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Potential herbs for treatment of dandruff: A review

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Abstract
Dandruff is a generic scalp disorder that is associated with itching, excessive scaling, redness, and hair fall. Most commonly this condition is caused by the Malassezia genus, while other fungal strains may also be responsible like Pityrosporum. Dandruff affects more than 50% of humans, and cannot be completely eradicated but can only be impeded and controlled effectively. In usual practice, two means are adopted to medicate dandruff, which include chemical and herbal treatments. Chemical agents like ketoconazole, selenium sulfide, zinc pyrithione, climbazole etc, show various after-effects like hair loss, irritation, itching, headache and nausea. This review describes extensively, the anatomy, hair physiology and problems particularly types, causes, symptoms, and prevailing treatments for dandruff. A comprehensive literature search was conducted to identify traditional herbs used to treat dandruff and other skin diseases. Herbal remedies have been in vogue since ancient times for hair care, especially to cure dandruff. We summarize the discernings of research which were centralised to assess the anti-dandruff activity of medicinal plants such as Neem powder, Tulsi, Henna, Guava leaves, Tea tree oil, Rosemary, kesumm leaves, Pomegranate, Pudding pipe tree, Garlic, hibiscus, Bhringraj, Mountain tobacco, Sage and Thyme.

Keywords: Hair; scalp; herbal shampoos; anti-dandruff; anti-fungal

1. Introduction

1.1 Hair Anatomy

The pilosebaceous unit is a complicated and essential structure of the skin that plays a vital role in hair growth and thermo regulation. It comprises hair follicles, arrector pili muscle, and sebaceous glands. The function of the sebaceous gland is to provide protection and lubrication through the production of sebum. The arrector pili muscle performs its role in thermoregulatory responses. Knowledge about the anatomy and function of the pilosebaceous unit is important for understanding the numerous dermatological conditions and their potential treatments. The hair follicle is responsible for producing and maintaining hair growth. It also has a major role in various skin functions and responses [1].

The hair growth cycle consists of four different phases that are anagen, telogen, catagen, and exogen which process in a continuous manner. A normal healthy scalp sustains a high anagen-to-telogen ratio usually between 14:1 to 12:1. Dislocation of this ratio often leads to hair disorders [2].

1.1.1 Factors that affect hair growth

- **Extrinsic factors**
  These factors include chronic stress, medications, nutritional deficiencies like iron, zinc etc. and environmental toxins, that disturb hair cycling.
- **Intrinsic factors**
  These factors include genetics, age, and hormonal fluctuations that play a significant role in the hair growth cycle. Ageing decreases the duration of the anagen phase and contributes to thinning and weakening of hairs.
- **Systemic health conditions**
  Autoimmune diseases, endocrine disorders such as thyroid dysfunction and infections can change the anagen-to-telogen balance. Hair follicles are critical structures that grow and renew hairs. These follicles are a part of groups called follicular units (FUs), which include fine hairs, tiny muscles, oil glands, and blood and nerve vessels. Follicular units vary in size and number as the people with higher hair density have more follicular units

containing three or four hairs as compared to people with low hair density [3]. Hair anatomy has been shown in Fig 1.

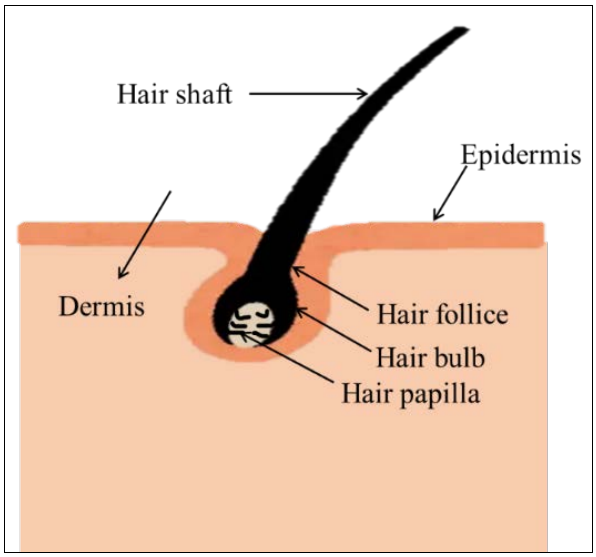

Fig 1: Hair anatomy [4]

Sebaceous glands are present in the mid-dermis layer of the skin. They are usually associated with hair follicles. They form a unit that is known as a pilosebaceous unit. This unit is made up of the sebaceous gland, arrector pili muscle and hair follicle. The function of the sebaceous gland is to produce sebum which is a lipid-rich substance. This anatomical and functional relationship between the hair follicle and sebaceous gland helps to maintain skin health and protect against environmental damage [5].

Hair follicles are very sensitive to environmental pollution because they grow quickly. They are well-supplied with blood and absorb harmful substances from blood bloodstream and through the skin directly. Pollutants such as heavy metals, pesticides, tobacco smoke, and UV rays can damage hair follicles. These pollutants lead to problems like hair loss, thinning and other hair disorders. Hair follicles are also influenced by hormonal fluctuations, and changes in the tiny ecosystem of microbes around them which can also be disturbed by pollutants. The fundamental building block of hair growth is the follicle, its histological structure is categorized into four parts as follows [6, 7].

1.1.2 Outer Root Sheath (ORS)

It is recognized as a multipotent stem cell reserve. Between the sebaceous organ channel and the arrector pili muscle inclusions, there is a perceptible distension that is the ORS.

1.1.3 Inner Root Sheath (IRS)

The three layers that make up it are the cuticle layer, huxley's layer, and henle's layer. Keratins and trichohyalin, which are created by IRS cells, go about as an intracellular concrete to invigorate the IRS backing and shape the developing hair shaft.

