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HERBAL ARMAMENTARIUM FOR THE CULPRIT DANDRUFF

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ABSTRACT

The present article discusses about the pathogenic agents responsible for dandruff, clinical manifestation and mechanism of action of dandruff. The article also discusses about various synthetic and herbal treatments available for dandruff and the side effects associated with synthetic antidandruff agents. These herbs have wide range of active principles and are used in their crude form or they may be extracted purified or derivatized to render them more suitable for use in cosmetics. The status of dandruff is ambiguous-a disease/disorder therefore relatively less medical intervention is sought after for the treatment of dandruff. Dandruff can be treated with over the counter products which are shampoos containing antifungal and antibacterial ingredients like zinc pyrithione, selenium sulfide, salicylic acid etc. These can slow down flaking. Herbal extracts have proved to be good alternatives for the chemical preparation. A number of herbal preparations have excellent result due to their synergistic antifungal, anti-inflammatory and immuno-stimulatory action.

Keywords: Dandruff, Herbal treatment, Herbal cosmetic, *Pityrosporum ovale*, Seborrheic dermatitis.

INTRODUCTION

In light of recent developments in scientific and technological world, even today herbs are widely used as remedial agents. India is one of the countries in this artificial world which is rich in large varieties of medicinal plants. WHO currently encourages, recommends and promotes traditional or herbal remedies in National health care programs because such drugs are easily available at low cost and comparatively safe and the people have good faith in such remedies [1].

Dandruff is a common scalp disorder affecting almost half of the pubertal population of any ethnicity in both the genders but most prevalent in male population between the age group of 20-60 years. Worldwide 55% of global population is suffering from the same problem. Dandruff is also called scurf historically termed *pityriasis capitis* it is due to the excessive shedding of dead skin cells from the scalp. As it is normal for skin cells to die and flake off, a small amount of flaking is normal and in fact quite common. Excessive flaking can also be a symptom of seborrheic dermatitis, psoriasis, fungal infection or excoriation associated with infestation of head lice. There are two types of dandruff (a) dry and flake type (*pityriasis scale*) (b) oily type (seborrheic scale). It sticks to the nails when the scalp is scratched. Other reasons of dandruff are excess androgenic hormone, excessive sebaceous secretion. Keratinization of the scalp tissue may be accelerated by physical irritation, such as scratching with the nails, chemical irritation from drugs,

photosensitivity, *tinea capitis*, xerotic eczema and vitamin B or zinc deficiency or however the result of poor personal hygiene or use of dirty comb.

Dandruff has been shown to be the result of 3 required factors.

- Skin oil commonly referred to as sebum or sebaceous secretions.
- The metabolic byproduct of skin micro-organisms (most specifically *Malassezia* yeast, a lipophilic fungus).
- Individual susceptibility against presence of *Malassezia* species.

Candida albicans is one of the major causes for dandruff together with the fungus. There may be some bacterial infestation on scalp wound by nail scratching [2].

Mechanism of action

Malassezia organism can be found on the skin in 75-90% healthy people. *Malassezia Furfur* is a lipophilic, saprophytic, budding, unipolar, dimorphic, gram positive double walled, oval to round yeast. Colonization by *M. furfur* begins soon after birth, the peak presence of yeast occurs in late adolescence and early adult life. *Pityriasis ovale* is present on 90-100% of surface of healthy skin, *pityrosporum folliculitides* is a most common in those aged 13-45 years. *Malassezia* yeast requires free fatty acid for survival. Usually found in stratum corneum and in pilar folliculi. The yeast hydrolyzes triglycerides into free fatty acids and creates long chain and medium chain fatty acids

from free fatty acids. The result is a cell mediated response and activation of the alternative complement pathway, which leads to inflammation. *C. albicans* is also a major cause of dandruff together with bacterial infestation on scalp. More than 7 species of *Malassezia* has been reported i.e. *M. globa*, *M. sympodialis*, *M. furfur*, *M. obtuse*, *M. sloofiae*, *M. restricta*, *M. pachydermatis* [3].

Antidandruff agents and their mechanism of actions

An agent is associated with treatment of scalp disorder that controls excessive formation of dandruff cells from the horny layer of skin. It may also alleviate the itching and scaliness associated with seborrhoeic dermatitis. Antidandruff agents may be natural or synthetic. These agents free the scalp from natural grease, oil, dirt or fatty lipids which avoid creating a prime environment for *Malassezia*, *Candida* and bacteria to thrive. This stops the formation of oleic acid and prevents the increased turnover of skin cells thus getting rid of dandruff [4].

