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Review Article

SKIN HEALTH AND COMPLEXION IMPROVEMENT BENEFITS OF SELECTED AYURVEDIC MEDICINAL PLANTS

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ABSTRACT

Skin health and complexion improvement have become more prioritized and the need for natural remedies are more in demand than the synthetic options. Research in the area of skin care is growing with regular updation of facts and data. In Ayurveda, skin complexion improvement is comparable to the modern concepts such as tyrosinase inhibition and anti-oxidant activity. In this review, selected Ayurvedic medicinal plants are screened from classical Ayurvedic texts as well as the modern scientific literature to investigate their probable potential for skin health and skin lightening effects. All the plants reviewed are found to act as complexion promoters directly or indirectly by their interference in melanogenesis pathway or through antioxidant potentials. This efficiently confirms the goodness of these plants as potential skin care and whitening agents.

INTRODUCTION

The current trend of well-being includes health, fitness, anti-ageing and beauty elements.[1] Skin complexion in terms of beauty is of social as well as medical importance, and many complexion improvement procedures such as laser techniques, dermabrasion, ultrasound therapy, etc. have come into practice.[2,3,4,5,6,7] In general, healthy and intact skin promotes confidence and cheerfulness. Traditional plant-based medicines provide a vital source for the innovations in skin-care and cosmetics. The cosmetic market in India is increasing by 15-20% yearly, twice as efficient as the two global leaders, namely, US and the Europe.[8]

The ideal, efficient and ever-lasting concept of beauty in Ayurveda has paved way to the creation of Ayur-cosmaceuticals. The concepts of *Varna*, *Chaya* and *Prabha* explained in Ayurveda are natural entities of beauty. The word "*Varna*" in Sanskrit means 'colour of the skin, especially in defining a lustrous and radiant complexion of the skin".[9]

Significantly, *Varna* not only explains the colour but it includes all the factors that are meant to define a healthy skin.[10] *Chaya* defines the structure which confines *Varna*, and *Prabha* defines the depth of complexion.[11] Thus whichever causes tenderness and beauty to the skin by the enhancement of complexion is termed as "*Varnya*".

According to Ayurveda, *Varna utpatti* (skin colour formation) and *Prabha* (maintenance of body complexion) are functions of *Pitta* or heat energy in the body and it constitutes our natural complexion which is expressed through *Varna*. Hence, the herbs which generally alleviate *Pitta* by action of their rasa (taste), *Vipaka* (post-digestion process) or *Prabhava* (specific property) are considered as "*Varnya* Herbs".[12]

Acharya Charaka has defined 50 *Mahakshaya* (plant-based extracts) in chapter no. 4 of Charak Sutra-Sthana in Charaka Samhita. *Varnya Mahakshaya* comprises of herbal drugs which are utilised internally as well as externally in various ways. In Samhita, Acharya Charaka mentioned ten *Dravyas* (substances) of *Varnya Mahakashaya*. In specific, *Varnya dravya* preserves skin complexion. When the herbs of *Varnya Mahakshaya* are applied externally, they act on the *Bhrajaka pitta* of the skin, which constitutes the skin colour. Herbs mentioned in the *Varnya Mahakshaya* not only constitute glorious skin but also cure skin related ailments.[13]

Scientifically, the amount and distribution of melanin pigment by the process of melanogenesis primarily determines the varied nature of human skin colour.[14,15] Skin-lightening agents may interfere in this

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process, and can constitute to the lowering of pigmentation on the surface of the skin,[16] which is usually achieved by tyrosinase inhibition, interference with melanosome maturation and exfoliation.[17]

Aside from tyrosinase inhibitors, anti-oxidants and vitamins can directly or indirectly be beneficial as skin lightening ingredients.[18] Antioxidants reduce the oxidation of tyrosine and quench the free radicals[19], by which the synthesis of melanin will be reduced and skin de-pigmentation effects may occur.[20]

Vitamins usually improve the skin texture and tone. Vitamin A is used for a long time in the treatment of melasma.[21,22] Among vitamin B classes, two are known to have skin-lightening potential: Vitamin B3[23] and Vitamin B5[24]. Vitamin C disengages the UV-induced free radicals and promotes tyrosinase inhibition, hence it causes skin lightening effects.[25] Vitamin E has antioxidant activity and protects against UV-induced hyperpigmentation.[26]

Traditional formulations with cosmetic benefits are known to have activities that can be utilized in modern formulations. Several modern studies have also proven the utility of Indian herbs both as cosmetic and curative agents as per their traditionally defined applications.[27] Hence, this review deciphers the potential of several Ayurvedic medicinal plants in improving skin health and complexion, by assessing the knowledge base from classic literatures and recent scientific studies.