1.1.4 Hair Bulb

The part of the follicle that actively generates hair is called the hair bulb. Two sections may be seen in the hair bulb: an upper region containing differentiated cells and a lower region containing undifferentiated cells. The infundibulum is a funnel-shaped part of the hair follicle and the isthmus is a short segment in the hair follicle, which is situated over the bulb. The sebaceous organ produces sebum, which is present in the pipe-molded structure known as the infundibulum, which runs from the skin's surface to the sebaceous channel. The isthmus connects the duct of the sebaceous gland to the arrector pili muscle, completing the upper portion of the hair follicle [8].

1.2 Hair Physiology

Hair improvement is a dynamic, repeating process where the length of the development cycle is managed by various chemicals and cytokines and is reliant upon different variables, including the singular's age and formative stage, dietary inclinations, and ecological changes like day length. Hair follicles fill in repetitive examples where periods of quick development and hair shaft creation substitute with periods of relative hair follicle peacefulness and relapse brought about by apoptosis [9]. In particular, three separate stages to the hair development cycle are Anagen (Development Stage), Catagen (Momentary Stage), and Telogen (Resting Stage) as shown in **Fig 2.**

The hair follicle grows during the anagen phase, which is a vigorous growth phase, taking on the shape of an onion and producing hair fibres. When the anagen growth phase ends, the catagen phase begins. Hair shaft formation is finished at the start of the catagen phase when melanocytes cease manufacturing pigment and differentiate and proliferate less rapidly in the hair matrix keratinocytes. Following the catagen stage, the hair enters the telogen stage, which is a resting stage that can endure anyplace from half a month for eyelashes to eight months for scalp hair. During this period, the dermal papilla stays in the resting stage even though the hair doesn't create. The IRS and the shortfall of color-creating melanocytes are qualities of hair follicles. Following half a month, the hair follicle re-enters the development stage by initiating foundational microorganisms from the lump region. Right now, the hair drops out [8].

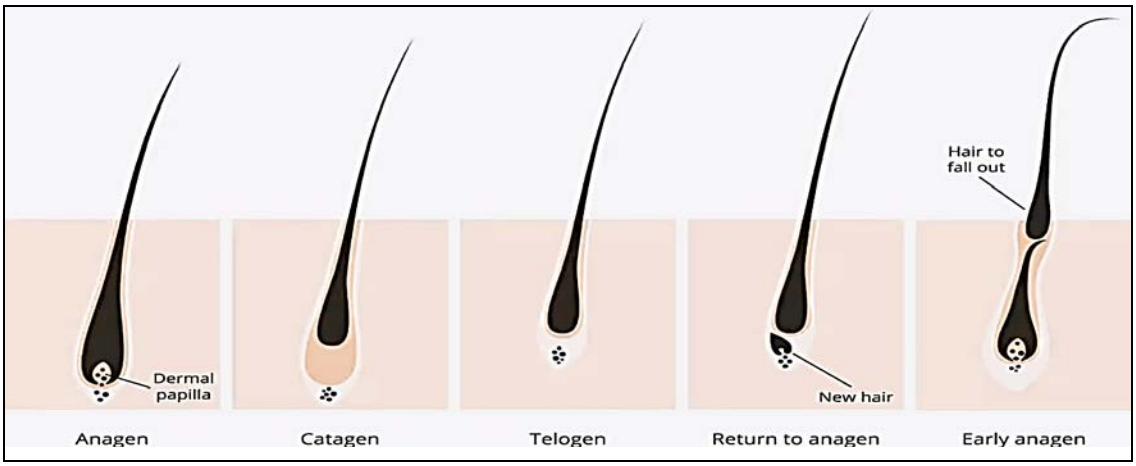

Fig 2: Hair growth cycle [10]

1.3 Problems related to Human Hair

1.3.1 Balding

The typical individual sheds around 100 hairs each day. Hair loss is an upsetting condition that can be caused by a variety of medical, nutritional, or physiological problems. Male pattern baldness, or androgenetic alopecia, for example, is increasingly recognized as a medically and psychologically significant illness that often requires general practitioners to provide specialist care. Certain hair care practices, such as wearing tight weaves or ponytails or constantly bleaching or perming the hair, can also cause hair loss. Trichotillomania is the name of the psychological disorder that causes some people to compulsively pull their hair off [11].

1.3.2 Weathering

The slow degradation of the hair's cortex and cuticle from the root to the tip due to everyday wear and tear is known as weathering. Although every hair ages to some extent, hair always weathers more severely when it is mistreated regularly. Deteriorated cuticles, longitudinal fissures called split ends, and transverse fissures that resemble the trichorrhexis nodosa nodes are all signs of weathering. One of the particular reasons for enduring is blanching. It oxidizes the current melanin of the cortex. Darker hair requires longer dying meetings. Contrasted with red hair, earthy-coloured hair is more straightforward to dye. The oxidation response breaks a portion of the keratin's disulfide bonds, which can harm the fingernail skin and increment its porousness [12].

1.3.3 Dandruff

A common condition known as dandruff is the optical perception of discrete flake formations on an irregularity if it appears on the scalp, in the hair, or on clothing. In contrast to seborrheic dermatitis, it just affects the scalp and does not seem to be inflamed. Given the strong temporal correlation between sebaceous gland activity and dandruff, sebum may be a contributing cause. According to this link, the incidence is higher in infancy, lower from infancy to puberty, higher during adolescence and early adulthood, and lower later in life. Furthermore, dandruff only appears on skin with high sebum levels [13].