Synthetic antidandruff agents and their side effects

In the current scenario many chemical substances are used for treating dandruff by controlling the abundance of fungi on the scalp. The main active agents used currently for controlling dandruff include imidazole derivative such as ketoconazole and other compounds such as selenium sulfide, zinc pyrithione, ethylene glycol, piroctone, olamine, salicylic acid, guar hydroxy propyltrimonium chloride, dimethiconol, glycolic acid, steroids, tar derivatives. Most products which are designed to fight dandruff contain zinc pyrithione. Zinc pyrithione has antifungal effect; it has the ability to disrupt membrane transport by blocking the proton pump that energizes the transport mechanism. A new study proposes that the mode of action of zinc pyrithione arises from iron starvation. Ketoconazole and Zinc pyrithione (ZnPTO) based shampoos (Over the Counter products) are used more by the consumers for common dandruff problems. The shampoos with ZnPTO are preferred by majority of the consumers, as the shampoos brands with ZnPTO (Anti Dandruff ingredient) are not only cheaper but also provide the desired functional benefit. However, in very severe cases of dandruff, ketoconazole based shampoos are preferred despite their relatively higher costs, so it may take some experimenting to find a formula that works for a specific condition. Antidandruff activity of ketoconazole coated silver nanoparticles (AgNp) of 4±2 nm on the dandruff scales collected from human volunteers by disc diffusion method was investigated. It was concluded that AgNp enhanced the activity of ketoconazole. This is because Ketoconazole acts on fungi at the level of cell wall, while AgNp powerfully penetrates through the membrane leading to complete eradication of the fungi [5]. Scalp lesions are quite common among all patients. A number of topical corticosteroids are used for the treatment, but corticosteroids as creams and ointments may have some undesirable effects. A shampoo containing fluocinoloneacetonide (0.01%) is approved for the treatment. This study showed that clobetasol propionate

shampoo improved the results [5]. Patients with dermatoses have a deficient cell mediated immune response to *Malassezia furfur*.

Salicylic acid

Salicylic acid is a beta hydroxy acid keratolytic agent that is useful in removing scaly, hyperkeratotic skin: it decreases cell to cell adhesion between corneocytes. Although the mechanism of action of organic acid is unclear, it may involve the release of desmogleins and the disintegration of desmosomes.

Sulfur

Sulfur is a yellow non-metallic element with both keratolytic and anti-microbial properties. Keratolytic effect is thought to be mediated by reaction between the sulfur and cysteine in keratinocytes, whereas anti-microbial effect may depend on conversion of sulfur to pentathionic acid by normal skin flora or keratinocytes.

Zinc

It is thought that zinc pyrithione heals the scalp by normalizing epithelial keratinization, sebum production, or both. Some studies have shown a significant reduction in number of yeast organisms after application of zinc pyrithione.

Tar

Tar have been classically used to treat psoriasis and proved as effective in treating dandruff. Tar is used as second line therapy due to its limitations such as staining, odor and messiness in its application. Tar products disperse scales, which may reduce *Malassezia* colonization.

Steroids

The pharmacokinetic properties of topical corticosteroids depend on the structure of the agent, the vehicle and skin on which it is applied. Topical corticosteroids work via their anti-inflammatory and anti-proliferative effects. Topical steroids are often used in combination with other treatments such as antifungal agents.

Selenium sulfide

It is thought that selenium sulfide controls dandruff by its anti-*pitryosporum* effect rather than its anti-proliferative effect. It also significantly reduces the rate of cell turn over. It has anti-seborrheic properties and appears to produce a cytostatic effect on cells of epidermis and follicular epithelium. The antidandruff effects of ketoconazole were superior to those of selenium sulfide and zinc pyrithione.

Ketoconazole

Ketoconazole acts by blocking the biosynthesis of ergosterol, a primary sterol derivative of fungal cell membrane. It is a broad spectrum antimycotic agent that is active against both *Candida albicans* and *M. furfur* of all the imidazole currently available, ketoconazole has become a leading contender among treatment option because of its

effectiveness in treating seborrheic dermatitis. A ketoconazole 1% shampoo has been approved for over the counter use and 2% shampoo is available by prescription (Nizoral). It may cause irritation and stinging.

Hydroxypyridones

Hydroxypyridones do not affect sterol biosynthesis; instead they interfere with active transport of essential macromolecule precursors, cell membrane integrity, and cell respiration processes of dermatophytes and yeasts. Ciclopirox, a member of hydroxypyridone family, has broad-spectrum action against dermatophytes, yeast and fungi. Its anti-inflammatory has been demonstrated in human polymorphonuclear cells. This agent also inhibits prostaglandin and leukotriene synthesis [6].

