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Integrating herbal components into pharmaceutical formulations for hair woes

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Abstract

This study explored the efficacy of herbal hair care products in managing various hair problems. By investigating the potential of natural ingredients to promote hair health, this research examined their impact on common issues such as hair loss, dandruff, and damaged hair. Through a comprehensive review of herbal remedies and their traditional uses, this study aimed to provide valuable insights into developing effective and sustainable solutions for maintaining healthy and vibrant hair. Herbal ingredients are integral part to the formulation of hair care products, offering a natural and holistic approach to maintaining hair health. This review integrates findings from diverse studies, highlighting the bioactive compounds present in herbs and their pharmacological effects on the scalp and hair follicles. The inclusion of herbs in hair care products dates back centuries, with various cultures harnessing the therapeutic properties of plants to address diverse hair concerns. In contemporary times, the demand for natural and sustainable alternatives has propelled the resurgence of herbal formulations. Commonly employed herbs include aloe vera, hibiscus, amla (Indian gooseberry), and fenugreek. Aloe vera, which is renowned for its soothing properties, contributes to scalp health and hydration. Hibiscus, recognized for its richness in vitamins and antioxidants, aids in hair growth and prevents premature graying. Amla, a power house of vitamin C, strengthens hair follicles and promotes overall hair health. Fenugreek, with its protein and nicotinic acid content, supports hair growth and addresses issues such as dandruff. This abstract explores the diverse range of herbal components commonly utilized in hair care formulations, emphasizing their traditional significance and modern scientific validation.

1. Introduction

The most important part of the human body is hair. Its main purpose is to control body temperature. Additionally, it serves as a way organ, lowers friction, and protects against sunlight. A person's hair is their most valuable possession and has a significant impact on their daily existence. In the past, hair on the scalp was thought to serve as a protective covering. One may identify the society to which people belong based on their hair colour, type, and amount (Gahlawat *et al*., 2019). Figure 1 shows the causes of hair problems. Regardless of a person's gender identity, hair also boosts their self-esteem and confidence. A person's dream has always been having black, healthy, shiny, and outstanding hair. All people prioritize keeping and maintaining them, regardless of how long or short they are (Alonso and Fuchs, 2006). Considering the psychological impact on quality of life that is seen in hair disorders, such as hirsutism and baldness, it also has significant effects on sexual and social communication. In addition, it has a sensory function, increasing the awareness of the skin surface for tactile stimulation (Randall and Botchkareva, 2009).

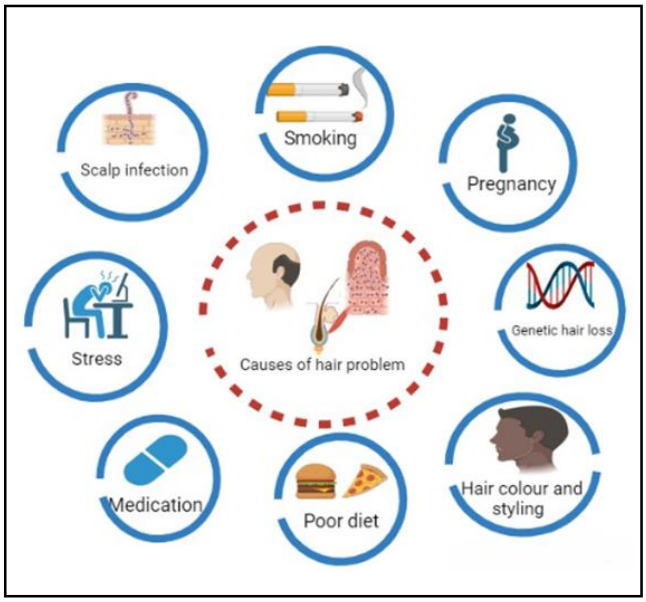

Figure 1: Different causes of hair problems.

Numerous hair decoration techniques, such as the use of certain naturally occurring dyes for hair colouring, have historical roots and have been passed through the ages to contemporary culture (Lascaratos *et al*., 2004). In addition to X-ray diffraction, electron microscopy has been crucial for determining the structure of hair.

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Specifically, transmission electron microscopy (TEM) and scanning electron microscopy (SEM) have revealed the internal structure of hair and have revealed information about the shape of the cuticle (Rogers, 2019). There are several synthetic medications available for hair loss, but they have serious negative impacts and do not provide permanent relief. Herbal treatments may be able to help with these types of problems (Pundkar *et al*., 2020).

2. Types of hair problems

Hair loss and thinning hair are frequent in women but are usually found in men. The most common causes of female hair loss include menopause, hormone alterations, stress, and medication. Hair loss may also be due to hormonal variations, which can be linked to events such as pregnancy, childbirth, menopause, or thyroid disease. Furthermore, many hair style products, which include chemicals or extreme heat, might cause hair loss (Dhot, 2005).