1.3.3.1 Overview of dandruff

A prevalent scalp condition that affects people of all ages, genders, and ethnicities in their postpubescent years is dandruff. It is recurrently known that during the development of dandruff, keratinocytes are indispensable for the expression and induction of immune responses. The potency of dandruff might change with the season because it frequently gets worse in the winter. Long-suit shampoos are effective in treating the majority of dandruff cases [14].

1.3.3.2 Causes of Dandruff

- **Overgrowth of *Malassezia* Yeast**
  Normally found on the scalp, *Malassezia* can overgrow in people who are prone to dandruff. Flaking and itching may result from the breakdown of sebum into irritant-free fatty acids caused by this excess. The development of dandruff is significantly influenced by the interaction between this yeast and a person's immune system [15].
- **Imbalance in Scalp Microbiome**
  Changes in bacterial and fungal populations are seen on dandruff scalps. For example, there has been a decrease in *Staphylococcus epidermidis* and an increase in *Staphylococcus capitis*, indicating that the condition is exacerbated by local disturbances in microbial balance [16].
- **Seborrheic Dermatitis**
  A minor type of seborrheic dermatitis that causes excessive skin cell turnover is dandruff. This causes the skin to shed more quickly than usual, which results in visible flakes. Inflammation and abnormal lipid compositions in the scalp are also linked to it [17].
- **External and Lifestyle Factors**
  Dandruff can be made worse by stress, cold temperatures, dry air, and harsh hair products. These elements could impair the skin barrier, influence oil production, or irritate the scalp [18].

1.3.3.3 Mechanism of Dandruff

The integumentary system, which covers and shields the human skull, includes the scalp. It has typical flora, where a square centimetre of human skin is home to one billion bacteria. Microorganisms comprise viruses, fungi, and bacteria that come together to form a complex community called the skin microbiome or normal flora. These microbes lack the enzyme machinery required for the synthesis of fatty acids, particularly *Malassezia* yeast. As a result, they rely on outside sources to meet their needs for fatty acids. *Malassezia* yeasts release a variety of lipases, which are lipid-rich secretions secreted by sebaceous glands that can hydrolyze triglycerides. These are beneficial bacteria that inhabit the upper sections of hair follicles and the skin's superficial layer (that make up normal flora). Any mismatch between these microbes can lead to a variety of undesirable scalp conditions, most notably dandruff and hair loss [16].

1.3.3.4 Symptoms of Dandruff

Dandruff is not an illness that has bad clinical results, but it can cause embarrassment and self-consciousness in the victim. Dandruff indeed weakens confidence and certainty. Dandruff's clinical symptoms include skin peeling, itching, irritation, and a tight or dry scalp sensation [19].

1.3.3.5 Types of Dandruff

Two kinds of dandruff are distinguished based on the symptoms

- Dry dandruff
- Oily dandruff

Pityriasis simplex named for dry dandruff, is described by an exorbitant measure of minuscule white, grayish, or powder-colored shaded scales that develop on the scalp. These estimations are at first amassed in the focal point of the scalp, then, at that point, move to the parietal, front-facing, and occipital locales. There is no recognizable critical balding with this sort of dandruff.

Pityriasis steroids, also known as oily dandruff, are the other type of dandruff. It shows up on the scalp skin in changing levels of sebum creation power. On the scalp, greasy, dirty-yellow scales that may develop into lesions emerge along with varying degrees of inflammation. In addition to being prevalent, hair loss can worsen androgenetic alopecia. This kind of dandruff usually affects the scalp, but it can also appear in the spaces between the eyebrows, on the nose sides, behind the ears, over the breastbone, and, surprisingly, in the armpits [20].

1.3.3.6 Fungi and bacteria associated with dandruff:

Four different fungal strains related to dandruff include genus *Malassezia* such as (*Malassezia restricta*, *Malassezia*

globossa, *Malassezia furfur*, and *Malassezia pachydermatis*) represented in Fig 3.

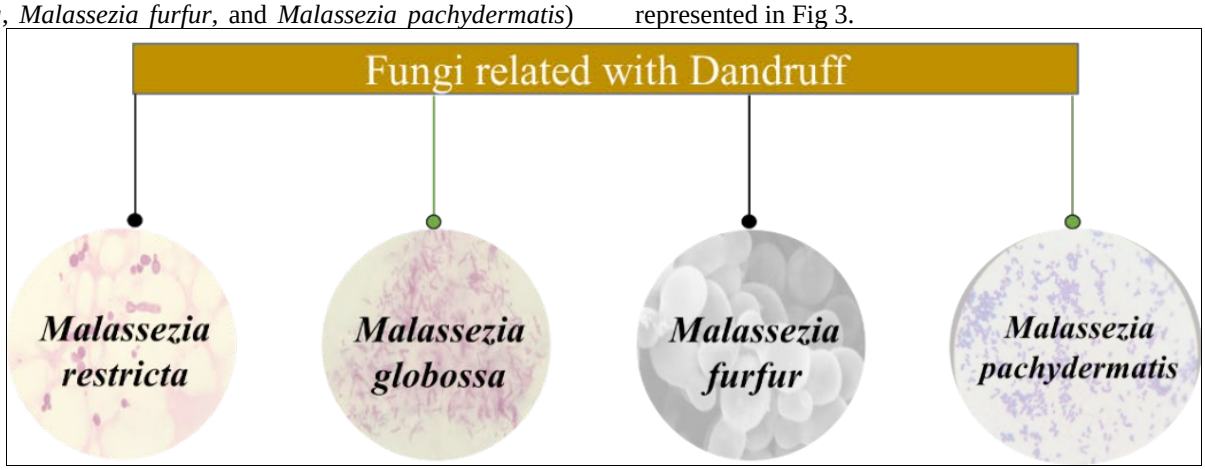

Fig 3: Fungi related to dandruff

Of the four bacterial species related to dandruff 3 belongs to the same genera Staphylococcus (*Staphylococcus epidermidis*, *S. aureus*, and *S. capitis*) and the left one belongs to the genera Propionibacterium (*Propionibacterium acne*) [21] shown in Fig 4.