Some of the very common side effects associated with antidandruff shampoos are itching, mild irritation or oiliness and dryness of hair and scalp. Severe allergic reactions includes rash, hives, itching, difficulty in breathing, tightness in chest, swelling of mouth, face, lips, increased or abnormal hair loss, blistering, peeling or burning of skin or scalp [7]. The chemicals used for the treatment of dandruff have certain limitations; they are unable to prevent occurrence, which is a common troublesome clinical problem.

Herbs as antidandruff

Dandruff is an overall scalp disorder/disease. The treatment of dandruff includes application of topical, antifungal or other products. Since recurrence occurs commonly prophylaxis using products for skin and hair to maintain good healthy skin of scalp and hairs. Herbs are compatible with both human skin and hair. Unlike chemical based products, herbs are completely safe, extremely effective and have almost no side effects due to their compatibility with human body.

Herbal drugs or their formulations are viable alternative to synthetic drugs. During the past few decades, there has been a dramatic increase in the use of natural products in cosmetics. The awareness and need for cosmetics with herbs is on the rise, primarily because it is believed that these products are safe and free from side-effects. Now-a-days, many herbal shampoos are available in the market which contains herbal ingredients such as plant extracts and essential oils [8]. There are large numbers of plants which are reported to have beneficial effects on hair and are commonly used in shampoos.

A novel protein from lemon grass- lemin can inhibit the generation upto 95%. Use of essential oils for controlling *Candida albicans* growth has gained significance due to the resistance acquired by pathogens towards a number of widely used drugs. The lemon grass essential oil vapour is more potent inhibitor of *C. albicans* growth leading to deleterious morphological changes in cellular structure of cell surface alteration as compared to lemon grass essential oil [9].

The Maka (*Lepidium meyenii*), Aloe (*Aloe barbadensis*), Neem (*Azadirachta indica*), Shikakai (*Acacia concinna*), Brahmi (*Centella asiatica*), Ritha (*Sapindus*

trifolatus), Amla (*Embilica officinalis*) powder decoction shampoo was prepared and it was found safer than the chemical conditioning agent. It also gradually reduces the hair loss during combing as well as strengthens the hair growth [10].

The Saponin containing *Acacia concinna*, *Sapindus trifoliata*, *Dodonea viscosa*, *Albizia amara* and *Trigonella foenum graecum* were used in poly herbal hair care powder and showed effective antidandruff property [11]. Polyherbal hair oil was prepared by using six methanolic crude extracts of herbs namely, *Albizia amara*, *Achyranthes aspera*, *Cassia fistula*, *Cassia auriculata*, *Datura stramonium* and *Azadirachta indica*. A zone of inhibition of poly herbal oil observed as 15 mm diameter for *Pityrosporum ovale* and 13 mm for *Candida albicans*. Preclinical trials were performed with human volunteers. There was a clear symptomatic relief from dandruff observed after 10 days usage [12].

The extracts of *Hibiscus rosasinensis* (China rose), *Centella asiatica* (Brahmi), *Eclipta alba* (bhringaraj), *Embilica officinalis* (amla) and *Terminalia bellerica* (vivitaki) were used to prepare antidandruff hair oil. This study was planned to evaluate the clinical efficacy and safety of "Anti-Dandruff Hair Oil" in the management of dandruff. The aim of treatment is to reduce the level of the *Pityrosporum ovale* on the scalp and the goals of therapy are to reduce morbidity and prevent complications. This study observed a significant reduction in the mean scores of itching and white scales. Subjective evaluation revealed remarkable improvement. The excellent antidandruff action of "Anti-Dandruff Hair Oil" might have been due to the synergistic antifungal, anti-inflammatory and local immunostimulatory actions of its ingredients [13].

Poly-herbal hair oil was studied for antidandruff activity using microbiological and clinical tests. There was a clear symptomatic relief from dandruff in all the volunteers after 10 days of use. The plant extracts included *Wrightia tinctoria* (Indrajev), *Cassia alata* (Dadmari) and bitter fraction of *Azadirachta indica* (Neem). Methylene blue reductase test was employed to study the anti-dandruff efficacy of the oil.