Hair loss may represent a number of medical illnesses, including lupus, diabetes, alopecia areata, and iron deficiency, all of which require treatment to address the root cause of the problem. Hair loss can be a side effect of medications, particularly those used for chemotherapy, blood-thinning medications, or some antidepressants. Stress management is crucial because both physical and emotional stress can cause temporary hair loss (Ebrahimzadeh-Ardakani *et al*., 2021).

Common problems that can arise for numerous reasons include dry hair, split ends, oily/greasy hair, frizzy hair, dull hair, heat-damaged hair, gray hair, and dandruff. Hair health can be affected by deficiencies in nutrition, especially iron, zinc, and vitamins, underlining the need for a balanced diet. Gentle care is necessary since external elements that may damage hair include chemical treatments, tight hairstyles, and excessive hairstyling. Treatments that inhibit the immune system may be necessary for treating autoimmune diseases when the body damages hair follicles. To mitigate this genetic tendency, doctors can prescribe finasteride or minoxidil (Whiting, 2001). Figure 2 describes the types of hair problems and their remedies.

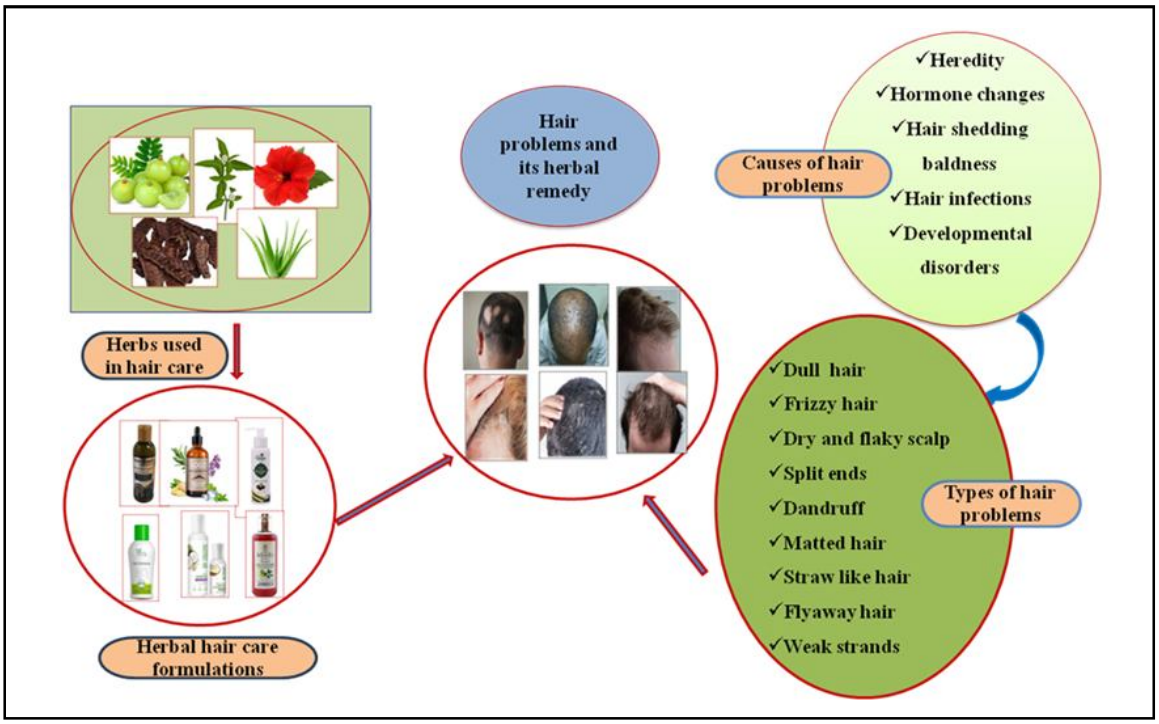

Figure 2: Hair problems and their herbal remedies.

3. Causes of hair problems

3.1 Diet

Hair loss results from the excessive consumption of nutritional supplements such as micronutrients (selenium, vitamin A, and vitamin E) (Finner, 2013). Hair loss, fatigue, bad breath (garlic breath), changes in nails (discolouration, brittleness), nausea, and vomiting are symptoms of exposure to a toxic dose of selenium (Duraisami *et al*., 2021). The occurrence of acute selenium poisoning was linked to the consumption of a liquid nutritional supplement that contained 200 times more selenium than the indicated concentration. Approximately 201 people suffering from selenium overdose experience side effects, 140 of which include hair loss (Macfarquhar *et al*., 2010). After consuming a handful of Ollaria nuts, two otherwise healthy women showed symptoms of selenium poisoning. Twelve days after consumption, 38-year-old women started to lose hair, and two weeks after consumption, 46-year-old women started to lose hair (Muller and Desel, 2010). According to a recent study, obesity accelerates hair thinning and causes hair loss in mice fed a high-fat diet, as evidenced by a reduction in hair follicle stem cells compared to those in mice fed a regular diet (Morinaga *et al*., 2021).

