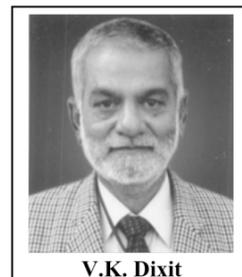


# Hair Growth: Focus on Herbal Therapeutic Agent

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**Abstract:** This review presents an overview on plants identified to possess hair growth activity in various ethno-botanical studies and surveys of tradition medicinal plants. It also highlights the developments in hair rejuvenation strategies from 1926 till-date and reviews the potential of herbal drugs as safer and effective alternatives. There are various causes for hair loss and the phenomenon is still not fully understood. The treatments offered include both natural or synthetic products to treat the condition of hair loss (alopecia), nonetheless natural products are continuously gaining popularity mainly due to their fewer side effects and better formulation strategies for natural product extracts. Plants have been widely used for hair growth promotion since ancient times as reported in Ayurveda, Chinese and Unani systems of medicine. This review covers information about different herbs and herbal formulation that are believed to be able to reduce the rate of hair loss and at the same time stimulate new hair growth. A focus is placed on their mechanism of action and the review also covers various isolated phytoconstituents possessing hair growth promoting effect.

**Keywords:** Alopecia, ayurveda, hair, herbal formulation.

## 1. INTRODUCTION

Hair loss is a disorder in which the hair falls out from skin areas where they are usually present, such as the scalp and the body. This loss interferes with the many useful biologic functions of the hair, including sun protection (mainly to the scalp) and dispersal of sweat gland products. As hair cover to the scalp has psychological importance in our society, patients with hair loss suffer tremendously. The most common hair disorder is termed as alopecia which is frequently used to express the patterned loss of scalp hair in genetically vulnerable men and women. In mammals, hair plays a vital role in thermal insulation and for social and sexual communication, both visually and as a means for dispersing scents secreted by skin glands. Humans are relatively hairless compared to other mammals

and human hair has no known significance for survival of species. However, it remains an important cosmetic asset [1]. Though hair loss (alopecia) is not a debilitating or life threatening sickness, the very thought of becoming bald can lead to emotional stress and traumatic experience for those who suffer from premature or excessive hair loss. The goal of the present article is to provide an overview of available treatment alternatives for hair loss. The article provides a brief review of the type and different causes of hair loss, followed by focus on the various types of drugs available for alopecia. The article also reviews various studies wherein efficacy of herbal drugs or isolated compound for hair growth-promotion is reported. The mechanism of action of herbal drug in preventing the hair loss or hair growth promotion is outlined as well.

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### 1.1. Hair and Hair Growth Cycle

Hair is a filamentous biomaterial that grows from follicles found in the dermis. Found

exclusively in mammals, hair is one of the defining characteristics of the mammalian class. The word "hair" often refers to two distinct structures: 1) the part beneath the skin, called the hair follicle or when pulled from the skin, called the bulb. This organ is located in the dermis and maintains stem cells, which facilitate regrowth of hair after fall or wound [2] and 2) the shaft, which is the hard filamentous part that extends above the skin surface.

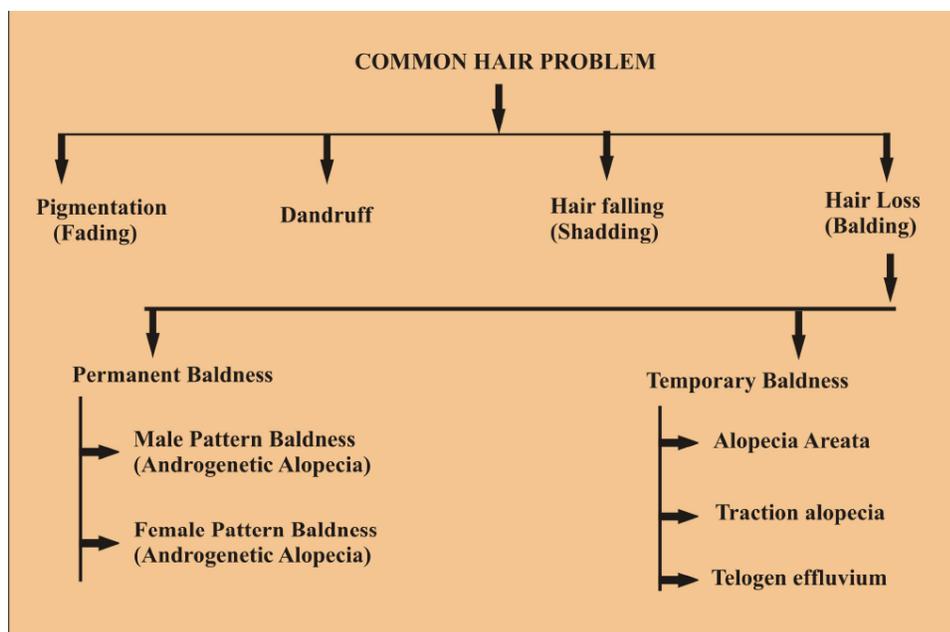
Hair growth is the cumulative, physical consequence of coordinated process of cellular proliferation and differentiation within a hair follicle. The stem cells, which commit to the fate of a hair follicle, enter a period of massive proliferation that results in the formation of mature hair follicle. Hair follicles are primarily composed of epithelial and dermal components. Hair follicles are hair shaft-producing mini-organs and exhibit regular cycles of regeneration, known as the hair cycle [3, 4]. The hair follicle, undergoes successive cyclic periods of growth, involving an active growing phase (anagen) during which the previous hair is shed, a small transitional regressive phase (catagen) and a dormant resting phase (telogen) [5], which allows the follicle to produce different types of hair in response to hormonal changes. Each strand of hair on the human body is at its own stage of development. Once the cycle is complete, it restarts and a new strand of hair begins to form.

The growth or anagen phase of human scalp hair lasts 2-7 years during which the hair follicle actively produces precursor cells that differentiate into different types of hair cells. Catagen which lasts for several weeks, is the stage during which production of precursor cells ceases and the hair bulb rapidly involutes the final phase is called telogen phase which is the resting phase of the hair cycle which lasts for an average of 3 month [6]. Ten to fifteen percent of the hair follicles on one's head are in this phase of growth at any given time. Three months later, these hairs begin to fall. The anagen phase begins again once the telogen phase is complete. The preceding hair strand is pushed up and out by the new, growing strand. Most common interest in hair is focused on hair growth, hair types and hair care, but hair is also an important biomaterial primarily composed of protein, notably keratin.

## 1.2. Disorders of Hair

The main problems associated with hairs are pigmentation (fading), dandruff and falling of hairs (shedding) and balding [7] (Fig. 1). There are various disorders of hair, which causes the hair loss (Table 1).

The term androgenetic alopecia is often used to describe the patterned loss of scalp hair in genetically susceptible men and women. This



**Fig. (1).** Major hair problems lead to hair loss.

**Table 1. Common disorder of Hair.**

Disease	Etiology	Clinical Features	Treatment
Anagen effluvium	Secondary to cytotoxic drugs like thallium, bismuth, arsenic, Cell division inhibition in hair follicle.	Loss of all hair on scalp	Scalp cooling
Telogen effluvium	Shedding of telogen hairs (no scars), Secondary to Stress like high fever, surgery, crash diet	Uniform decrease in density all over scalp, Positive hair pull test	Shampoo less frequently. Can get up to years to grow back
Alopecia Areata	Genetic Factor, Autoimmune disease	Circular patches of hair loss, Hairs grow back white.	Inject steroid (kenalog)
Traction alopecia	Hair styling like Pony tails.		Hair grafts
Androgenic Alopecia	Male and female pattern baldness	Beginning with bitemporal recession, bald patch	Rogaine (Minoxidil), Propecia (Finasteride), Transplants.
Trichotillomania	pulling hair out	Chronic, repetitive hair-pulling	Self-monitoring, Stimulus control, Habit-reversal training

condition is also known as male pattern hair loss or common baldness in men and as female pattern hair loss in women. Alopecia in these cases is characterized by thinning of hair as opposed to follicular loss, at least in early stages [8].