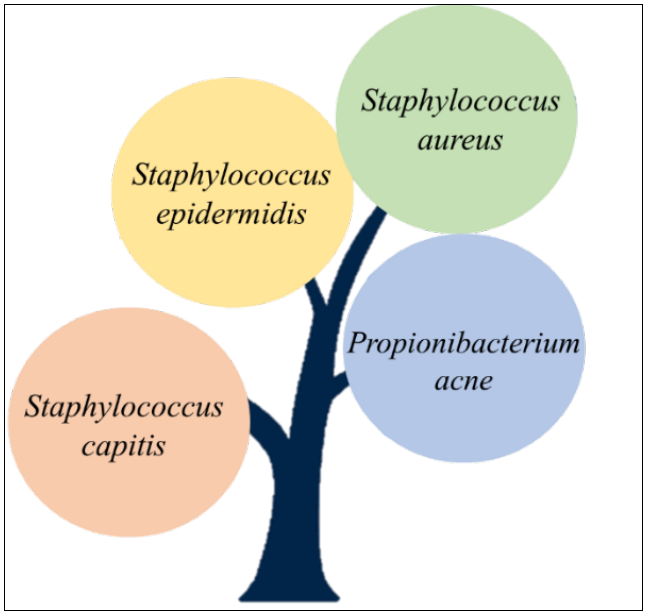

Fig 4: Bacteria related to dandruff

2. Methodology

A comprehensive literature search was conducted to identify traditional herbs used to treat dandruff and other skin diseases. The search was performed using online databases, including Google Scholar, ResearchGate, PubMed, and NISCAIR Online Periodicals Repository.Studies published between 2009 and 2024 were included in the review.

Data extracted from the selected studies were organized in a systematic mannaer

1. Plant species used in traditional medicine for scalp diseases.
2. Pharmacological activity of these plants and their preclinical evidence.
3. Herbal drugs and cosmetic products used in hair care products.
4. Fungal and Bacterial species responsible for dandruff in humans and related symptoms.

3. General remedies for the treatment of dandruff

Treatment of dandruff can be done by following these strategies

1) Treatment of cause
2) Treatment of symptoms

Treatment of the cause included the use of antifungal agents like selenium sulphide, ketoconazole, zinc pyrithione and climbazole, etc.

Treatment of symptoms included the use of anti-proliferative agents like coal tar, and keratolytic agents like salicylic acid. Zinc pyrithione is the most common anti-fungal drug or treatment of dandruff. Usually, ZPT is used in shampoos in 0.5-2% concentration for anti-fungal activity. It has no common side effects but can be harmful to ingestion and difficulty in breathing. Ketoconazole is the other type of drug used for antifungal activity. It is used in concentrations of 0.25-2%. Its side effects include itching, skin irritation or headache. Climbazole is the newer anti-fungal drug which is usually used in combination. 0.25-2% concentration of climbazole is used. It caused allergic reactions. Selenium sulphide is used in concentrations of 1-2.5%. It causes unusual oiliness, dryness of hair, and discolouration of the scalp [22].

4. Herbal Remedies

Herbs are natural medications and have been utilized for the remediation of various ailments for decades. However, a few herbal extracts have shown themselves to be beneficial when used in treating conditions involving the scalp layer [23].

Medicinal plants are gifts to humanity that have few adverse effects on health; plant extracts and essential oils are rich in physiologically active metabolites that have strong anti-inflammatory, antioxidant, and anti-microbial properties. Several plant extracts with antioxidant qualities have been utilized, either alone or in combination with other natural compounds, to treat dandruff and hair loss [24].