3.2 Chemical exposure

Thorium and mercury are two heavy metals that are strongly linked to an increased risk of alopecia. Research indicates that these substances are harmful to hair (Wu *et al*., 2013; Namba *et al*., 2013).

3.3 Drugs

Gloriosa superba, which is an alkaloid, has high colchicine content. Amyloidosis, Bechet's illness, gout, and familial Mediterranean fever are among the conditions for which colchicine is utilized (Nakamura *et al*., 2012; Murakami *et al*., 2015). The window for therapeutic toxicity and individual differences in tolerance is limited. There are three stages to symptoms of colchicine poisoning. The first phase symptoms include reduced blood volume, diarrhea, leucocytosis, and digestive distress (within the first 24 h after administration of a hazardous colchicine dose). In the second phase, leukopenia, bone marrow hypoplasia, and possibly multiple organ failure occur (from the 2nd to 7th day) (Vijayalakshmi *et al*., 2022). Bone marrow activity renewal, leucocytosis rebound, recovery from failure of multiple organs, and the start of baldness in the third phase (the recovery period begins in the second week). After three to twelve weeks, the hair begins to grow (Levsky *et al*., 2008).

3.4 Diseases or disorders

Hair health is affected by abnormal skin disorders such as tinea capitis, psoriasis, dandruff/seborrheic dermatitis, and atopic dermatitis (Sameemabegum *et al*., 2022)

3.5 Smoking

According to observational research, smoking causes males to go bald, and women suffer from premature graying of hair (Mosley and Gibbs, 1996).

3.6 Genetics

The relationship between a male person's (from the general community) androgenic alopecia expression and their family history of the condition. They reported that the two main risk factors for the occurrence of male-pattern hair loss are age and family history. Other risk factors include hair loss in the mother, father, and maternal grandparents. (Chumlea *et al*., 2004)

3.7 Stress

Stress enhances the likelihood of both hair loss and hair growth suppression. Acute or chronic stress is a major cause of telogen effluvium, a hair growth problem. It also contributes to other hair development disorders, including androgenetic alopecia and alopecia areata (Thom, 2016).

3.8 Menopause

Various physical alterations are frequently caused by menopause, and hair health is no exception. Changes in hormone levels, especially reductions in estrogen levels, can have important impacts on the cycle and quality of hair growth (Chitra *et al*., 2022). Estrogen is necessary for maintaining the strength and thickness of hair; therefore, a decrease in estrogen during menopause can cause hair thinning and increase the likelihood of hair breaking (Goluch-Koniuszy, 2016). Furthermore, changes in hormone levels can lead to an increase in the hormone dihydrotestosterone (DHT), which is related to hair loss and may increase hair thinning and possible balding tendencies. Menopause can cause dry, brittle hair in addition to hair loss because it reduces the production of oil in the scalp, which causes the hair to lose moisture. Hormonal imbalances can also result in a hang-in hair texture, such as increased frizziness or curliness (Mirmirani, 2011).

4. Treatment of hair problems

4.1 Herbs used in hair oil

Several herbs have been added to hair oils due to their supposed capacity to enhance the health, thickness, and growth of hair. These oils are produced by combining a wide variety of beneficial herbs with carrier oils; each herb has unique characteristics that address different hair problems. Herbal oils use the healing properties of nature to strengthen and revitalize hair follicles, stimulate hair growth, nourish the scalp, and reduce dandruff (Banerjee *et al*., 2009). Table 1 and Figure 3 provide an outline of various popular herbs used in hair oils, emphasizing the primary benefits and contributions to the health of hair.

Table 1: The different plants and their phytoconstituents in hair oil

Herbs	Botanical name/family	Phytoconstituents	Purpose	References
Amla	*Phyllanthus emblica* L. (Euphorbiaceae)	Flavonoids-rutin and quercetin, gallic and ellagic acids, tannins, minerals, vitamins, and amino acids	Conditioner	Joshi, 2017
Nirgundi	*Vitex negundo* L. (Lamiaceae)	D-guaiene, germacrene d, and hexadecenoic acid	Growth of hair	Gautam *et al*., 2012
Bringaraj	*Eclipta alba* (L.) Hassk. (Asteraceae)	Luteolin, apigenin, ursolic acid, oleanolic acid, eclalbasaponins, and wedelolactone	Preventing early graying, decreasing dandruff, hydrating dry, lifeless hair	Joshi, 2017
Jatamansi	*Nardostachys jatamansi* (D. Don) DC. (Caprifoliaceae)	Sesquiterpenes and coumarins	Reverses hair graying. It combats dandruff, promotes hair development, and regulate hair loss	Gottumukkala *et al*., 2011
Neem	*Azadirachta indica* A. Juss (Meliaceae)	Glycoproteins, triterpenes, nimbins, saponins, limonoids, flavonoids, tannins, catechins, azadirachtin and gallic acid	Reduce hair loss, minimize dandruff, and encourage hair growth	Majeed *et al*., 2017
Aprajita	*Clitoria ternatea* L. (Fabaceae)	Taraxerol and taraxerone, ternatins, alkaloids, flavonoids, saponins, tannins, and carbohydrates	Prevents hair loss and promotes the growth, free from dandruff	Gautam *et al*., 2012