In androgenetic alopecia, shortening of the anagen phase and continuous miniaturization of sensitive hair follicles takes place that result into conversion of thin terminal hairs into fine vellus hairs. The 5 $\alpha$ -reductase type-2 enzyme plays a central role by intra-follicular conversion of testosterone to di-hydrotestosterone [9]. Some degree of follicular miniaturization and consequential hair loss is universal and is considered a physiological secondary sexual characteristic. Androgenetic alopecia only becomes a medical problem when the hair loss is excessive, premature and distressing to the patient. A number of medical treatments aimed at arresting the progression of the hair loss have become available in recent years, and surgical treatments are constantly being refined.

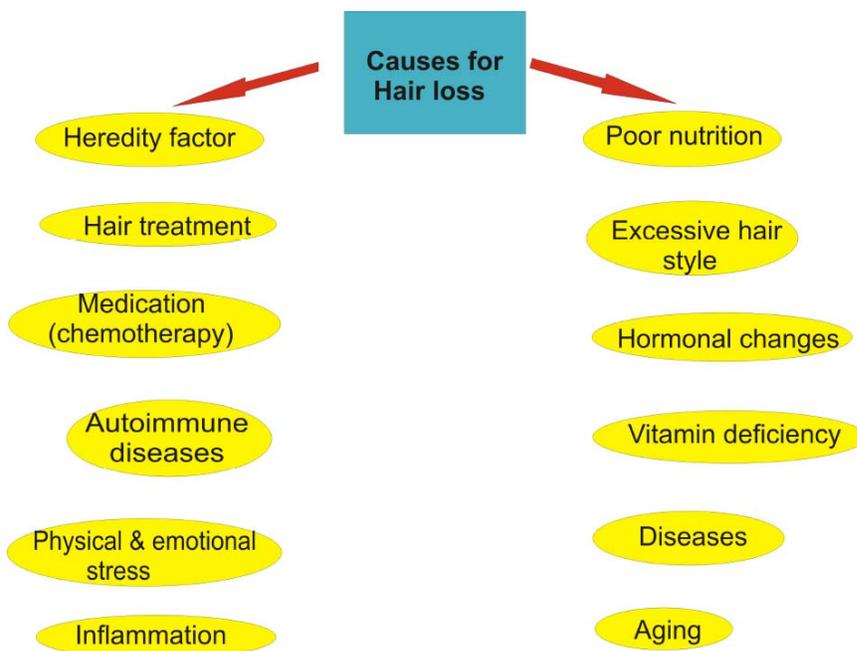
### 1.3. Causes of Hair Loss

It is a controversial issue as there is no general agreement about what are the main factors that cause loss of hair. It is a universal problem having affected both sexes of all races to different extents for as long as humankind has existed [10]. Various factors contributing to hair loss includes genetic

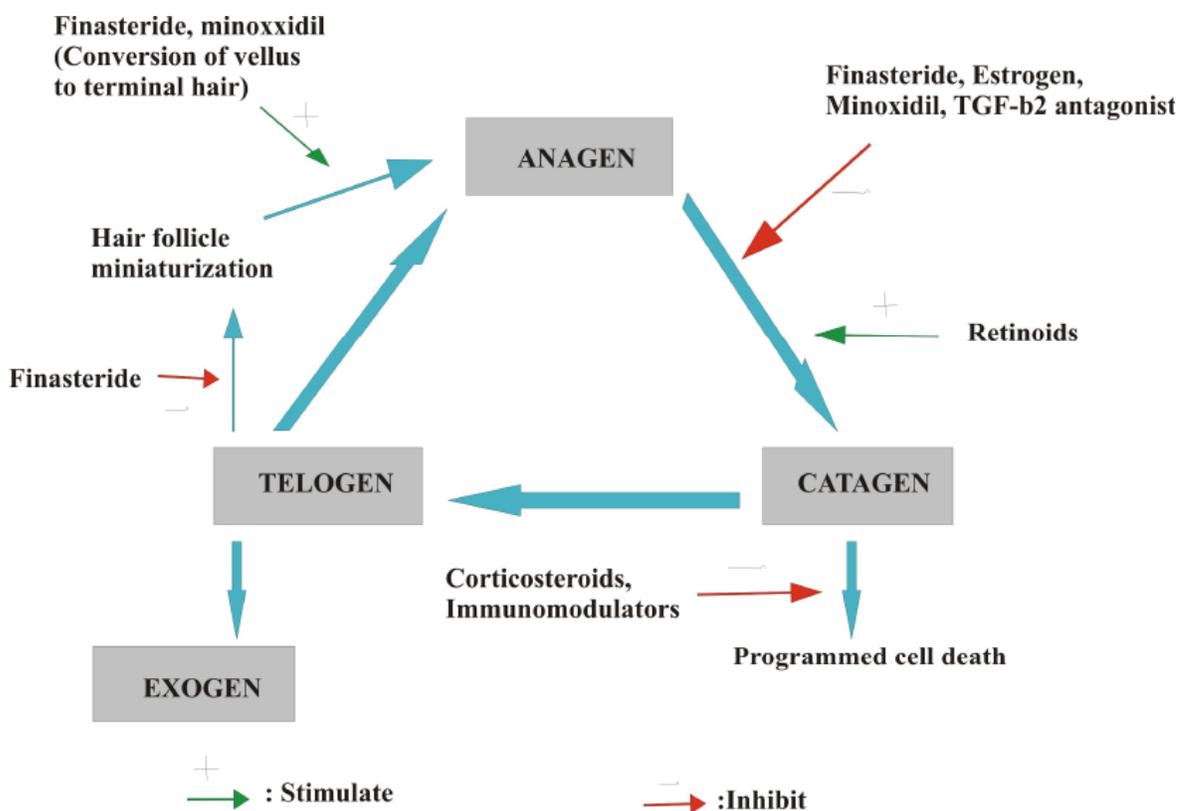
predisposition, hormonal factors, and disease states such as typhoid, malaria, jaundice and use of chemotherapeutic agents (Fig. 2). It is a dermatologic disorder, and the surge for discovering natural products with hair growth promoting potential is continuous [11].

### 1.4. Management of Hair Loss

Drugs, which claim to treat hair loss, target a steadily growing, multi-billion dollar market worldwide. Great opportunities are associated with pharmaceutical hair loss management, but still there is no radical improvement in the availability of specific therapies. The status of treatment of alopecia is the result of recent advances in our understanding of its etiology and progression. Angiogenesis (through endogenous substances), androgen antagonism, vasodilation through potassium channel opening 5-alpha reductase inhibition and modulation of hair cycle are the major non-surgical therapeutic strategies for hair growth promotion (Fig. 3). Minoxidil (useful in both male and female pattern baldness) and Finasteride (useful in male pattern baldness) are two US FDA-approved synthetic drugs finding concomitant use for treatment of androgenic alopecia, but their side effects have reduced their usage [12]. The side effects associated with the use of these synthetic compounds include erythema, scaling, pruritus, gynaecomastia, dermatitis, itching or skin rash.



**Fig. (2).** Common cause that promote the hair loss.



**Fig. (3).** Synthetic modulators of hair cycle.

Therefore, to cope with the problem of hair loss, here we have looked into the nature's treasure and found a number of herbs with proven records for the treatment of alopecia. Being natural drugs there are many advantages of using them like

patient compliance, less side effects and more than one mode of action for treatment of alopecia. Topical application of biological response modifiers and anti-androgens are currently available therapies for the management of

alopecia. However, the low success rate and associated adverse effects confines their use [13].

Natural products are considered fancy in cosmetics and numerous plant extracts have been examined with respect to hair growth activity. There is a steadily growing demand for plant-based medicines and cosmetics in the recent days. In traditional Indian system of medicine, many plants and herbal formulations are reported for hair growth promotion as well as for the improvement of quality of hairs, but lack of sound scientific backing and information limits their use [11].

### 1.5. Ayurvedic Claim of Hair Growth Activity

Ayurveda is the traditional medicinal system of India and believed to have originated over 6000 years ago. It describes the ways to remain healthy as well as methods to treat disease. The name itself means “Knowledge (Veda) of life (Ayu)” [14]. In Ayurveda, hair is considered as a by-product of bone formation. The tissue responsible for building bones is also responsible for the growth of hair. Ayurvedic practitioners believe that early hair loss is related to the body type and the balance of the mind-body constitution (doshas). Pitta individuals, and those who have excess pitta in their system, are likely to lose their hair early in life, or have prematurely thin or grey hair. Excess pitta in the sebaceous gland, at the root of the hair, or folliculitis can make the person start losing hair.