5. Herbs with Anti-Dandruff properties

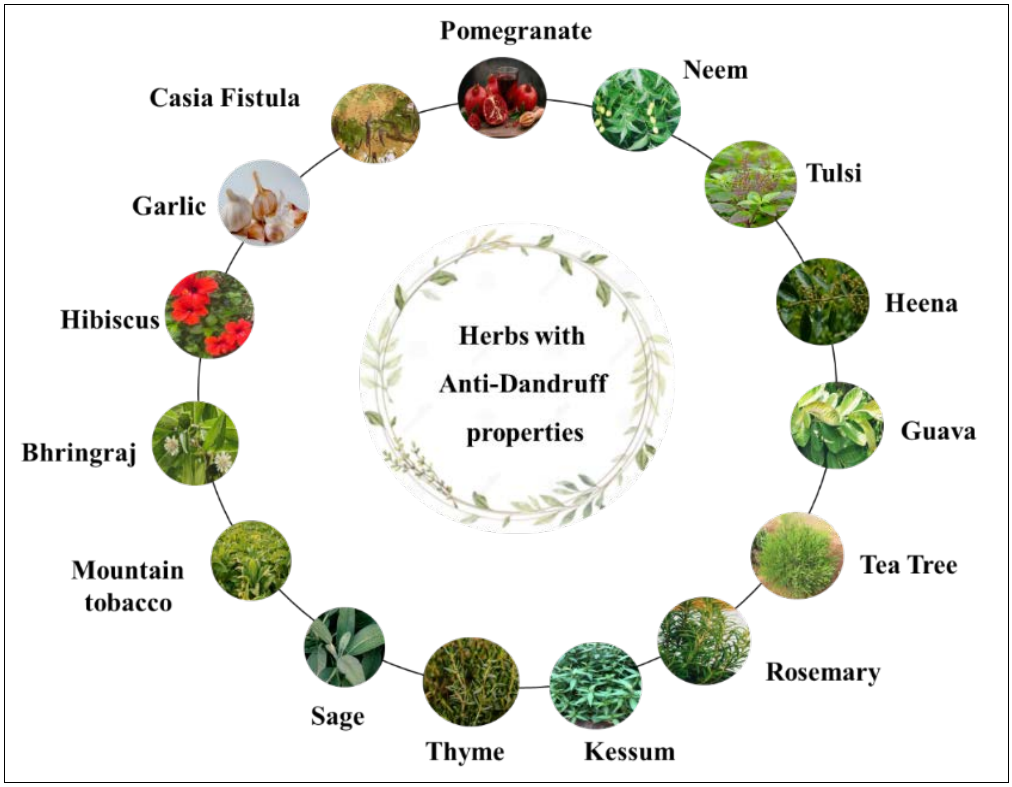

Fig 5: Herbs with Anti-Dandruff properties

5.1 Neem (*Azadirachta indica* A.Juss.)

Neem has antiseptic, regenerative, and healing properties. It also plays a vital role in scalp care, especially in treating dandruff by clearing pores and promoting hair growth. It is mostly used in hair care routines along with other ayurvedic herbs like amla, reetha, and shikakai. These herbs reduce hair fall and increase hair volume [25].

Eby George *et al*. prepared an emulsion for anti-dandruff or anti-fungal use from neem oil by extracting the bitter agent 'Nimbidin'. An *in vitro* study of emulgel in carbopol showed a 12mm inhibition zone against dandruff [26].

Mandike Ginting *et al*. synthesized anti-fungal neem leaf extract shampoo. Evaluation parameters proved that ethanol extract of neem leaf in shampoo is best inhibition zone (13.61mm) against *M. furfur* at a concentration of 8% [27]. Neem leaves are shown in Fig 6.

Fig 6: Neem leaves [28]

5.2 Tulsi (*Ocimum tenuiflorum* L.)

Holy basil, also known as tulsi, has long been employed in religious endeavours. It aids in blood circulation and maintains a calm scalp, which lessens dandruff and irritation and encourages hair development. It is applied as a paste to keep the scalp roots clean and dandruff-free. Tulsi is an effective remedy for hair loss. It is commonly used in herbal treatments. It nourishes hair roots to reduce hair falls. Moreover, it prevents fungal infections and supports overall scalp health [29, 30].

Ansari *et al*. extracted tulsi leaves as manifested in Fig 7 and tested them against over growth of fungal yeast in comparison to ketoconazole. The tested antimicrobial activity showed that tulsi leaves in combination with some other herbs show the highest activity while individually showing mild activity [31].

Fig 7: Tulsi plant [32]

5.3 Henna (*Lawsonia inermis* L.)

The botanical name of the henna plant as appeared in Fig 8 is *L. inermis* L., also named a perennial shrub belonging to the family Lythraceae. Lawsone is the main phytochemical in henna leaves also known as hennotannic acid. Henna gives strength to hairs. It acts as a natural colourant and adds volume to the hair by coating each strand. It conditions hair

soft, calms the irritation on the scalp, prevents dandruff, and protects against fungal infections [33, 34].
Mallamma *et al*. synthesized herbal anti-dandruff styling hair gel using henna by mixing other herbs also. After assessing the prepared hair gel, a 20mm inhibition zone for anti-fungal and 29mm inhibition zone for anti-bacterial was shown [35].

Fig 8: Henna plant [36]

5.4 Guava Leaves (*Psidium guajava L.)*

Guavas (*P. guajava* L.) are high-nutritional values fruits present in tropical and subtropical regions belonging to family Magnoliophyta family. Bioactive compounds such as more vitamin C than orange, iron, phosphorus, phenolic content and flavonoids are present in it. Guava has a highly anti-cancerous property as an anti-oxidant. Guava leaves shown in **Fig 9** are a natural effective solution to promote hair growth. They can be used internally as a tea and can also be applied externally as a hair rinse, serum, or oil. They directed a wide range of hair issues like hair loss, dandruff, scalp inflammation, and infections [37, 38].
Shubham Singh *et al*. conducted a study on guava leaves powder shampoo as an anti-dandruff and to check its antifungal effect against gram +ve and gram -ve bacteria. Then in Sri Lanka, patients were treated with this herbal shampoo formulation. In feedback, excellent results for this herbal anti-dandruff shampoo were received [39].

Fig 9: Guava leaves [40]

5.5 Tea tree oil (*Melaleuca alternifolia* (Maiden & Betche) Cheel)

Essential oils are aromatic, naturally occurring volatile oils that are extracted from the bark, roots, flowers, seeds, and leaves of plants. Oil extracted from tea tree shown in **Fig 10** has a strong lipophilic defence mechanism. Tea tree oil enters, breaks the wall of fungi and stops its growth to prevent dandruff formation. It is rich in anti-microbial terpene-4-ol. It shows a great effect against *Malassezia* which is the main dandruff-causing agent. Tea tree oil shampoo reduces dandruff with less irritation [41].
Humra Umar *et al*. conduct *a* study on in-vitro formulation and characterization of anti-dandruff shampoo from tea tree oil. That oil was used in a concentration of 0.5 to 3% against *M. furfur*. Anti-fungal activity of tea tree oil in different concentrations showed good potential to address dandruff problems [42].