Shatavari	*Asparagus racemosus* L. (Asparagaceae)	Steroidal glycosides, saponins (shatavarinsi, ii, iii and iv), polyphenols, flavonoids, alkaloids (racemosol)	It promotes faster hair growth. Increases hair luster and shine	Jhadav *et al*., 2018
Methi	*Trigonella foenum-graecum* L. (Fabaceae)	Steroids, alkaloids, saponins, polyphenols, flavonoids, lipids, carbohydrates, and amino acids	To treat dandruff, hair loss, and dry scalp	Banerjee *et al*., 2009
Brahmi	*Bacopa monnieri* L. (Plantaginaceae)	Alkaloids, flavonoids, saponins, bacosides A and B	Reduced dryness, itching, and flakiness	Banerjee *et al*., 2009
Kapur	*Cinnamonum camphora* L. (Lauraceae)	Linalool, cineole and camphor	Softens coarse hair, and helps against split ends and hair breakage	Kashid, 2021
Pudina	*Mentha piperita* L. (Lamiaceae)	Carvone, menthol, isopulegol, pulegone, menthone, cineole, menthofuran, flavonoid glycosides (*e.g.*, narirutin, luteolin-7-0-rutinoside, and hesperidin), and phenolic acids (caffeic, vanillic, ferulic, and chlorogenic)	Reduce irritation, dryness, stimulate hair growth and minimize hair loss	Jadhav *et al*., 2022
Hibiscus	*Hibiscus rosasinensis* L. (Malvaceae)	Flavonoids, anthocyanins, alkaloids, polysaccharides, sesquiterpene, quinones, and naphthalene	Provides silky texture, nourishes the follicles, and promotes the growth	Kuber *et al*., 2019

Figure 3: The diverse plants used in hair oil.

4.2 Herbs used in hair shampoo

Due to their potential advantages in cleaning the scalp, promoting hair development, and preserving the general health of hair, a number of herbs are frequently found in hair shampoos. It is a hair care product that we use on a daily basis to clean our hair and scalp. Shampoos are a viscous solution of cleansers with appropriate additives, preservatives, and active compounds that are most commonly used as beautifying agents. Typically, it is rubbed into wet hair after being applied, and then the hair is cleaned by running water over it. Shampoo is used to remove accumulated dirt from hair without removing a significant amount of sebum (Vijayalakshmi *et al*., 2018). The Table 2 and Figure 4 shows the various plants and their phytoconstituents used in herbal shampoos.