The shampoo extract of *Ocimum sanctum* (tulsi) and *Azadirachta indica* (neem) leaves have good antimicrobial activity due to the presence of flavonoids, it was found to be effective, harmless and economic [14]. A number of plants have been used for antidandruff shampoos and oils like *Glycine max* (soyabean), *Rosmarinus officinalis* (rosemary), *Arctium lappa* (burdock), *Zingiber officinalis* (ginger), *Plantago major* (greater plantain), *Melaleuca spp* (tea tree), *Camellia chinensis* (tea), *Salvia officinalis* (sage), *Mentha piperata* (mint), *Thymus vulgaris* (thyme), *Glycerriza glabra* (yashtimadhu) [15]. Inhibitory effect of the fruit extracts of *Terminalia bellerica* (baehra) can be attributed to the chemical substances gallic acid and ethyl gallate present in the fruits [16] and in the case of *Terminalia chebula* (haritaki) tannins like beta sitosterol, gallic acid, ellagic acid, gallate, galloyl glucose, chebulagic acid [17]. Crude and methanol extracts of dry fruit of *Terminalia bellerica*

possessed broad spectrum antimicrobial activity [18].

Among the herbal ingredients tea tree oil recorded significant anti-fungal activity. Tea tree oil is an essential oil of the leaves of the Australian *Melaleuca alternifolia* (tea tree) tree. It is a mixture of hydrocarbons and terpenes, consisting of almost 100 substances. The antimicrobial property is attributed primarily to the major component, terpinen-4-ol. Tea tree oil represents a sound alternative for patients with dandruff who prefer a natural product and who are willing to shampoo their hair daily. Basil oil and Coleus oil are known to have the highest activity among the herbal ingredients. Other herbs used were *Nyctanthes arbortristis* (Harshingar), *Hibiscus rosasinensis* (Gurhal), *Azadirachta indica* (Neem), *Embllica officinalis* (Amalki), *Casytha filiformis* (Amar Bel), *Cinnamomum camphora* (Karpoor), *Curcuma longa* (Haldi), *Rubia cordifolia* (Majistha). Herbal ingredients like tea tree oil, rosemary oil, clove oil, pepper extract, neem extract, rosemary oil, henna, and lemon also recorded good anti-pityrosporum activity [19]. A polyherbal shampoo containing the extracts of *Rosmarinus officinalis* (rosemary), *Vetiveria zizanioides* (khus), *Nigella sativa* (nutmeg), *Santalum album* (sandalwood), *Ficus bengalensis* (banyan), *Citrus limon* (lemon) and oil of *Melaleuca leucadendron* (tea tree), showed anti-fungal, anti-inflammatory and local immunostimulatory actions [20].

Formulated polyherbal antidandruff hair oil is very effective in management of dandruff. Experiments with volatile oils of *Eucalyptus globules* and *Ocimum gratissimum* (African basil) along with the petroleum ether extract of *Hibiscus rosa-sinensis* (china rose), *Phyllanthus emblica* (Amla), *Tridax procumbens* (jayantiveda) possess antifungal activity. The last two extracts have significant hair growth activity. *Hibiscus* is used in management of dandruff. Its leaves and flowers not only promote the growth of hair but also color the hair and are good for healing ulcers. Amla helps in good growth of hair hence most of the marketed herbal hair oils contain amla as one of the chief ingredients [21]. A total of 50 patients who were diagnosed as suffering from moderate to severe form of dandruff with dry and damaged hair were included in a study using polyherbal cream recommended for the treatment of dandruff. The formulations contained the extracts of *Cicer arietinum* (Indianpea), *Rosmarinus officinalis* (rosemary), *Ocimum sanctum* (Tulsi) and oils of *Pongamia glabra* (karanja) *Melaleuca leucadendron* (Teatree), *Azadirachta indica* (Neem), *Sesamum indicum* and *Vitis vinifera* (common grape vine) [22].

Henna is shown to have strong fungicidal as well as anti-inflammatory, analgesic and antibacterial properties. The chemical constituents of this plant extract include naphthalene derivatives, quinoids, beta sitosterol, flavonoids and gallic acid. It also acts as a very good conditioner to the hair and has anticancer properties [23]. Antifungal effects of chloroformic, methanolic and aqueous extracts of henna (*Lawsonia inermis*) leaves on *Malassezia furfur* were studied. The study reported that chloroformic extract of henna completely inhibited the growth of *Malassezia furfur* [24]. Plant extracts were prepared from *Citrus limon* (lemon), *Embllica officinalis*

(amla), *Trigonella foenum graecum* (fenugreek), *Vitis vinifera* (grape vine), *Papaver somniferum* (poppy) and *Allium cepa* (onion) in different concentration. The aqueous plant extracts were added to the wells of *Malassezia furfur* inoculated plates. Results showed that *Citrus limon* extract had maximum zone of inhibition than other plant extracts and extracts of *Papaver somniferum* and *Allium cepa* did not show any inhibition zone [25].