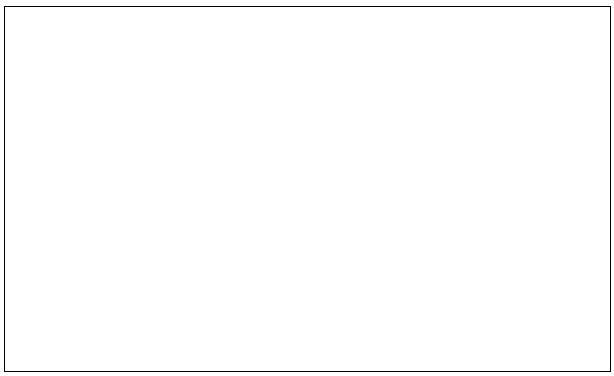

Fig 10: Tea tree plant [43]

5.6 Rosemary (*Rosmarinus officinalis* L.)

R. officinalis L. (rosemary) is a herb shown in Fig 11 with a rich history in traditional medicine and cosmetic uses? Its main constituents include caffeic acid and rosmarinic acid. It has strong antioxidant properties. These characteristics support its use as a hair rinse to nourish hair growth. Moreover, it is a useful natural ingredient in health [44].
Katarzyna *et al*. evaluated that rosemary is an evergreen shrub that belongs to the family Lamiaceae. Its essential oil contains terpenes like α-pinene and 1,8-cineole, due to which it has anti-fungal, anti-microbial and antiviral properties. It aids in regulating blood glucose. It benefits diabetic patients and lowers cholesterol levels. It also reduces anxiety, and pain, treats neurodegenerative diseases and promotes better sleep [45].

Fig 11: Rosemary plant [46]

5.7 Kesum Leaves (*Polygonum minus* Hudus.)

People of West Kalimantan, have been using kesum leaves (*P. minus* Hudus.) seen in Fig 12 for a long time to treat dandruff commonly known as Kelumar. A fungus called *Pityrosporum ovale* (*M. furfur*). It grows well in humid and warm conditions. Kesum leaves are an effective remedy that helps to fight against fungus and soothe the scalp [47].

Paritala Vikram *et al*. study the polygonum minus also known as kesum is an aromatic plant which is mostly used in traditional medicine. It belongs to the family polygonaceae. It is valuable for its high oil content. It is used as an antioxidant. It is used to treat ailments like dandruff. The plant consists of phytochemical constituents like flavonoids, tannins, alkaloids, glycosides, and resins due to which it found its uses in industrial and commercial industries [48].

Hamid *et al*. evaluated that polygonum minus extracts consist of strong anti-inflammatory and antioxidant effects. These benefits are due to the presence of natural compounds which are tannins, ascorbic acid, phenolic compounds and alkaloids. It formed a natural remedy for diseases caused by oxidative stress, and inflammation like heart disease [49].

Fig 12: Kesum leaves [48]

5.8 Pomegranate (*Punica granatum* L.)

P. granatum peel has a high content of tannins, which exhibit exceptional antibacterial properties. The plant, which is a member of the Punicaceae family shown in fig 13 is grown throughout the world in warm climatic regions such as Southeast Asia, the Mediterranean, the Americas, and others. Various parts of the plant including seeds, peel, and flowers contain bioactive compounds such as flavonoids, polyphenols, anthocyanins and tannins. These compounds contain anti-oxidant, anti-microbial, and anti-inflammatory properties. These characteristics make the pomegranate useful in treating dandruff and skin inflammation [50].

Somnath D. Bhinge *et al*. worked on the extract of *P. granatum* L. as anti-lice and antidandruff activity. Alcoholic extracts of 3% *P. granatum* L. showed strong antidandruff effects against the investigated fungal strains [51].

Fig 13: Pomergranatum [52]

5.9 Pudding Pipe Tree (*Cassia fistula* L.)

C. fistula L. (Cassia) family Caesalpiniaceae is normally known as "Amaltaas" and in the English language, is named "Brilliant Shower" shown in **Fig 14**. This tree is deciduous, with sets of leaves that are every 5 to 12 cm long, compound leaves, and greenish-dark bark a semi-wild tree with perfect yellow blossom bunches that are likewise used for various purposes in customary medication. Leaf juice is utilized to treat skin conditions. In the Indian subcontinent and adjacent regions of Southeast Asia, the plant is grown as an ornamental. It is renowned for having a high concentration of glycosides, flavonoids, phenols and tannins. Many traditional medical systems employ it because of its supposed hepatoprotective, anti-inflammatory, antitussive, antifungal, and antibacterial properties. It is also used to monitor the healing of wounds [53].

Mariam Busharat *et al*. performed anti-dandruff activity using an extract of fruit husk against *Malassezia* species by agar well diffusion method. Using a concentration of 3000 mg/mL n-hexane, the inhibition zone of 23.60 mm was observed. That was proof that an in-vivo study of the extract of *C. fistula* L. was effective for the treatment of dandruff [54].

Fig 14: Casia Fistula [55]

5.10 Garlic (*Allium sativum* L.)

One of the herbs is garlic visible in Fig 15. It is most well-known for flavouring meals. However, a variety of diseases can be prevented or treated with garlic as a medication.

Numerous substances, including allicin, ajoene, diallyl disulfide, and diallyl trisulfide, are tracked down in garlic. The essential antibacterial part of garlic is allicin. It possesses antifungal, antibacterial, and antiparasitic properties. It is not advisable to apply garlic topically as it might lead to allergic responses and contact dermatitis in certain individuals, as well as blisters and burning sensations in others [56].

S. Sharma *et al*. verify the garlic phytoconstituents' ability to combat the fungal protein. Nine phytoconstituents were identified, and each one's inhibitory constant was calculated. Allicin has a positive effect on black fungus by making the most stable hydrogen bonds [57].