Table 2: The various plants and their phytoconstituents used in herbal shampoos

Herbs	Botanical name/family	Phytoconstituents	Purpose	References
Reetha	*Sapindus trifoliatus* L. (Sapindaceae)	Triterpenoidal saponins of oleanane, dammarane and tirucullane	Foaming agent	Gubitosa *et al*., 2019
Sheekakai	*Acacia concinna* DC. (Leguminosae)	Saponins like flavonoids and mono-terpenoids	Controlling hair loss and preventing dandruff	Gubitosa *et al*., 2019
Amla	*Phyllanthus emblica* L. (Euphorbiaceae)	Flavonoids such as rutin and quercetin, gallic and ellagic acids, tannins, minerals, vitamins, and amino acids	Improve blood flow to the scalp and boost the synthesis of collagen, to regenerates hair follicles	Panda *et al*., 2018
Sidr	*Zizphus spinachristi* L. (Rhamnaceae)	Flavonoids, alkaloids, saponins, tannins, and steroids	Washing the skin and hair instead of soap	Alzomor *et al*., 2021
Lemon	*Citrus limon* L.(Rutaceae)	Alkaloids, phenols, flavonoids, quinines, and terpenoids	Reduces flaky skin, moisturizes, cleans scalp, and reduces irritation	Gubitosa *et al*., 2019
Aloe vera	*Aloe barbadensis* Mill. (Asphodelaceae)	Alkaloids, phenolics, flavonoids, tannins, steroids, anthroquinones,	Washes the hair shaft, removing excess oil and sebum	Al Badi and Khan, 2014
Bhringraj	*Eclipta alba* L. Hassk. (Asteraceae)	Wedelolactone, luteolin, oleanolic acid, ursolic acid, eclalbasaponins, and apigenin	Reducing excessive hair loss, repairing damaged hair, and enhancing the health, strength, and volume of the hair	Al Badi and Khan, 2014
Cassia	*Cassia afrofistula Brenan* (Caesalpiniaceae)	Alkaloids, flavonoids, cardiac glycosides, phenols, saponins, tannins, and terpenoids	Promotes the growth of natural hair by boosting blood flow to the scalp	Vijayalakshmi *et al*., 2018
Hibiscus	*Hibiscus rosasinensis* L. (Malvaceae)	Lavonoids, polysaccharides, amino acids, lipids, anthocyanins, steroids, sesquiterpene, quinones	It soothes the scalp	Al Badi and Khan, 2014
Henna	*Lawsonia inermis* L. (Lythraceae)	Flavonoids, tannins, phenols, quinones, alkaloids, glycosides	Prevents hair from graying too soon and is used to nourish hair, keeping it smooth and shiny	Telrandhe, 2023
Neem	*Azadirachta indica* A. Juss (Meliaceae)	Alkaloids, flavonoids, terpenoids, saponins, glycosides, tannins, and phenolics	Treatment of dandruff, hair loss, and dry scalp	Dhayanithi *et al*., 2023
Methi	*Trigonella foenum-graecum* L.(Fabaceae)	Alkaloids, hydrocarbons, flavonoids, polyphenols, saponins, lipids, carbohydrates, and amino acids	Provide the hair roots, prevent the dryness and brittleness	Dhayanithi *et al*., 2023
Ashwagandha	*Withania somnifera* L. (Solanaceae)	Alkaloids, steroidal lactones, (withanolides, withaferins), and saponins (isopelletierine, anaferine, cuseohygrine, anahygrine)	It gives hair more luster, radiance, thickness, and shine by nourishing and revitalizing hair follicles	Lodha, 2019
Brahmi	*Bacopa monnieri* L. (Plantaginaceae)	Brahmine, herpestine, hersaponin, bacoside A and B, bacogenins A1-A4	Eliminating split ends, strengthening hair roots, and providing your hair a natural shine	Dhayanithi *et al*., 2023

Paan	*Piper betle* L. (Piperaceae)	Chavicol, chavibetol, estragole, hydroxycatechol, α and β -pinene, caryophyllene	Make the hair long and thick, treatment of split ends, dandruff, and itching	Lodha, 2019
Nagarmotha	*Cyperus rotundus* L. (Cyperaceae)	Terpenoids, steroidal saponins, cyperene, cyperol, cyprotene, flavonoid	Dandruff can be removed, removes dust and debris from the scalp, lessens scalp itching	Kuchekar, 2021
Tulsi	*Ocimum tenuiflorum* L. (Lamiaceae)	Eugenol, rosmarinic acid, apigenin, myretenal, luteolin, β-sitosterol, and carnosic acid	Reduces dandruff and itchiness, and helps to restore normal blood circulation	Kuchekar, 2021

Figure 4: The various medicinal plants used in herbal shampoos.

4.3 Herbs used in hair serum

The combination of oils, herbal extracts, and other components intended to nourish, protect, and style hair are frequently found in hair serum. Hair serum enriched with strong herbal extracts redefines hair care by providing a variety of natural gifts. These serums, which use the power of botanical miracles, provide a comprehensive approach to improving hair health, treating issues from frizz and dryness to promoting growth and vitality. Every herb has a special set of advantages, whether it is nutritious, stimulating the scalp, or calming (Anusha *et al*., 2023). Table 3 provides a summary of various popular herbs used in hair serum, emphasizing their main advantages and contributions to the health of hair.

4.4 Herbs used in hair gel

The main purpose of hair gels is to provide hair retention and style capabilities. Some hair gels include herbal extracts or essential oils for added advantages, even if they might not contain as many herbal ingredients as oils or serum. The harmonic relationship between nature's abundance and current maintenance requirements is marked by the introduction of herbs, especially hair gel, into hair care products. For centuries, various civilizations have valued herbs for their therapeutic qualities. Adding herbs to hair gel formulations not only improves style ability but also provides nourishment to the scalp and hair follicles. Herbal-infused hair gels, which address both style and nourishment, provide a comprehensive approach to hair care because of the calming properties of aloe vera and the energizing aroma of peppermint (Ramakrishna and Gopikrishna, 2022; Majeed, 2017). Table 4 presents a summary of various popular herbs used in hair gel, emphasizing their main advantages and contributions to the health of hair.