Ayurvedic texts define about 200 minerals and herbs that constitute beauty and skin health.[28] A set of different popular Ayurvedic plants were chosen and reviewed for their skin health and complexion improving properties from classical literatures such as *Varnya mahakashaya,[29] Lodhradi varnya gana,[30] Eladi varna prasadana gana[31]* and a few *Varnya* formulations viz. *Haridra khanda,[32] Nimbadi curna,[33] Candanadi taila*,[34] *Kunkumadi taila,[35] Kanakarishta,*[36] etc., and the relevant recent scientific literature were obtained from databases such as Google Scholar, PubMed, Web of Science, Scopus, Research Gate, etc.

Skin Health and Complexion Improvement Properties of the Selected Plants

Neem (*Azadirachta indica* A. Juss.)

It is a traditionally used aid for skin ailments in India. It is utilised in several Ayurvedic polyherbal preparations. The tender leaves of neem are consumed as such to reduce skin diseases. Neem consists of complex multifunctional phytocompounds, which show variable stability and penetration effects, hence neem extracts are being used in several skin and personal care products.[37]

Neem is commonly used against skin diseases and is particularly regarded as a beauty aid by native women.[38] The use of neem for skin complexion improvement is not well known but its powdered leaves and purified oil are a major component of widely used facial creams and other cosmetics used for skin whitening.[39] Recent reports have proven its potential for skin complexion improvement by the significant tyrosine inhibition activity of the methanolic extract of neem bark of upto 43.59%[40] and by the significant antioxidant activity of the hydro-distilled extract of its heart wood.[41]

Sweet flag (*Acorus calamus* L.)

The rhizomes of this plant are responsible for many ethnobotanical and ethnomedicinal uses. It has been utilised in traditional Indian and Chinese medicine for its beneficial anti-aging effect on skin. It is commonly used for treating rashes in the skin.[42]

Its ethanolic extract promotes wound-healing activity significantly. Enhanced wound contraction, reduced epithelialisation time and increased hydroxyproline content proved that its extract potentially has therapeutic wound healing benefits.[43] Charaka categorized it as a *Sitaprasamana*, which relieves cold sensation on the skin.[44]

The antioxidant property of its aqueous, ethanol and hydro-ethanol extracts have been determined by phytochemical screening, estimation of total phenolics and flavonoids and by in-vitro antioxidant screening models. The ethanol extract was found to possess better antioxidant activity followed by hydro-ethanol and aqueous extracts, confirming its potency for relevant applications.[45] Antioxidant activity of methanol extracts of its leaves and rhizomes are also reported. The amounts of flavonoids, phenolics and proanthocyanidins recorded in the leaf extracts were found to be greater than in the extracts of its rhizome. The leaf extract was found to have good radical-scavenging activity, ability of chelating ferrous ions and reducing power.[46,47]

Indian Barberry (*Berberis aristata* DC.)

It is widely used in traditional medicines for skin diseases. It is an Ayurvedic herb which is used since ancient times as anti-inflammatory agent for osteoporosis, joint pain, fever and skin infection. Ethnobotanical studies indicate that its decoction is commonly used to treat skin disorders.[48]

It is traditionally known as a skin complexion promoter, similar to turmeric.[49] It is rich in alkaloids, namely, berberine, epiberberine, oxycanthine, palmatine,[50] karachine,[51] dehydrocaroline, taximaline etc,[52] and berberine is the major component with a yield of 2.34%.[53] The 50% aqueous ethanolic root extract of Barberry is found to have good antioxidant activity.[54] Its methanolic extract is found to have 20.80% tyrosinase inhibitory potential.[55] These facts support that it is a varnya herb.

Deodar (*Cedrus deodara* (Roxb. ex. D.Don) G.Don)

It is a medicinal tree traditionally significant and well utilised in the traditional system of medicine of India, Pakistan, China, Korea etc. for its use in the management of skin diseases, microbial infections, joint disorders, asthma, kidney stones, ulcer, brain disorders and immunological disorders.[56] Traditionally, its bark, wood and stem have been widely used for the management of skin diseases. The oil is antiseptic in nature and helpful in curing skin diseases and wounds.[57]

Distinct sesquiterpenes, viz., atlantone, atlantolone, deodardione and himaphenolone have been identified from its chloroform extract. Its extract exhibits significant antioxidant potential chiefly due to the presence of sesquiterpenes, which are responsible for the diverse pharmacological activities of the plant.[58] An antioxidant polysaccharide has been isolated recently from its leaves. It is reported to have potential antioxidant activity for scavenging free radicals and inhibition of the oxidative injury in cells. The antioxidant polysaccharide might be useful as a good antioxidant agent in nutraceutical and cosmeceutical products.[59]

Black oil plant (*Celastrus paniculatus* Willd.)