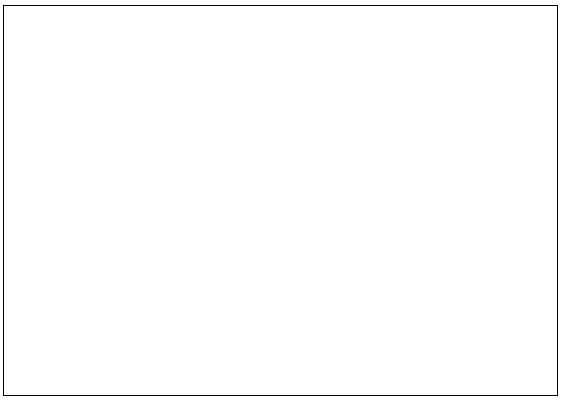

Fig 15: Garlic [58]

5.11 Hibiscus (*Hibiscus rosa-sinensis* L.)

Hibiscus is also known as 'Gudar'. It is a dominant natural ingredient for hair care. It supports hair growth, prevents hair loss and provokes regrowth. It consists of alpha hydroxy acids, amino acids, vitamins A and C. It nourishes the scalp, keeping it healthy and decreasing the possibility of dandruff. Hibiscus has anti-inflammatory, antioxidant, and antibacterial qualities in addition to having high levels of iron and vitamins C and A. Herbal hair masks made with hibiscus flower paste or infused oil can treat dandruff, increase hair regrowth (both length and thickness), enhance hair gloss, and improve hair condition [59, 60].

Both flowers and leaves of plant seen in fig 16 have numerous therapeutic benefits. It is rich in amino acids that nourish hair and promote hair growth. It gives softness and natural shine to the hair. The mucilage content of hibiscus leaves provided natural moisture to the hair strands. Its use in anti-dandruff formulations reduces dandruff and soothes the scalp [61].

Khadasare *et al*. focus on creating and testing a herbal hair serum using a blend of organic ingredients, such as hibiscus leaves and flowers. The primary building block of keratin, amino acids, are abundant in hibiscus blossoms. Additionally, the leaves lessen the formation of fungus that causes dandruff, lessen flakes of dandruff, and stop it from happening again [62].

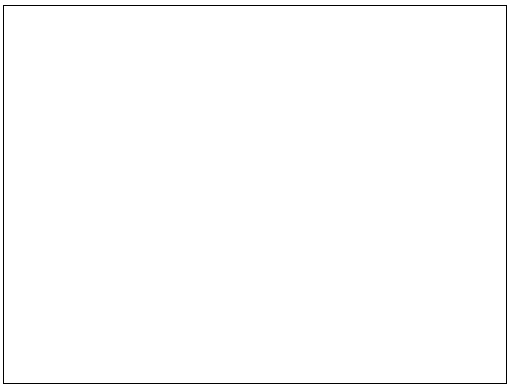

Fig 16: Hibiscus plant [63]

5.12 Bhringraj (*Eclipta prostrata* Lour.)

In English, Bhringraj is also known as False Daisy. Bhringraj's botanical name is *E. prostrata* Lour. It is also referred to as *E. alba* which is a synonym for *E. prostata* in botany, originating from the Asteraceae family. It works well as a medication for skin conditions, coughs, asthma, eye problems, and illnesses affecting any portion of the brain. It addresses premature greying of the hair, stops hair loss, and promotes hair growth. Bhringraj leaves manifested in **Fig 17** extract are used to prepare an anti-dandruff shampoo. The shampoo formed from these leaves works well and is effective in fighting against dandruff. Dandruff is caused by certain fungi often lead to itching and flaking. While many conventional shampoos have side effects. This shampoo provides a natural, effective alternative with good cleansing, foaming and anti-dandruff properties [64, 65].

Das *et al*. study the *E. prostrata* which is commonly known as false daisy or bhringraj. It is a versatile herb with a lot of medicinal applications in traditional systems like Ayurveda and Unani medicine. This herb is rich in bioactive components such as alkaloids, glycosides, flavonoids and triterpenoids which contribute to the antioxidant, anti-inflammatory, antimicrobial and other pharmacological properties. It also shows its effective properties in promoting scalp health, hair hair-related issues, including dandruff. Its anti-microbial properties helped to control the growth of dandruff-causing malassezia fungi [66].

Fig 17: Bhringraj leaves [67]

5.13 Mountain tobacco (*Arnica montana* L.)

A. montana, often known as Arnica, is a member of the Asteraceae family shown in Fig 18. The flowering herb arnica is indigenous to rocky, cold areas such as Eastern Europe and the Russian Far East. In India, it is Cultivate sparingly. The floral section of the plant is utilized. It stimulates hair follicles and is used as a hair tonic. Because of its antibacterial and anti-inflammatory qualities, some people think arnica oil works well as a dandruff remedy [68].

Gyawali *et al*. studied numerous pharmacological effects, including anti-inflammatory, anticancer, antioxidant, antibacterial, antiplatelet, and immunomodulatory properties of *A. montana* extract and compounds. Through clinical trials, it was found that anti-inflammatory qualities are mostly attributed to helenalin and dihydrohelinalin [69].

Fig 18: Mountain tobacco [70]

5.14 Sage (*Salvia officinalis* L.)

There are at present around 500 assortments of Salvia, with the species officinalis being the most critical for culinary purposes. Sage seen in Fig 19 has for some time been esteemed as a therapeutic spice. *S. officinalis* L. (Labiatae), in some cases alluded to as "genuine sage," "normal sage," or "nursery sage," is utilized as a cream to upgrade the nature of skin and hair. There have been claims that it very well may be utilized, either all alone or related to rosemary, to keep up with the radiance of dim, wavy hair and to strengthen and advance hair improvement. The primary parts of *S. officinalis* that affect hair are the tannins, saponins, borneol, and camphor. Accompanying it is a time-tested remedy for dandruff, hair loss, and oily skin and hair. When used topically, a sage extract can help manage dandruff, hair loss, and falling hair, provided that the papillae are quiescent and not destroyed [71].