Ayurveda has described hair disease in three Sanskrit terms in Charak samhita a Sanskrit text:

1. Khalitya (Alopecia): Means loss of hairs
2. Palitya (Premature grey hair and cavities): Means premature hair greying
3. Indralupta (Baldness): Means alopecia areata, totalis, universalis [15, 16].

Some plants and their mixture mentioned in Charak Samhita [17], Sharangdhar Samhita Grantha say [18] are traditionally used in treatment of Khalitya (Alopecia), and Indralupta (Baldness) by Charak, born 300 BC was one of the principal contributors to ancient art and science of Ayurveda as a system of medicine (Table 2).

There are various plant used for hair growth mentioned in the Ayurvedic Pharmacopoeia of India. These plants are defined under a common term known as “Kesya Rasayana” (Table 3).

## 2. HAIR GROWTH PROMOTING HERBAL DRUGS

There are various plants, extracts used in different part of world for care of the hair and have hair growth promoting activity, and numbers of herbal products acclaimed with hair growth promoting activity. All over the world, many poly-herbal mixtures are employed as hair tonic, hair growth promoter, hair conditioner, hair cleansing agent, anti-dandruff agents, as well as for the treatment of alopecia and lice infection. This section of review reports the scientific evidence of hair growth promoting activities of plants their parts used, type of extracts and also *in-vitro, in-vivo* and clinical trial data available from different experiments (Table 4, Table 5). Various phyto-constituents isolated from plants and having hair growth promoting potential are reported in (Table 6) followed by their chemical structure (Fig. 4).

## 3. HERBAL DRUGS FOR HAIR GROWTH

Some of the most widely researched plants for hair growth promoting activity are defined hereafter:

### 3.1. *Emblica officinalis* Linn.

*E. officinalis* Linn. (Syn. *Phyllanthus emblica* Linn.), the Indian gooseberry, or *aamla*, is a deciduous tree. *Emblica* is used to promote the growth of hair in traditional medicine. Embelica is reported to improve the iron metabolism; Iron is involved in the oxygenation of our body's red blood cells. It is essential for normal hair growth and for the maintenance of healthy hair. Iron deficiency leads to hair loss because of oxygen deficiency. Embelica extracts stimulate proliferation of dermal papilla cell in a concentration dependent manner, suggesting their role in hair growth promotion [19]. Its polyherbal ointment and herbal hair oil have hair growth promoting activity [20, 21]. Herbal Formulation containing *Tridax procumbens* (Linn.), *Hibiscus rosa sinensis* (Linn.), *Trigonella foenum graecum* (Linn.), and *E. officinalis* (Linn.) showed synergistic effects by significant increase in hair growth activity [22].

### 3.2. *Bacopa monnieri* Linn.

*B. monnieri* Linn. a small, creeping herb and bitter in taste; it has been used in the traditional system of medicine for centuries. Compounds

**Table 2. Plants mentioned in Charak Samhita and Shandrdhar Samhita Grantha say in treatment of alopecia.**

Indian vernacular name	Botanical name	Family	Parts used
Bhringraj	<i>Wedelia chinensis</i> (Osbeck)/ <i>Eclipta alba</i> / <i>Tridax</i>	Asteraceae	Leaves
Tulsi	<i>Ocimum sanctum</i> L.	Labiatae	Leaves
Mulethi	<i>Glycyrrhiza glabra</i> L.	Fabaceae	Root
Kaner	<i>Nerium oleander</i> L.	Apocynaceae	Bark
Dudhi	<i>Trichospermum lucidum</i>	Apocynaceae	Leaves
Makoy	<i>Solanum nigrum</i> L.	Solanaceae	Berries
Devdaru	<i>Cedrus Deodara</i> (Roxb.) <i>Polyalthia longifolia</i> Sonn.	Pinaceae Annonaceae	Leaves Leaves
Harad	<i>Terminalia chebula</i> Retz.	Combretaceae	Fruits
Bahede	<i>Terminalia bellerica</i> (Gaertn.)	Combretaceae	Fruits
Manjistha (Indian Madder)	<i>Rubia cardifolia</i> L.	Rubiaceae	Leaves
Lodh	<i>Symplocos racemosa</i> Roxb.	Symplocaceae	Aerial parts, Bark
Bhilawa	<i>Semecarpus anacardium</i> L.F.	Anacardiaceae	Nuts
Mallika	<i>Jasminum officinale</i> L.	Oleaceae	Leaves
Babchi	<i>Psoralea corylifolia</i> L.	Fabaceae	Seed
Sahchar	<i>Calacanthus grandiflorus</i> Mill	Acanthaceae	Leaves
Kumbher	<i>Gmelina arborea</i> Roxb.	Lamiaceae	Fruits
Arjuna	<i>Terminalia arjuna</i> (Roxb.)	Combretaceae	Bark
Patol	<i>Trichosanthes</i> species	Cucurbitaceae	Leaves, Fruits
Kateri	<i>Solanum xanthocarpum</i>	Solanaceae	Leaves
Dakh	<i>Ribes rubrum</i> L.	Grossulariaceae	Flowers, Leaves

responsible for the pharmacological effects include alkaloids, saponins, and sterols. Brahmi contains alkaloids that enhance protein kinase activity that may be responsible for hair growth activity [23]. Herbal oil formulation of *Bacopa* showed prominent hair growth promoting activity [21].

### 3.3. *Trigonella foenum graecum* Linn.

*Trigonella foenum graecum* Linn. commonly known as Fenugreek is an aromatic herb. It mainly contains flavonoids, quercetin, luteolin, saponins,

diosgenin, tigogenin, gitogenin, trigonelline, protein (26%), fats(6%), carbohydrates, galactomannan (44%).The leaves are useful in external and internal swellings and burns as well as in prevention of hair fall [24]. Formulation containing petroleum ether extract showed the minimum time to initiate (5 days) as well as to complete the hair growth (18 days) at denuded surfaces. Formulation with ethanolic extract showed the best hair lengthening properties as compared to *Aloe vera* and *Semecarpus* [25]. Formulation containing

**Table 3. List of some plant having hair growth promoting activity according to Ayurvedic Pharmacopoeia of India (Part1, Volume I-V) [76].**

Traditional name	Parts used	Biological name	Family
Asana	Heartwood Stem bark	<i>Pterocarpus marsupium</i> Roxb.	Leguminosae
Bibhitaka	Fruits	<i>Terntinalia bellerica</i> Roxb.	Combretaceae
Gunja	Seed	<i>Arbus precatorius</i> Linn.	Leguminosae
Ketaki	Roots	<i>Pandanus tectorius</i> Soland	Pandanaceae
Bharngaraja	Whole plant	<i>Eclipta alba</i> Hassak	Asteraceae
Gambhari	Fruits	<i>Gmelina arborea</i> Roxb.	Verbenaceae
Nili	Leaf, Root, Whole plant	<i>Indigofera tentoria</i> Linn.	Papilionaceae
Kadali	Rhizome	<i>Mussa paradisiaca</i> Linn.	Musaceae
Nirgundi	Leaf, Root	<i>Vitex negunda</i> Linn.	Verbenaceae
Sahacara	Whole plant	<i>Barleria prionitis</i> Linn.	Acanthaceae
Utpala	Flower	<i>Nymphae stellata</i> Willd.	Nymphaeaceae
Karnasphota	Seeds, Roots	<i>Cardiospermom halicacabom</i> Linn.	Sapindaceae
Nilajhinti	Roots	<i>Barleria strigosa</i> Willd.	Acanthaceae

*Tridax procumbens* (Linn.), *Hibiscus rosa sinensis* (Linn.), *Trigonella foenum graecum* (Linn.), and *Embilica officinalis* (Linn.) showed synergistic effects by significant increase in hair growth activity [22].

### 3.4. *Hibiscus rosa-sinensis* Linn.

The herb *Hibiscus rosa sinensis* Linn is a glabrous shrub widely cultivated in the tropics as an ornamental plant and has several forms with varying colour of flowers. The leaves and flowers promote hair growth and aid in healing of ulcers. It contains taraxeryl acetate, beta-sitosterol, campesterol, stigmasterol, ergosterol, flavonoids, glycosides, lipids, citric and oxalic acids. Leaf extract of *Hibiscus rosa-sinensis* increases hair length and the anagen/telogen ratio of hair follicles in mice [26]. Formulation containing *Eclipta alba* Hassk, *Hibiscus rosa sinensis* Linn, *Nardostachys Jatamansi* have excellent hair growth promoting activity, they mainly act by an enlargement of follicular size and a prolongation of the anagen phase [27].