Table 3: The different plants and their phytoconstituents in hair serum

Herbs	Botanical name/family	Phytoconstituents	Purpose	References
Orange	*Citrus sinensis* L. (Rutaceae)	Citrus flavanones, anthocyanins, hydroxginnamic acids and a variety of polyphenols	Enhance hair's natural shine and reduce the dandruff	Tiwari *et al*., 2021
Ginger	*Zingiber officinale* Rosc. (Zingiberaceae)	Flavones, isoflavones, flavonoids, anthocyanin, coumarin, lignans, catechins and isocatechins	Increase scalp circulation, encourages the growth	Tiwari *et al*., 2021
Flax	*Linum usitatissimum* L. (Linaceae.)	G caffeic acid, p-coumaric acid and ferulic acid, and secoisolariciresinol-diglucoside	Help hair become softer and more radiant	Anusha *et al*., 2023
Black cumin	*Nigella sativa* L. (Ranunculaceae)	Saponin and alpha hederine and in trace amount carvone, limonene and citronellol	Keeps hair strong and nourished	Anusha *et al*., 2023
Fenugreek	*Trigonella Foenum-graecum* L. (Fabaceae)	Carbohydrates, lipids, amino acids, polyphenols, alkaloids, flavonoids, and the saponins	Nourishes the root of hair, preventing hair loss	Penkar *et al*., 2023
Ice apple	*Borassus flabellifer* L. (Arecaceae)	Quercetin, catechin, phloridzin and chlorogenic acid	Natural conditioner and strengthens hair	Gayatri *et al*., 2023

Table 4: The different plants and their phytoconstituents used in hair gel

Herbs	Botanical name/family	Phytoconstituents	Purpose	References
Guar gum	*Cyamopsis tetragonolobus* L.(Fabaceae)	Galactose and mannose acting as a conditioner	It smooths and shines hair	Ramakrishna and Gopikrishn, 2022
Jatamansi	*Nardostachys jatamansi* (D. Don) DC. (Caprifoliaceae)	Sesquiterpenes and coumarins	Promoting hair growth and reducing hair loss	Ramakrishna and Gopikrishn, 2022
Bhringaraja	*Eclipta alba* (L.) Hassk. (Asteraceae)	Luteolin, apigenin, ursolic acid, oleanolic acid, eclalbasaponins, and wedelolactone	Prevents premature graying, itchiness, and dandruff	Regupathi *et al*., 2017
Turkey tangle fogfruit	*Phyla nodiflora* (L.) Greene.(Verbenas)	Alkaloids, diterpenes, saponins, phytosterols, tannins, flavonoids and carbohydrates	Antidandruff	Regupathi *et al*., 2017
Guava	*Psidium guajava* L. (Myrtaceae)	Gallic, casuariin, catechin, chlorogenic, rutin, vanillic, quercetin, syringic, kaempferol, apigenin, cinnamic, luteolin, quercetin-3-o-α-l-arabinopyra-nosid, morin, ellagic, guaijaverin, pedunculoside, asiastic, ursolic, and oleanolic	Its antimicrobial and anti-fungal qualities can help prevent infections on scalp	Abiyarasu *et al*., 2022
Aloe vera	*Aloe barbadensis* Mill. (Asphodelaceae)	Alkaloids, tannins, flavonoids, phenolic molecules, anthroquinones, chromones, and anthrones	It facilitates hair hydration and moisturization	Abiyarasu *et al*., 2022
Amla	*Phyllanthus emblica* L. (Euphorbiaceae)	Higher number of flavonoids include rutin and quercetin, minerals, vita-mins, amino acids, fixed oils, and polyphenols such as gallic acid and ellagic acid	Natural conditioner and an approach for controlling hair fall	Abiyarasu *et al*., 2022

4.5 Herbs used for hair colour

Herbs are not used as the primary colouring ingredients in hair colour solutions because they usually lack the strength and durability required for effective hair colouring. However, because of their calming, conditioning, or scalp-nourishing qualities, some herbal compounds are occasionally used for hair colour formulations. With their vibrant colours and nourishing qualities, herbs have become a gentle yet powerful substitute for those who care about their hair's health and freshness but still want to express their unique personality (Dweck, 2002). Table 5 provides a summary of various popular herbs used for hair colour, emphasizing their main advantages and contributions to the health of hair.

Table 5: Shows the different plants and their phytoconstituents used for hair colouring