The potentials of four extracts viz. *Hibiscus rosasinensis* (chinarose), *Phyllanthus emblica* (amla), *Allium sativum* (garlic) and *Terminalia chebula* (haritaki) were established as active antidandruff plants [26]. *Acacia concinna* (shikakai) is an important medicinal plant in Thailand and throughout Asian countries. Its dried pods are traditionally utilized as herbal medicine to treat many health symptoms e.g. constipation, cough, dandruff and skin diseases. The antimicrobial potential of *A. concinna* extracts against the fungal causative agents has been worked out [27].

In an investigation nineteen plant spp. were collected from in and around Karur District of Tamil Nadu and were tested for their antimycotic activity against *M. furfur*. *Aloe vera*

(kumari) *Eucalyptus globules* (blue gum), *Phyllanthus emblica* (Amla) and *Wrightia tinctoria* (pala) leaf extracts and oil showed antifungal property as they progressively inhibited the growth of *M. furfur* on Sabouraud's dextrose agar medium. The volatile oil of *Eucalyptus globulus*, significantly reduced the growth of *M. furfur* [28].

The effect of piroctoneolamine and climbazole with extracts of *Urtica dioica* (nettle), *Matricaria chamomilla* (chamomile), *Rosmarinus officinalis* (rosemary), *Salvia officinalis* (sage), *Mentha piperata* (pepper mint) and *Triticum* (wheat germ) were assessed. Benefit of these herbal extracts on the skin and hair is clear and are widely used in Iranian shampoos. Both shampoos containing climbazole or piroctoneolamine besides herbal extracts are effective in the reduction of dandruff and relief of other seborrheic dermatitis symptoms but climbazole seems to be more effective than piroctoneolamine in the treatment of dandruff. The petroleum ether extract of *Tridax procumbens* was found to be effective against dandruff. Formulation (liquid cream shampoo) was developed using active extract of *Tridax procumbens* and was evaluated using various parameters, which proved its efficacy and safety [29].

A polyherbal hair oil containing methanolic extracts of *Albizia amara*, *Achyranthes aspera*, *Cassia fistula*, *Cassia auriculata*, *Datura stramonium* and *Azadirachta indica* was formulated. The hair oil was effective against dandruff and was safe [30]. *Embllica officinalis* decreased the induction of nitric oxide synthase. The antifungal activity of the plant extracts was determined by well diffusion method using *Terminalia bellerica*, *Terminalia chebula*, *Embllica officinalis* and *Lantana camara* [31]. *Lantana camara* possesses antifungal properties. The essential oil of *Lantana camara*, tested against seven bacteria and eight fungi showed a wide spectrum of antibacterial and antifungal activity [32]. *Ocimum sanctum* has a high content of flavonoids. The

principle ingredients of *Ocimum sanctum* are fatty acid i.e, stearic, palmitic, oleic and linoleic acid [33]. It has significant anti inflammatory activity against prostaglandin E2, leukotriene, and arachidonic acid and acts as a microbial agent [34]. Studies have been conducted to check the antifungal properties of Neem (*Azadirachta indica*) leaves extract to treat hair dandruff. The 100% extract of neem leaves produced the widest zone of inhibition which was found statistically higher than the other concentration. It can also cure skin diseases or epidermal problems ranging from dandruff, acne, and psoriasis and ringworm infection. It is also known to produce pain relieving anti-inflammatory compounds [35].

A completely herbal shampoo from *Asparagus racemosus*, *Acacia concina*, *Sapindus mukorossi* as main ingredients along with other herbal ingredients was prepared. This shampoo was self-preserving to avoid the risk posed by chemical preservatives. They used *Aloe vera*

gel and other plant extracts to provide the conditioning effects [36].

DISCUSSION AND CONCLUSION

Herbs are compatible with both human skin and hair. Unlike chemical based products herbs are completely safe, extremely effective and have almost no negative side effects due to their compatibility with human body, cost effectiveness, their demand is increasing day by day. This also promotes research for newer plant constituents. The synthetic treatments available have certain limitations which may be either due to poor efficacies or due to compliance issues, furthermore, these synthetic drugs are unable to prevent recurrence, the common problem associated with them. The best approach to treat dandruff is to use herbal products and go for a balance diet. A combination of nutritional and herbal treatment should bring improvement 6-8 weeks.

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