### 3.5. *Polyporus umbellatus*

*Polyporus umbellatus* is a saprophytic mushroom that grows on withered beech and maple trees roots. The major active components are polysaccharides and steroidal compounds. Ethanolic extract were reported to promote hair growth in mice, and 3, 4-dihydroxybenzaldehyde was isolated as an active component [28]. A later study isolated 3 hair regrowth substances, acetosyringe and polyporusterone A and B [29]. *In-vitro* evaluation of *P. umbellatus* extract using organ culture of human scalp hair follicles showed that low doses of extracts (1.28 and 6.4 µg/ml) markedly enhanced the hair growth and lengthened the period of hair growth, while high doses of mixture extracts (4 and 20 mg/ml) sharply inhibited hair growth and shortened the period of hair growth [30].

### 3.6. *Rosmarinus officinalis* Linn.

Rosemary is a common dense, evergreen, aromatic shrub grown in many parts of the world. Historically, it used as a medicinal agent to treat renal colic and dysmenorrhoea (painful menstruation). It is also

Table 4. Herbs having hair growth promoting activity.

Biological source	Parts Used	Family	Type of extract	Type of animal	Ref.
<i>Allium cepa</i> L.	Bulb	Liliaceae	Juice	Human	[59]
<i>Aloe vera</i> L.	Leaves	Liliaceae	Gel	<i>in-Vitro</i> Culture method	[77, 78]
<i>Asiasari radix</i> F.	Roots, Rhizome	Aristolochiaceae	Ethanollic extract	C57BL/6 C3H mice	[33]
<i>Abrus precatorius</i> L.	Seed	Fabaceae	Petroleum ether extract, Ethanollic extract	Male albino Rat	[79]
<i>Aconiti ciliare</i>	Tuber	Ranunculaceae	Aqueous Extract	Mice	[120]
<i>Boehmeria nipononivea</i> K.	Aerial Parts	Utricaceae	Acetone extract	Mice	[34]
Boxthorn ( <i>Lycium Linn.</i> )	Leaves	Solanaceae	Aqueous Extract	Mice	[80]
<i>Buxus wallichiana</i> Linn.	Wood	Buxaceae	Methanollic extract	Albino Rats	[38]
<i>Camellia sinensis</i> (L.) Kuntze	Leaves	Theaceae	Methanollic extract	Female Balb/black mice	[51, 61, 74]
<i>Capsicum annum</i> Linn.	Fruits	Solanaceae	—	Mice	[63]
<i>Cardiospermum halicacabum</i> Linn.	Whole Plant	Sapindaceae	Volatileoil	-----	[10]
<i>Carthamus tinctorius</i>	Whole plant	Asteraceae	Ethanollic extract	SpragueDawley rats	[121]
<i>Cercidiphyllum japonicum</i> Sieb.	Heart Wood	Cercidiphyllaceae	Methanollic extract	Mice	[81]
<i>Chamaecyparis obtuse</i> Endl.	Leaves	Cupressaceae	Essential Oils	C57BL/6 mice	[82]
<i>Citrullus colocynthis</i> (L.) Schrad.	Fruits	Cucurbitaceae	Petroleum ether extract	Albino rat	[44]
<i>Citrus bergamia</i> Wright	Pulp	Rutaceae	Aqueous Extract	Mice	[80]
<i>Crinum asiaticum</i> Linn.	Bulb	Amaryllidaceae	Ethanollic extract	Wistar rats	[83]
<i>Curcuma longa</i> Linn.	Rhizome	Zingiberaceae	Ethanollic extract	Mice	[84]
<i>Cuscuta reflexa</i> Roxb.	Stems	Convolvulaceae	Petroleum ether extract	Albino rat	[58], [126], [127]
<i>Cyperus rotundus</i> Linn.	Rhizome	Cyperaceae	Ethanollic extract	Albino rat	[8]
<i>Eclipta alba</i> ( L ) Hassak.	Whole Plant	Asteraceae	Petroleum ether extract, Methanollic extract	Albino rat C57/BL6 mice	[48] [47]

(Table 4) contd...

Biological source	Parts Used	Family	Type of extract	Type of animal	Ref.
<i>Erica multiflora</i> Linn.	Whole Plant	Ericaceae	Ethanollic extract	Mice	[85]
<i>Ficus religiosa</i> Linn.	Bark	Moraceae	Ethanollic extract	Albino mice	[86]
<i>Fructus Panax ginseng</i>		Araliaceae	Ethanollic extract	C57BL6 mice, Human DPC's	[87]
<i>Ginkgo biloba</i> Linn.	Leaves	Ginkgoaceae	Ethanollic extract	C3H strain mice	[5]
<i>Hibiscus rosa sinensis</i> Linn.	Flowers, Leaves	Malvaceae	Oil, Petroleum ether extract	Albino rat, Mice	[26]
<i>Illicium anisatum</i> Linn.	Leaves, Fruit, Root	Illiciaceae	Methanollic extract	Hybrid mice	[88]
<i>Ishige sinicola</i>	Algae		Aqueous extract	Rat	[124]
<i>Laminaria Angustata</i> Kjellman	Kelp	Laminariaceae		C3H mice	[89]
<i>Larrea divaricata</i> Cav.	Aerial Parts	Zygophyllaceae	Hydroalcoholic extract	Mice	[90]
<i>Lawsonia alba</i> L.	Leaves & Seeds	Lythraceae		<i>In vitro</i> Culture method	[91]
<i>Lygodii spora</i>	Spore	Schizaeaceae	Aqueous Ethanollic extract	Syrian hamster, C57Black/6CrSlc mice	[54]
<i>Myrica rubra</i> Siebold & Zucc.	Cortex	Myricaceae	Aqueous Ethanollic extract	Syrian hamster, C57Black/6CrSlc mice	[92]
<i>Nicotiana tabacum</i> Linn.	Leaves	Solanaceae	Microbial biotransformed extract	<i>In vitro</i> Culture method	[93]
<i>Nordostachys jatamansi</i> DC	Rhizome, Roots	Valerianaceae	Volatile oil, Ethanollic extract	Rabbit, Albino rats	[8, 55]
<i>Ocimum gratissum</i> Linn.	Leaves	Lamiaceae	Volatile oil	Albino rats	[94]
<i>Piper nigrum</i> Linn.	Leaf	Piperaceae	Aqueous Ethanollic extract	C57Black/6CrSlc strain mice	[95]
<i>Polygala senega</i> var. <i>latifolia</i> Torr.	Root	Polygalaceae	Methanollic Extract	C3H/He mice	[96]
<i>Polygonum multiflorum</i> L.	Root, Leaves	Polygonaceae	Aqueous extract	Human, C57BL/6N mice	[60] [118][62, 28,29]
<i>Polyporus umbellatus</i> (Pers.) Fr.	Fruiting Body	Polyporaceae	Ethanollic extract	C3H/He mice	[28]
<i>Prunus dulcis</i> Mill.	Seed	Rosaceae	Petroleum ether extract	Albino rat	[97]

(Table 4) contd...