Sahraie-Rad *et al*. examined a clinical trial using pirocton olamine and zinc L-pyrrolidone carboxylic acid (Zinc-PCA) in conjunction with six extracts from medicinal plants including *S. officinalis* to treat dandruff. It was found that *S.officinalis* has potent antibacterial, antifungal, and anti-inflammatory properties by preventing the lipid peroxidation of liposomes on the scalp [72].

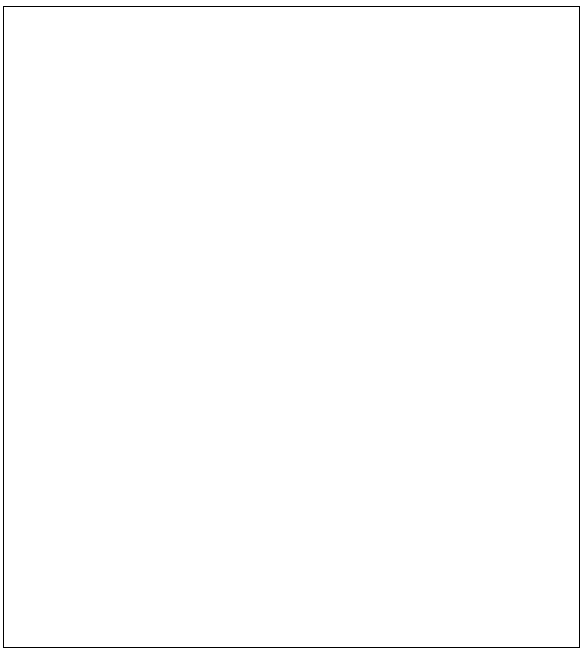

Fig 19: Sage [73]

5.15 Thyme (*Thymus vulgaris* L.)

It is said that thyme or *T. vulgaris* L. (Labiatae) shown in Fig 20, inhibits dandruff. When used topically, it also stops hair loss, and rosemary and thyme rinses support healthy, natural hair. Natural compounds from *Origanum dictamnus* and *T. vulgaris* block an enzyme present in *M. globosa* (a fungus related to dandruff and seborrheic dermatitis). Two compounds rosmarinic and xanthomicrol are particularly strong inhibitors. These compounds are safe, and non-toxic and target the blockage of enzymes without affecting *M. furfur*. These plant-derived compounds are useful for treating dandruff [74].

Majedi *et al*. study the aromatic and medicinal herb *T. vulgaris* which possesses various antifungal, anti-oxidant, anti-microbial and anti-inflammatory properties. This plant is used for various respiratory disorders, digestive issues, and skin ailments. Due to its antifungal, anti-inflammatory anti-oxidant properties, it is also used against dandruff. It is used as a natural effective remedy for treating dandruff. Dandruff is most commonly caused by *Malassezia* yeast which can be controlled by thyme's bioactive compounds. The key components that are effective against dandruff include phenolic and flavonoids, thymol and carvacrol, and essential [75].

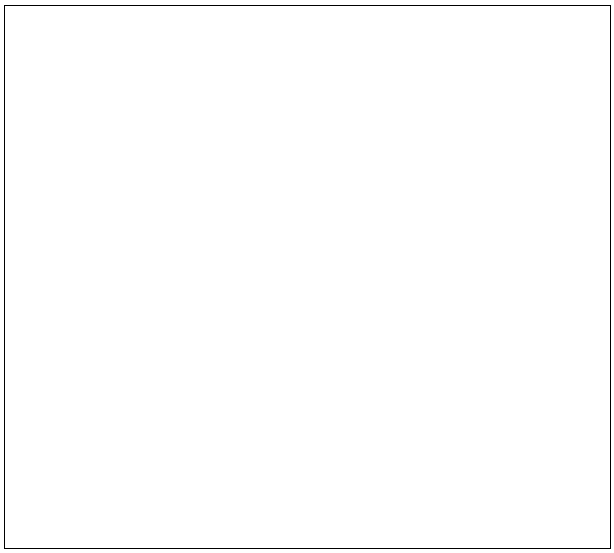

Fig 20: Thyme [75]

6. Conclusion

Hair is a key aspect of human personality, affecting morale and self-confidence. Dandruff is a scalp condition with high incidence in population, it is caused by fungal and bacterial infections like Malassezia and affects social behaviour with possessing an unhealthy skullcap. Traditional treatments like shampoos, lotions and creams have been used for ages. Both synthetic and natural herbal products are commercially available for the treatment of dandruff. Herbal shampoos are more potent concerning safety, thus investigations have been made recently to formulate herbal products. Interpretations and comparisons of findings may be laborious in such studies because combined preparations are used. The authors would like to recommend further in-vitro and clinical studies on these distinguished herbs that are Neem, Tulsi, Henna, Guava leaves, Tea tree oil, Rosemary, kesumm leaves, Pomegranate, Pudding pipe tree, Garlic, hibiscus, Bhringraj, Mountain tobacco, sage and Thyme to evaluate the nontoxicity and to isolate and purify the chemical constituents with anti-dandruff effect, that will be worthwhile for product development. In conclusion, the extracts of spotted plants that have displayed

anti-Malassezia effects in invitro tests are commonly available plants in South Asia. As most of these are conventional home remedies, development of commercial aesthetic products after manifesting appropriate scientific and clinical validation should be fostered.

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