Herbs	Botanical name/family	Phytoconstituents	Purpose	References
Henna	*Lawsonia inermis* L. (Lythraceae)	Alkaloids, henna essential oil, tannins, phenols, quinones, and derivatives of naphthoquinone	Provides colour depth and a deep red colour. Stops graying and hair aging	Rao *et al*., 2008
Indigo	*Indigofera tinctoria* L. (Fabaceae)	Total phenolics, total tannins, saponins and flavonoids	Treats the earliest signs of gray hair	Kumar *et al*., 2016
Aloe vera	*Aloe barbadensis* Mill. (Asphodelaceae)	Alkaloids, flavonoids, tannins, phenolic compounds, anthrones, chromones, and steroids	Lessen dryness and enhance the general health of hair before colouring it by assis-ting in moisture balance	Shahi *et al*., 2017
Tulsi	*Ocimum sanctum* L. (Lamiaceae)	Eugenol, rosmarinic acid, apigenin, myretenal, luteolin, β-sitosterol, and carnosic acid	Keep hair's natural colour by delaying the onset of graying	Kumar *et al*., 2016
Bhiringraj	*Eclipta alba* (L.) Hassk. (Asteraceae)	Wedelolactone, luteolin, oleanolic acid, ursolic acid, eclalbasaponins, and apigenin	Preserving hair's natural colour and avoiding early graying	Kumari *et al*., 2021
Amla	*Phyllanthus emblica* L. (Euphorbiaceae)	Amino acids, fixed oils, flavonoids like rutin and quercetin, various tan-nins, polyphenols like gallic acid and ellagic acid	Increase the microcircula-tion in the scalp's epidermal cells, which darkens hair colour	Bhuvaneswari *et al.,* 2021
Guava	*Psidium guajava* L. (Myrtaceae)	The acids such as, gallic, casuariin, catechin, chlorogenic, rutin, vanillic, quercetin, syringic, apigenin, and cinnamic, luteolin, quercetin-3-o-α-l-arabinopyranoside, morin, ellagic acid, guaijaverin, pedunculoside, asiastic acid, ursolic acid, and oleanolic acid	Improve the texture of hair, making it more mana geable, large, shinier, softer, and smoother	Kumar *et al*., 2016
Black catechu	*Acacia catechu* (L.f.) Willd. (Fabaceae)	Aldobiuronic acid, gallic acid, afzelchin gum, l-arabinose, d-rhamnose, quercetin, procyanidin, epicatechin, catechin, epigallocatechin, epicatechingallate, and taxifolin	Can be mixed with other herbs to colour, condition, or treat hair	Kumar *et al*., 2016

Table 6: The different plants and their phytoconstituents used in the hair conditioner

Herbs	Botanical name/family	Phytoconstituents	Purpose	References
Guava	*Psidium guajava* L. (Myrtaceae)	Ellagic acid, guaijaverin, pedunculoside, asiastic acid, ursolic acid, oleanolic acid, luteolin, quercetin-3-o-α-l-arabinopyra-noside, syringic acid, kaempferol, luteolin, rutin, vanillic acid, quercetin, cinnamic acid, and luteolin	It keeps hair hydrated, keeping tresses attractive and silky	Patil, 2019
Hibiscus	*Hibiscus rosasinensis* L. (Malvaceae)	Flavonoids, polysaccharides, amino acids, lipids, anthocyanins, terpenoids, steroids, sesquiterpene, quinones, and naphthalene	Nourishes hair, giving it a shinier, smoother appearance	Patil, 2019
Neem	*Azadirachta indica* A. Juss (Meliaceae)	Alkaloids, flavonoids, terpenoids, sapo-nins, glycosides, tannins, and phenolics	Hair follicles are actively cleansed and strengthened	Patil, 2019
Curry	*Murraya koenigii* (L.) Spreng. (Rutaceae)	Alkaloids, flavonoids, triterpenes, tannins, and unsaturated steroids	Hydrate the scalp and elimi -nate damaged hair follicles	Patil, 2019
Amla	*Phyllanthus emblica* L. (Euphorbiaceae)	Flavonoids- rutin and quercetin, minerals, vitamins, amino acids, fixed oils, and polyphenols-gallic acid and ellagic acid	Strengthens, nourishes, and smoothes hair.	Patil, 2019
Fenugreek	*Trigonella Foenum-graecum* L. (Fabaceae)	Steroids, alkaloids, saponins, polyphenols, flavonoids, lipids, carbohydrates, amino acids, and hydrocarbons	Strengthens hair roots and shields from environmental pollutants	Patil, 2019
Aloe vera	*Aloe barbadensis* Mill. (Asphodelaceae)	Alkaloids, flavonoids, tannins, phenolic compounds, anthrones, chromones, and steroids	Conditioner, leaving hair shiny and silky	Patil, 2019