Biological source	Parts Used	Family	Type of extract	Type of animal	Ref.
<i>Psidium guajava</i> Linn.	Leaves	Myrtaceae	Hydroalcoholic extract	Albino mice	[86]
<i>Pueraria thomsonii</i> Benth.	Flowers	Fabaceae	Ethanollic extract	C57Black/6NCrSlc strain mice	[98]
<i>Pygeum africanum</i> Hook.f.	Dried Bark	Rosaceae	Chloroform extract	Mice	[51, 99]
<i>Rosmarinus officinalis</i> Linn.	Leaves, Flowers	Labiatae	Essential Oils	Human	[100, 31]
<i>Rubus idaeus</i> Linn.	Beries	Rosaceae		C57BL/6 mice	[101]
<i>Russelia equisetiformis</i> Schlecht.	Whole Plant	Scrophulariaceae	Methanolic extract	Albino rats	[102]
<i>Radix Panax ginseng</i> C.A. Mayer	Root, Stem	Araliaceae	Methanolic extract	Mice	[49]
<i>Schisandra nigra</i> Maxim.	Berries	Schisandraceae	Ethanollic extract	C57BL/6 mice	[103]
<i>Seneroa repens</i> Bartram	Berries	Arecaceae	Petroleum ether extract	Mice	[99]
<i>Sophora flavescens</i> Aiton	Roots	Leguminosae	Methanolic extract	C57BL/6 mice	[53]
<i>Swertia japonica</i> Linn.	Aerial part	Gentianaceae	Glycol extract		[104]
<i>Tamarindus indica</i> Linn.	Seed Coat	Leguminosae	Ethanollic extract	Mice	[84]
<i>Tectona grandis</i> Linn.	Seed	Lamiaceae	Petroleum ether Extract	Albino mice	[105]
<i>Thuja occidentalis</i> Semen	Leaves, Fruits	Cupressaceae	Ethanollic, Ethyl acetate extract	Fuzzy rats, AGA mouse	[66]
<i>Thuja orientalis</i>	Leaves	Cupressaceae	Hot water extract	Male C57BL/6 N mice	[122]
<i>Trichosanthes dioica</i> R.	Leaves	Cucurbitaceae	Ethanollic, Aqueous extract	Albino rats	[2]
<i>Tridax procumbens</i> Linn.	Aerial Parts	Compositae	Oil	Mice	[57]
<i>Urtica dioica</i> Linn.	Roots, Leaves	Urticaceae	Water, Alcoholic extract	Mice	[51]
<i>Zizyphus jujuba</i> Linn.	Seed	Rhamnaceae	Essential oil	Mice	[106]

used to relieve symptoms caused by respiratory disorders and to stimulate the growth of hair. It constitutes 1-2% volatile oil containing 0.8-6% of esters and 8-20% of alcohols. The principal constituents are 1, 8-cineole, borneol, camphor,

bornyl acetate and monoterpenes hydro-carbons. The essential oils enter your system through the olfactory system (inhalation) and/or through skin and reach circulatory system (the blood) where they bind to receptors and change the chemical

Table 5. Herbal formulation.

Plants in Herbal Formulation	Formulation	References
<i>Citrus limonis</i> Osbek, <i>Cuscuta reflexa</i> Roxb., <i>Embolica officinalis</i> L., <i>Centella asiatica</i> (L.) Urban, <i>Allium cepa</i> L., <i>Lawsonia inermis</i> L., <i>Azadirachta indica</i> (L.) Adleb., <i>Eclipta alba</i> (L.) Hassak, <i>Ocimum sanctum</i> Linn. and <i>Eugenia caryophyllus</i> Thunb.	Herbal hair oil	[45]
<i>Hibiscus rosa-sinensis</i> L., <i>Tridax procumbens</i> L.	Herbal hair oil	[107]
<i>Eclipta alba</i> (L.) Hassak, <i>Hibiscus rosa sinensis</i> Linn, <i>Nardostachys jatamansi</i> DC	Herbal hair oil	[27]
<i>Glycyrrhizae radix</i> , <i>Persicae Semen</i> , <i>Salviae radix</i> , <i>Angelicae gigantis radix</i> , <i>Zanthoxyli fructus</i> , <i>Ginseng Radix Alba</i> , <i>Cnidii rhizoma</i> , and <i>Carthami flos</i>	Herbal hair oil	[108]
<i>Embolica officinalis</i> , <i>Centella asiatica</i> (L.) Urban, <i>Aloe vera</i> (L.) Burm.f., <i>Ocimum sanctum</i> Linn., <i>Eclipta alba</i> (L.) Hassak	Polyherbal Ointment	[20]
<i>Cuscuta reflexa</i> Roxb., <i>Citrullus colocynthis</i> Schrad., and <i>Eclipta alba</i> Hassk.	Herbal cream	[11]
<i>Trigonella foenum-graecum</i> Linn., <i>Semecarpus anacardium</i> L.F., <i>Trigonella corniculata</i> (L.)	Herbal gel	[25]
<i>Poria cocos</i> , <i>Thuja orientalis</i> , <i>Espinosilla</i> , <i>Lycium chinense</i> Mill, <i>Coix lacryma-jobi</i> and <i>Polygonum multiflorum</i>	Cubosomal suspension	[119]
<i>Trigonella foenum-graecum</i> Linn. and <i>Butea monosperma</i>	Herbal hair ointment	[123]
<i>Sophora flavescens</i> , <i>Pleuropterus multiflorus</i> , <i>Fructus rubi</i> , <i>Semen glycine</i> , <i>Rehmanniae radix</i>		[109]
<i>Arnica Montana</i> L., <i>Aloe socotrina</i> Linn., <i>Embolica officinalis</i> Gaertn, <i>Terminalia chebula</i> Retz, <i>Nyctanthes arbortristis</i> L., <i>Pilocarpus jaborandi</i> Vahl	Herbal Cream	[110]
<i>Tridax procumbens</i> Linn., <i>Hibiscus rosa sinensis</i> Linn., <i>Trigonella foenum graecum</i> Linn., <i>Embolica officinalis</i> Linn.	Herbal hair oil	[22]
<i>Embolica officinalis</i> Linn, <i>Hibiscus rosa sinensis</i> Linn, <i>Bacopa monnieri</i> L., <i>Trigonella foenum graecum</i> Linn	Herbal hair oil	[21]

composition. Topical herbal therapy stimulates hair follicles [31]. Aromatherapy considered being a safe and effective treatment for alopecia areata. Treatments with these essential oils obtain from *Thyme*, *Rosmarinus*, *Lavender* and *Cedarwood* were significantly more effective than treatment with the carrier oil alone [31].

### 3.7. *Asiasari radix* F.

*Asiasari radix* is the root and/or rhizome of *Asiasarum heterotropoides* F. *Maekawa* var. *mandshuricum* F. *Maekawa* or *Asiasarum sieboldi* F. *Maekawa*. It mainly contains safrole, methyl eugenol and monoterpenes, named asarinol A, asarinol B, car-3-ene-2, 5-dione, asarinin, sesamin, methyleugenol and elemicin [32]. Extract of

*Asiasari radix* have prominent hair growth-promoting potential and this effect may be due to its regulatory effects on both cell growth and growth factor gene expression [33].

### 3.8. *Boehmeria nipoonivea* Kogenmushi

*Boehmeria nipoonivea* is a perennial herb. The plant is used as a medicine to relieve fevers and infections of the urethra. It contains 10%-30% fatty acid, 10% chlorogenic acid, linoleic acid, protocatechuic acid, caffeic acid and alpha-linolenic acid. Acetone extract of *B. nipoonivea* showed both potent 5 $\alpha$ -reductase inhibitory activity and hair re-growth promotion effects on mice. 5 $\alpha$ -reductase inhibitory activity-guided fractionation led to six active fatty acids:

**Table 6. Phytoconstituents having hair growth activity.**

Constituent	Category	Biological source	References
Piperine	Alkaloid	<i>Piper nigrum</i> Linn.	[95]
3,4-dihydroxy benzaldehyde	Terpenoids	<i>Polyporus umbellatus</i> (Pers.)	[28]
Acetosyringe and Polyporusterone A & B	Steroids	<i>Polyporus umbellatus</i> (Pers.)	[29]
Capsaicin	Alkaloid	<i>Capsicum annum</i> Linn.	[63]
Proanthocyanidins	Flavonoids	<i>Vitis vinifera</i> L. (Grape seed)	[111]
Epigallocatechin 3-gallate	Flavonoids	<i>Camellia sinensis</i> (L.)(Green tea)	[61]
Procyanidin B-3	Flavonoids	<i>Hordeum vulgare</i> L. (Barley)	[71]
Procyanidin B-2	Flavonoids	<i>Malus domestica</i> Borkh.(apple)	[112]
Ginsenoside R <sub>o</sub>	Saponin	<i>Panax ginseng</i> L.	[52]
Hinokitiol	Alkaloid	<i>Chamaecyparis obtuse</i> <i>Thuja plicata</i> Don	[113]
Isoflavone	Flavones	Various Legumes plant	[63, 114]
Bisbenzylisoquinoline	Alkaloid	<i>Stephania cepharantha</i> Hayata	[115]
Soyasaponin I	Saponin	<i>Pueraria thomsonii</i> (Benth.) Maesen	[98]
Kaikasaponin III	Saponin	<i>Pueraria thomsonii</i> (Benth.) Maesen	[98]
Norgalanthamine	Alkaloid	<i>Crinum asiaticum</i> Linn.	[83]
Senegose A, Senegin II, Senegin III, Senegasaponin b	Polysaccharide Saponin	<i>Polygara senega</i> Torr.	[96]
Nardin Jatamansic acid	Sesquiterpene Acid	<i>Nardostachys jatamansi</i> DC	[116]
6- Gingerol	Flavonoid	<i>Zingiber officinale</i>	[125]
Ginsenoside F2	Saponin	<i>Panax ginseng</i> L.	[128]

alpha-linolenic, linoleic, palmitic, elaidic, oleic and stearic acids [34]. A specific extract from leaves of this plant has a very effective 5 $\alpha$ -reductase inhibitory activity may be due to presence of several specific fatty acids. The receptor affinity and the most efficacious dose was compared with finasteride. In this evaluation, *Boehmeria nipononivea* show a very significant inhibitory effect on 5 $\alpha$ -reductase receptor, which was lower than the effect exhibited by finasteride [35].

