limon</i> (L.) <i>Osbeck</i> (Lemon)	Calories, Water content, Protein, Carbohydrates, Fat, Vitamin C, Vitamin B6, Folate, Potassium	Limonene, beta-pinene, gamma-terpinene, citric acid, flavonoids, Pectin	58

SNo.	Plant Spices	Nutritional Value	Active constituent	Ref
23	<i>Acalypha indica</i> L. (Indian nettle)	Proteins, vitamin A, vitamin C, calcium, iron, phosphorus	alkaloids, flavonoids, tannins, saponins, and phenols, Triterpenoids, Sterols, Fatty Acids	59

DISCUSSION

The systematic investigation into the utilisation of plant species to prevent hair loss and stimulate hair growth provides valuable insights into the diverse plant life of the region and its historical significance in hair care. This thorough investigation adds to the existing knowledge on medicinal plants that benefit hair health and emphasises the importance of investigating diverse biodiversity for creating new therapeutic treatments. The review highlighted various plant species that have been researched for their potential advantages in hair care management, with some nutritional importance and active constituents as shown in table 1 including Brahmi (*Bacopa monnieri*), coat buttons (*Tridax procumbens*), Jatamansi (*Nardostachys jatamansi*), Asian ginseng (*Panax ginseng*), Indian gooseberry (*Emblica officinalis*), Gotu kola (*Centella asiatica* (L.) Urb), Aloe Vera (*Aloe barbadensis* Mill), Tulsi (*Ocimum sanctum* L), Giant dodder (*Cuscuta reflexa* Roxb), False daisy (*Eclipta prostrata* L), Night-flowering Jasmine (*Nyctanthes arbor-tristis* L), Fenugreek (*Trigonella foenum-graecum* L), Hibiscus (*Hibiscus rosa-sinensis* L), Mango (*Mangifera indica* L), Henna (*Lawsonia inermis* L), Rosemary (*Rosmarinus officinalis* L), Amaranth (*Amaranthus spinosus* L), Sesame (*Sesamum indicum* L), Guava (*Psidium guajava* L), Neem (*Azadirachta indica*), Marshmallow (*Althaea officinalis* L), Lemon (*Citrus limon* (L.) Osbeck), Indian nettle (*Acalypha indica* L). The plants have been thoroughly studied, and their bioactive components have shown to significantly promote hair growth, repair and regenerate hair follicles, provide nutrients, and improve scalp health. The hair loss and hair growth therapy of these plants is due to the presence of bioactive substances like alkaloids, flavonoids, saponins, phenolic compounds, vitamins, and polysaccharides.

The ingredients work in several ways to activate hair follicles and encourage hair growth by enhancing blood circulation to the scalp, fortifying hair follicles, moisturising the scalp, and relieving issues such as dryness and inflammation. The review emphasises the promise of these plants for hair care but stresses the need for additional research to confirm their effectiveness, establish the best dosage and formulation, and evaluate their safety and any interactions with other treatments. Further

clinical trials with larger sample sizes and longer durations are necessary to confirm the effectiveness and safety of these treatments in human patients, despite promising results from preclinical studies and certain clinical trials.

CONCLUSION

The utilisation of plant species for managing hair loss and promoting hair growth has its roots in traditional practises and is supported by recent scientific study. The active compounds included in several plants can help to a healthy scalp, improved blood circulation, and reduced hair loss. The review employs both indigenous wisdom and empirical research to elucidate the mechanisms of action, bioactive constituents, and benefits of various botanical specimens. Nevertheless, further investigation is necessary to ascertain the effectiveness of these botanical remedies, as well as their safety and underlying mechanisms of action. By integrating these natural remedies into their comprehensive hair care routines, consumers can expand their range of choices for maintaining optimal hair health.

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Nil

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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