Table 7: The different plants and their phytoconstituents used in hair tonics

Herbs	Botanical name/family	Phytoconstituents	Purpose	References
Virgin coconut oil	*Cocos nucifera* L. (Arecaceae)	Phenols, tannins, leucoanthocyanidin, flavonoids, triterpenes,	Nourishment	Badhe *et al*., 2015
Amla	*Phyllanthus emblica* L. (Euphorbiaceae)	Amino acids, fixed oils, flavonoids-rutin and quercetin, tannins, polyphenols-gallic acid and ellagic acid	Reversing premature gray hair and inhibits the growth of new hair	Satheeshan *et al*., 2020
Hibiscus	*Hibiscus rosasinensis* L. (Malvaceae)	Lavonoids, polysaccharides, anthocyanins, quinines, sesquiterpene	Treating greasy scalp, dandruff, and itching	Patel *et al*., 2024
Curry	*Murraya koenigii* (L.) Spreng. (Rutaceae)	Alkaloids, flavonoids, triterpenes, tannins, and steroids	Stimulate new hair growth and prevent hair loss	Patel *et al.,* 2024
Aloe vera	*Aloe barbadensis* Mill. (Asphodelaceae)	Alkaloids, flavonoids, tannins, phenolic compounds, anthrones, chromones, and steroids	Improves shine, soothes irritated scalps, and hydrates dry scalps	Rajeswari *et al*., 2012
Henna	*Lawsonia inermis* L. (Lythraceae)	Alkaloids, henna essential oil, tannins, phenols, quinones, and naphthoquinone	Gives all hair types a long-lasting, natural feeling hold	Satheeshan *et al*., 2020
Bhringraj	*Eclipta alba* (L.) Hassk. (Asteraceae)	Wedelolactone, oleanolic acid, ursolic acid, eclalbasaponins, and apigenin	Enhances blood flow to the scalp and encouraging the growth	Shahi *et al*., 2017
Krishna tulsi	*Ocimum tenuiflorum* L. (Lamiaceae)	Oleanolic acid, ursolic acid, rosmarinic acid, carvacrol, and β-caryophyllene	Treat dandruff, alopecia and fungal infections	Shahi *et al*., 2017
Small onion (Shallots)	*Allium cepa* L. (Amaryllidaceae)	Allicin, quercetin, fisetin, sulphurous compounds: diallyl disulphide and diallyl trisulphide	Nourishing hair strands and hair follicles to increase hair growth	Satheeshan *et al*., 2020
Neelaamari	*Indigofera tinctoria* L. (Legumes)	Flavonoids, alkaloids, glycosides, terpenoids	Keep hair strong and shiny	Satheeshan *et al*., 2020
Lavender	*Lavandula angustifolia* Mill. (Lamiaceae)	Anthocyanins, sugars, coumaric acid, glycolic acid, herniarin, coumarin, and tannins	Removal of fungus, head lice, and dandruff	Satheeshan *et al*., 2020

Figure 5: Assorted medicinal plants used in hair care products.

4.6 Herbal hair conditioner ingredients

Herbs are frequently added to hair conditioners to offer a range of advantages, including strengthening, hydrating, and nourishing the hair. Conditioners are cosmetic hair care ingredients that improve hair management, feel, texture, and look. Its main purpose is to reduce friction between hair strands so that brushing or combing may be performed more gently and without risking damage to the scalp (Sonawane *et al*., 2023). Table 6 presents a summary of various popular herbs included in hair conditioners, emphasizing their main advantages and contributions to the health of hair.

4.7 Herbs used in hair tonics

Hair tonics are frequently used to enhance the general health of the scalp, encourage hair growth, and increase the quality of the hair. Typically, they include a blend of essential oils, herbal extracts, and other components that have been shown to have positive effects on the scalp and hair follicles. Herbal hair tonics are made by combining a variety of selected herbs that have been shown to have health benefits. Favourite plants, including aloe vera, amla, lavender, coconut oil, and henna, are frequently included in these blends. Every herb has a special combination of vitamins, minerals, and antioxidants that combine to enhance the general health of the hair and scalp (Badhe *et al*., 2015; Vaidya *et al*., 2023). Table 7 highlights the main advantages and contributions of some popular herbs used in hair tonics.

5. Conclusion

The introduction of herbal elements into a range of hair care products has emerged as a potential option in the constantly changing field of hair care, with the goal of addressing a wide range of hair problems**.** This review explored the diverse range of hair problems and the herbs frequently employed in different hair care formulations. From the challenge of hair loss and thinning to concerns such as dandruff, dryness, premature graying, and more, herbal remedies have demonstrated efficacy in promoting hair health. The incorporation of specific herbs in hair care products reflects a harmonious blend of traditional knowledge and modern scientific validation.

The holistic benefits of herbal ingredients extend beyond mere cosmetic improvements, fostering overall scalp health and resilience against environmental stressors. As consumers increasingly prioritize natural and sustainable options, herbal-infused hair care products are at the forefront of this demand. The diversity of products, ranging from shampoos and conditioners to masks and serums, reflects the versatility of herbal ingredients in catering to a wide array of hair concerns. Hence, a comprehensive and successful strategy to manage a variety of hair issues is provided by the fusion of current scientific knowledge with traditional herbal knowledge in hair care products. Herbal formulas have the potential to significantly influence the direction of customized and environmentally friendly hair care in the future as the hair care cosmetic sector continues to innovate.

Conflict of interest

The authors declare no conflicts of interest relevant to this article.

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