### 3.9. *Buxus wallichiana* Baill.

*Buxus wallichiana* Baill. is commonly known as Himalayan boxwood. Boxwood is an evergreen

monoecious tree growing to the height of 6 meters with variable forms. The bark of *Buxus wallichiana* is used as a hair growth stimulant [36, 37]. Principle active constituent are alkaloids viz. buxemenol E, buxaltine H, buxiramin D, buxatine, buxandrine F, buxidine F, semperviraminol, buxamine F. Only methanolic extract which possesses potential free oxygen radical scavenger activity was used to investigate the hair growth stimulant property. The phytochemical studies showed the presence of flavonoids in this extract. The results of hair growth experiment in rat model, strongly suggested that it has potential components to stimulate the hair growth. The interesting feature of this extract was

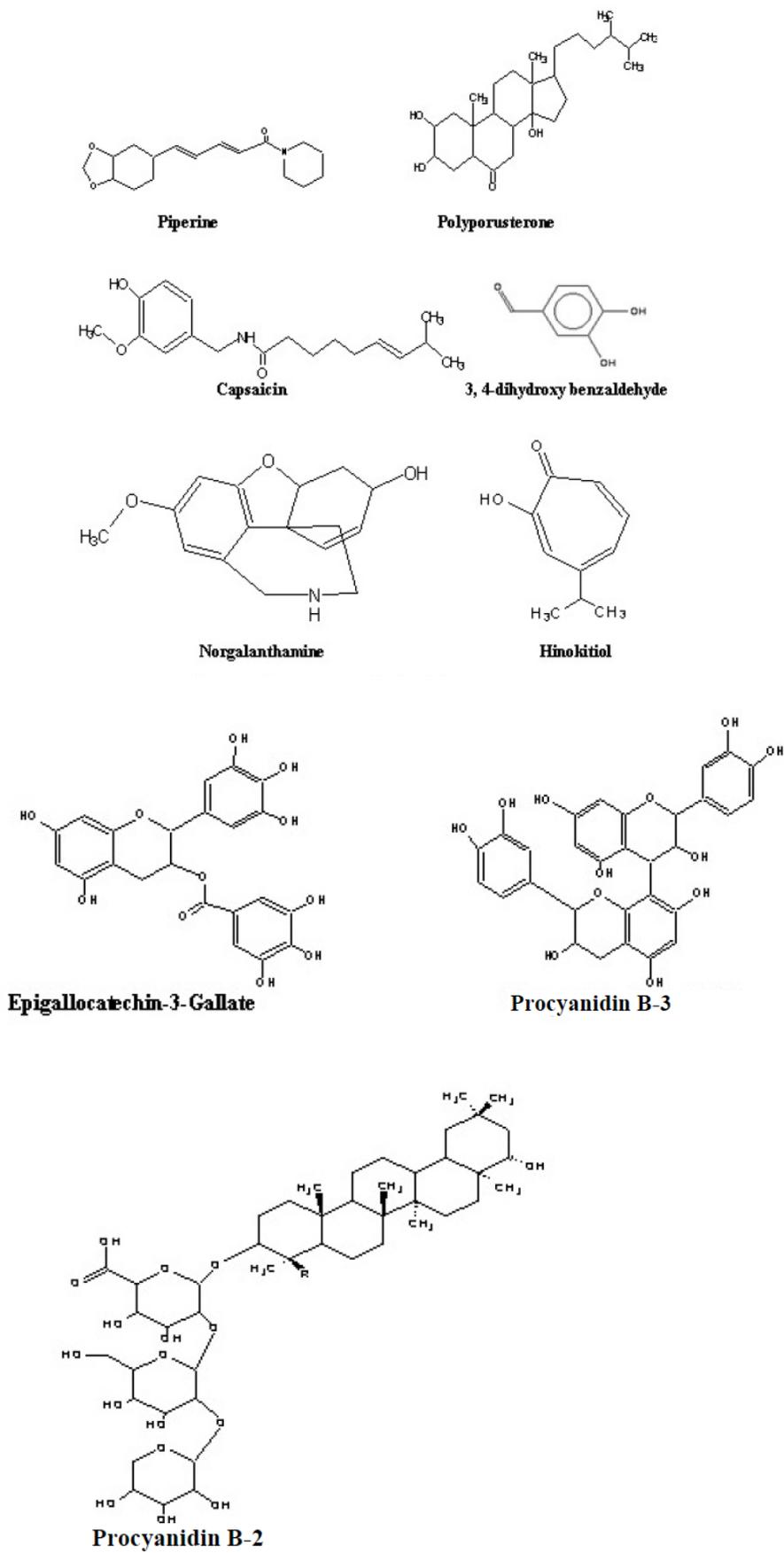


Fig. (4). Structure of isolated phytoconstituents.

its efficiency at systemic as well as topical level. The oral treatment, however proved more effective than the topical application [38].

### 3.10. *Ginkgo biloba* Linn.

*Ginkgo biloba* is a very popular herbal remedy with numerous health benefits. Among them is its role in improving the circulation of blood to the brain and skin and hence increased oxygen supply. Main constituent are ginkgolides A, B, C, J, M, bioflavin, sitosterol, lactones and anthocyanins. Hormones and *Ginkgo* extracts were synergistic in promoting human hair growth [39]. *Ginkgo biloba* extracts (5–40%) and *Liquiritia officinarum* extracts (3–35%) glycerrhizinate claimed to be useful for the treatment of hair [40]. Stearyl glycyrrhetinate and *Ginkgo* extracts acted synergistically on hair growth [39]. *Ginkgo biloba* leaf extract promote hair regrowth through combined effects on proliferation and apoptosis of the cells in the hair follicle, thus suggesting potential as a hair tonic [5].

### 3.11. *Citrullus colocynthis* (L.) Schrad

*Citrullus colocynthis* is a herb that has been recommended in traditional literature as a hair growth promoter [41]. The dried pulp of the unripe but full grown fruit freed from the rind constitutes the drug, colocynth of commerce, and is used for treating loss of hair. The oil from the seeds of the plant has been reported and is used by ethnic tribes for controlling premature falling and graying of hairs [37]. It contains mainly glycosides, which upon enzymatic hydrolysis yield elaterin (cucurbitacin E), elatericin B (cucurbitacin I) and dihydroelatericin B (cucurbitacin L) [42]. *Citrullus colocynthis* promotes the growth of hairs with least hair growth initiation and completion time and maximum number of hair follicles in anagenic phase [43]. Herbal formulations containing petroleum ether extracts of the three herbs (*Cuscuta reflexa*, *Citrullus colocynthis*, *Eclipta alba*) in varying ratio was evaluated for the hair growth promoting activity [17]. In another study Petroleum ether extract of fruits of *Citrullus colocynthis* was evaluated for hair growth promoting activity in albino mice using testosterone induced alopecia model. It was proposed that extract probably act by competing with testosterone for testosterone receptor [44].

### 3.12. *Eclipta alba*(L) Hassak.

*Eclipta alba* Hassk. (Bhringaraja) is a small-branched annual herb with white flower heads inhabiting tropical and subtropical regions of the world. It traditionally used to check hair loss and stimulate hair growth. The extracted juice if taken internally and applied to the scalp blackens the hair [37]. The principal constituents of *Eclipta alba* are coumestan derivatives like wedololactone (1.6%), demethyl wedelolactone, desmethyl-wedelolactone-7glucoside and ecliptal,  $\beta$ -amyrin, luteolin-7-O-glucoside, hentriacontanol, heptacosanol, stigmaterol. *Eclipta alba* is a component in various polyherbal formulations [11, 27,45, 46] for hair growth promotion. Methanolic extract has been shown potential as a hair growth promoter [47]. It is also reported that the petroleum ether extract of *E. alba* promote follicular enlargement and prolongation of anagen phase [48].

### 3.13. *Ginseng radix*

*Ginseng radix* is the steamed and dried root of *Panax ginseng* C.A. Mayer. It is an important crude drug, which is used from ancient time to improve constitutional tendencies to poor body condition, to promote appetite, to increase vitality and to reduce over sensitivity to cold. It mainly contains ginsenosides, essential oil, sesquiterpenes, polyacetylenes, polysaccharides, peptidoglycans, steroid, choline, vitamin- B, C, E, fatty acid, carbohydrates, and amino acids. It was reported that the 70% methanolic extract from red ginseng has superior activity to that of white ginseng in a hair growth-promoting assay using mouse vibrissal follicles in organ culture. The activity is credited to the saponin component of ginseng [49]. Studies revealed that ginseng act as a 5 $\alpha$  reductase inhibitor [50, 51]. Ginsenosides Ro enhance *in vivo* hair re-growth based on their inhibitory activity against 5 $\alpha$  reductase in the androgenetic alopecia model [52].

### 3.14. *Sophora flavescens* Aiton

*Sophora flavescens* is a species of plant in the genus *Sophora*. Ku shen (the root) is a typical traditional Chinese medicine, possess Kushenin- a flavanoid compound. The extract of *Sophora flavescens* has excellent hair growth promoting activity. Its extract induced mRNA levels of growth factors such as IGF- 1 and KGF in dermal papilla cells, suggesting that the effect of extract

on hair growth may mediate through the regulation of growth factors in dermal papilla cells. In addition, the extract revealed to possess potent inhibitory effect on the type II 5 $\alpha$  reductase activity [53].

### 3.15. *Lygodii spora*

*Lygodium* (climbing fern) is a genus of about 40 species of ferns, native to tropical regions across the world. It is the sole genus in the family Lygodiaceae, though included in the family Schizaeaceae by some botanists. Hydroalcoholic extract was studied for testosterone 5 $\alpha$ -reductase inhibitory activity and anti-androgenic activity using growth of flank organ in castrated Syrian hamsters and hair regrowth after shaving in testosterone-treated C57Black/6CrSlc mice respectively. From the lipophilic constituents of *Lygodii spora*, oleic, linolenic and palmitic acids identified as the main active principles inhibiting testosterone 5 $\alpha$ -reductase activity [54].

### 3.16. *Nardostachys jatamansi* DC

*Nardostachys jatamansi* DC commonly called Jatamansi or spikenard in English and it is a small shrub. The rhizomes of the plant are used since antiquity in the indigenous systems of medicine. It mainly contains bornyl acetate, valeranone, jnonon, menthylthymyl-ether and 1, 8-cineol. It is reported that *Nardostachys jatamansi* is having hair growth activity [55]. It was investigated that the ethanolic extract of Jatamansi has prominent hair growth effect in chemotherapy induced alopecia [8]. It was proved that formulation containing *Eclipta alba* Hassk, *Hibiscus rosa sinensis* Linn, *Nardostachys Jatamansi* have excellent hair growth promoting activity as shown by an enlargement of follicular size and a prolongation of the anagen phase [27]. Hexane extract of the rhizomes of *N. jatamansi* showed positive response in hair growth activity due to two compound nardin and jatamansic acid. They showed moderate reduction in hair growth time [56].

### 3.17. *Tridax procumbens* Linn.

*Tridax procumbens* commonly known as 'Ghamra' in Hindi and popularly called 'coat buttons' in English because of the appearance of flowers, has been extensively used in Ayurvedic system of medicine for various ailments. It mainly contains flavonoids, procumbenetin, fumaric acid,

beta sitosterol, alkaloids, tannin, luteolin, glucoluteolin, quercetin, isoquercetin. Its leaves are used in the treatment of bronchial catarrh, dysentery and diarrhoea and for preventing hair loss. Hair growth promoting activity of *Tridax procumbens* has been reported [57]. Formulation containing *Tridax procumbens* (Linn.), *Hibiscus rosa sinensis* (Linn.), *Trigonella foenum graecum* (Linn.), and *Embilica officinalis* (Linn.) showed synergistic effects by significant increase in hair growth activity [22].

### 3.18. *Cuscuta reflexa* Roxb.

*Cuscuta reflexa* Roxb. is a golden yellow leafless, perennial, parasitic herb. *Cuscuta*, a holoparasitic vine attacks the aerial parts of many shrubs, trees, and is used in the Indian system of medicine. Main chemical constituents are cuscutin, amarbelin,  $\beta$  sitosterol, stigmasterol, kaempferol, dulcitol, myricetin, quercetin, and coumarin. Petroleum ether extract of *Cuscuta reflexa* and its isolate has been shown useful in treatment of androgen-induced alopecia by inhibition of the enzyme 5 $\alpha$  reductase [58]. Herbal formulations containing petroleum ether extracts *Cuscuta reflexa*, *Citrullus colocynthis*, *Eclipta alba* in varying ratio show hair growth-promoting activity [11].

### 3.19. *Allium cepa* L.

*Allium cepa*, known as onion mainly contains protein (albumin), allyl propyl disulphide, diallyl sulphide, alliin, allicin. It also contains some mineral like potassium, zinc, calcium, magnesium. Onion has been reported beneficial in patchy baldness. The affected part should be rubbed with onion juice in morning and evening until it is red. It should be rubbed with honey afterwards. Zinc helps to secrete the scalp with much needed oil and avoid dandruff that may cause hair loss. Iron is involved in the oxygenation of body's red blood cells. Which are essential for normal hair growth and maintaining healthy hair [59].

### 3.20. *Polygonium multiflorum* Thunb.

*Polygonium multiflorum* root tubers are used in traditional Chinese medicine as a tonic and an anti-aging remedy, particularly for hair loss and premature greying of hair. It is also known by the Chinese name He Shou Wu (Heshouwu) or Fo-Ti.

Over the centuries, it has mythical reputation for its power to produce longevity, increase vigor and promote fertility. Standard extract of this plant have beneficial effect on hair quality and is helpful for improving hair growth and quality in pre- and postmenopausal women [60]. In fact, experimental studies showed that the phenolic substances contained in *Polygonium* extract appear to be very potent inhibitors of 5 $\alpha$  reductase enzyme, which is responsible to convert testosterone to DHT, the alleged cause of hair loss in men [61]. *Polygonium multiflorum* extract promotes hair growth by inducing anagen phase in resting hair follicles [62].

### 3.21. *Capsicum annum* Linn.

Capsicum is a crop that is widely cultivated because of its spicy nature and nutritional value. The crop accounts for a large portion of vitamins A and C in many Nigerian diets. It mainly contains capsaicin and isoflavone. Experiment observations strongly suggested that combined administration of capsaicin and isoflavone might increase IGF-I production in hair follicles in the skin, thereby promoting hair growth. Such effects of capsaicin and isoflavone might be mediated by sensory neuron activation in the skin. Insulin-like growth factor-I (IGF-I) plays an important role in hair growth. Capsaicin activates vanilloid receptor-1, thereby increasing the release of calcitonin gene-related peptide (CGRP) from sensory neurons, and CGRP has been shown to increase IGF-I production [63]. Intradermal injection of capsaicin (a component of *Capsicum annum* L.) caused anagen induction in mice [64].

### 3.22. *Thuja occidentalis* Semen

*Thuja occidentalis* L. (*Arbor vitae*) is a native European tree widely used in homeopathy and evidence-based phytotherapy. The fresh plant contains 0.6% essential oil, 2.07% reducing sugar, 4.9% water-soluble polysaccharides, 2.11% water-soluble minerals, 1.67% free acid and 1.31% tannic agents. The essential oil of the fresh leaves contains 65% thujone, 8% isothujone, 8% fenchone, 5% sabinene and 2%  $\alpha$ -pinene as the main monoterpenes [65]. The inhibitory activity of extract for 5 $\alpha$ -reductase type 2 and its biological action in two animal models Fuzzy rats and AGA mouse, suggested that extract would be used as an effective agent for male pattern baldness by modifying androgen conversion [66].

### 3.23. Procyanidin

Procyanidin B-2 (epicatechin-(4b-8)-epicatechin) obtained from apples [67]. It suggested that protein kinase C (PKC) isozymes, especially PKC-bI and -bII, play an important role in hair cycle progression and that the hair-growing mechanisms of procyanidin B-2 are at least partially related to its down regulation of PKC isozymes or its inhibition of translocation of PKC isozymes to the particulate fraction of hair epithelial cells [68]. It is reported that procyanidin therapy potential hair-growing activity in male pattern baldness. Male pattern baldness was treated by external application of 0.7% apple procyanidin oligomers [69]. Procyanidin B-2 and Procyanidin C-1, which selectively inhibit protein kinase C, intensively promote hair epithelial cell proliferation *in vitro* and stimulate anagen induction *in vivo*. Other procyanidin have low activity on both protein kinase C and A [70]. Procyanidin B-3 from Barley can directly promote hair epithelial cell growth *in vitro*, has the potential to counteract the growth inhibiting effect caused by TGF $\beta$ -1 *in vitro*, and has potential to stimulate anagen induction *in vivo* [71].

### 3.24. *Camellia sinensis* (L.) Kuntze

Green tea is made solely with the leaves of *Camellia sinensis*. Green tea is a popular beverage worldwide, and its potential beneficial effects such as its anti-cancer and anti-oxidant properties are thought to be mediated by epigallocatechin-3-gallate (EGCG), a major polyphenol in green tea [72, 73]. It is reported that the tea polyphenolic compounds has effect on hair loss among rodents and concluded that anti-inflammatory and stress inhibitory effects of these natural substances might influence hair regrowth among mice [74]. Epigallocatechin-3-gallate stimulates human hair growth via its proliferative and antiapoptotic effects on dermal papilla cells [75].

## 4. HERBS FOR HAIR GROWTH WITH THEIR MODE OF ACTIONS

Herbs used for promoting hair growth have different type of mechanism of action. In the following table and figure, we have summarized the herbs according to their mechanism of action (Table 7, Fig. 5).

Table 7. Mechanism of action of Plants used in treatment of hair loss.

Mechanism of Action	Herbs
5α reductase Type II Inhibitors	<i>Boehmeria nipoonivea</i> [117], <i>Panax ginseng</i> [51, 50], <i>Sophora flavescens</i> [53], <i>Lygodii spora</i> [54], <i>Cuscuta reflexa</i> Roxb.[58], <i>Polygonium multiflorum</i> [61], <i>Abrus precatorius</i> L. [79]
Decreased DHT level	<i>Pygeum africanum</i> [51]
Increased blood supply to scalp	<i>Zanthoxylon rhetsa</i> (Roxb.) DC., <i>Rosmarinus officinalis</i> Linn.[31], <i>Salvia officinalis</i> , <i>Illicium anisatum</i> Linn. [88]
Check Apoptosis	<i>G.biloba</i> [5], Green tea [75]
Supply nutrients	<i>Emblica officinalis</i> , <i>Bacopa monniera</i> , <i>Polygonum multiflorum</i> , <i>Juglans regia</i> L., <i>Prunus amygdalus</i>
Follicular enlargement and prolongation of Anagen phase	<i>Hibiscus rosa sinensis</i> [27], <i>Fructus Panax ginseng</i> [87], <i>Eclipta alba</i> [48], <i>Nordostachys jatamansi</i> [27], <i>Polygonium multiflorum</i> [62]
Aromatherapy	<i>Rosmarinus officinalis</i> [31], <i>Pilocarpus jaborandi</i> , <i>Arnica Montana</i> , <i>Thyme vulgaris</i>
Nerve stimulation	<i>Allium sativum</i> L.
Production of IGF-I	<i>Capsicum annum</i> [63], Dietary Isoflavone [63]
Affect PKC (Protein kinase) Enzymes	<i>Bacopa monniera</i> [23], Procyanidin [67]
Affect cell growth and growth factor gene expression	<i>Asiasari radix</i> F. [33], <i>Sophora flavescens</i> [53], <i>Laminaria angustata</i> [89]

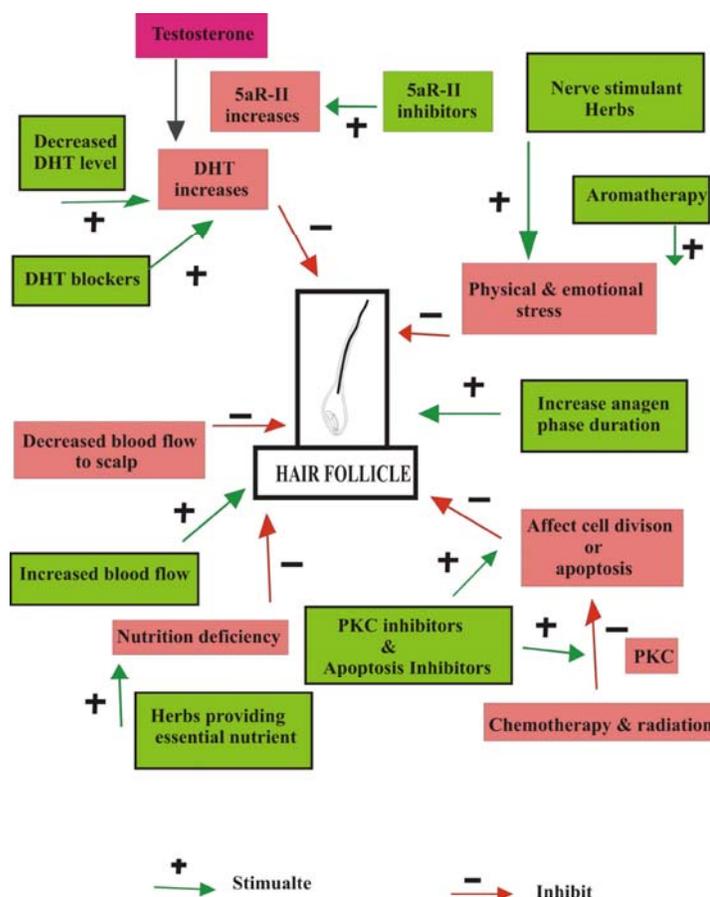


Fig. (5). Different Mechanism of action of herbs for hair growth.

## CONCLUSION

In the present article, an attempt has been made to emphasise on herbal option for treatment of hair loss. Hair loss is a common and ever increasing problem in cosmetics as well as primary health care practice. Hair loss occurs due to various reason mentioned in this article. Many will try anything and everything to bring back their looks. Hair loss sufferers spend billion of dollar annually on remedies ranging from drugs, vitamins to special tonics and shampoos. Minoxidil and Finasteride are the only two drugs approved by the FDA for hair growth in men. Minoxidil is the only drug available for women with androgenetic alopecia. Besides having hair growth promotion effect, therapy with the synthetic drug has become questionable due to their occasional lack of efficacy, safety and their potential side effect. This has led to increase interest in alternative remedies such as herbal medicine. Herbal drugs provide a new revolution for hair growth.

In this review, we summarized some of the herbs that are believed to reduce the rate of hair loss and at the same time stimulate new hair growth, and also compiled the isolated phytoconstituents i.e. Piperine, 3,4-dihydroxy benzaldehyde, Polyporusterone, Acetosyringe, Capsaicin, Epigallocatechin-3-gallate, Procyanidin B-2, B-3, Proanthocyanidins, Soyasaponin, Kaikasaponin, Norgalanthamine, Senegin, Jatmansic acid, Ginsenosides R<sub>o</sub>, Hinokitiol from various plants extract that are also believed to reduce the rate of hair loss. This article also cover the mechanism like inhibition of 5 $\alpha$  reductase type II enzyme, DHT receptor blockage, decreased level of DHT, supply nutrients, increased blood supply, follicular enlargement and prolongation of anagen phase, and also aromatherapy by which some plants extracts and their phytoconstituents inhibit the hair loss or promote hair growth. At last, it is concluded that a majority of hair growth promotion studies was performed with plants and their extracts in animals models. However, there has been a gap between these research and clinical trials. More scientific evidences and documentation is desirable for promotion of herbal treatment to hair loss which must be substantiated by reliable clinical trials with standardised material and formulation. The review may facilitate the case and cause of natural remedies for the distressing and disturbing problem of hair loss to world community.

## CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

## ACKNOWLEDGEMENTS

Declared none.

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Received: February 26, 2015

Revised: April 04, 2015

Accepted: April 06, 2015