It is an important medicinal plant widely used in Ayurveda, which has remarkable nervine, cognition enhancing, and other therapeutic properties. Its seeds act against ulcers, scabies, pruritis, leucoderma, wounds and skin diseases.[60]

The oil obtained from its seeds has significant properties that enhance the medicinal value of the plant. Its oil, being an effective stimulant for neuromuscular system, has also been used in treating inflammatory skin conditions.[61] The essential oil of its seeds is highly rich in antioxidant constituents that has free radical scavenging potential and can be useful in oxidative stress reduction. The prime constituents of the oil, namely, linalool, phytol, and palmitic acid are known to be natural antioxidants that have various roles in alleviating oxidative stress and reducing free radicals.[60]

The crude methanolic extract of its seeds along with its organic soluble fractions have been evaluated for their possible antioxidant activity. The extracts showed promising 1,1-Diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging activity, and inhibition activity of peroxynitrite and total reactive oxygen species (ROS) generation. It has been reported that its seed extract and its organic fractions have good antioxidant and moderate anticholinesterase activity.[62] In-vitro antioxidant activity of ethanolic extract of it leaves was evaluated by reducing power assay. In this method, an increase in absorbance of the reaction mixture was reported, possibly due to the active phyto-constituents present in the leaf extract.[63]

***Guggulu* (*Commiphora wightii* (Arn.) Bhandari)**

Guggulu has a long history of usage in Ayurvedic system of medicine. It has a wide range of utility in indigenous medicine, including its usage against skin related diseases.[64] Gugulipid is reported to be effective in the treatment of nodulocystic acne.[65]

Its antioxidant activity can be attributed to the presence of guggulsterones. The free radical scavenging property can be responsible for the protective action of guggulsterone. And, its antioxidant activity may be contributed by the metal chelating capacity of guggulsterone.[66]

The in-vitro antioxidant potential of its ethyl acetate extract has been studied in detail. The ethyl acetate extract has good reducing power activity at higher concentration. The total antioxidant activity was evaluated by thiocyanate method. In these tests, a potential correlation was found between the extract concentration and the inhibition percentage of free radicals and its reducing power. The antioxidant property can be possibly related to the antioxidant vitamins, phenolic acids and micronutrients in the extract. Hence, *Guggulu* is proven efficient against free radical mediated conditions.[67] Also, its alcoholic extract is known to possess efficient antioxidant property.[68]

Guggulsterones are particularly useful in the cure for allergic dermatitis. Guggulipid and alcoholic fractions possess antisebum activity and antioxidant activity, both beneficial to the skin. These control the sebum secretion from sebocytes, prevent skin from damaging free radical activity, which reduces the appearance of wrinkles on aged skin and delivers improved skin colour. They efficiently treat photo aged skin, improve skin's radiance and constitute an healthy appearance of the skin.[69]

Coriander (*Coriandrum sativum* L.)

It is used as an herbal medicine popularly for the treatment of diabetes, hyperlipidemia and liver disease. Its ethanolic extract has protective effects against UVB-induced skin photoaging in normal human dermal fibroblasts (NHDF).[70] It has the potential to prevent skin photoaging. Coriander oil has anti-wrinkle activities that could have a main role in amending extrinsic aging.[71]

Coriander leaves have better antioxidant activity than the seeds, and its ethyl acetate extract has been found to have the best activity. Positive correlations exist between total phenolic content in the extracts and its antioxidant activity.[72] The methanolic extracts of its fruits possess potential DPPH radical scavenging activity, which shows that their fruits might constitute a rich source of natural antioxidants.[73] Also, Coriander aqueous extract fractions are found to possess antioxidant activity that can be quantified by the β-carotene/linoleic acid system. Its aqueous

extract fractions were found to have several phenolic acids, which are responsible for its antioxidant activity.[74]

Its essential oil has the highest collagenase, elastase, hyaluronidase and tyrosinase inhibitory activities when compared to other Apiaceous oils (anise, cumin and fennel). The pharmaceutical dosage forms of its oil has anti-wrinkle potential which could have a promising role in amending extrinsic ageing.[75] Coriander seed oil has a unique composition of fatty acids, which imparts soothing effect on sensitive skins.[76]

Cumin (*Cuminum cyminum* L.)

Although the seeds of cumin are widely used as a spice for their distinctive aroma, they are also used in traditional medicine for the treatment of a variety of diseases, such as chronic diarrhoea, acute gastritis, diabetes, and even cancer.[77] Cumin has antimicrobial and anti-inflammatory properties which help to keep the skin free of blemishes. Its essential oils can help tone the skin and increase blood flow and circulation.[78]

The skin-whitening effect of Cumin extract was studied using cell-free mushroom tyrosinase assay, free radical scavenging assay, cell viability assay, cellular tyrosinase assay and melanin content assay. The results revealed that cumin extract possess concentration-dependent inhibitory effect on both monophenolase and diphenolase activities of mushroom tyrosinase. Kinetic study on diphenolase proved that the cumin extract was a reversible mixed-type inhibitor. In addition, Cumin extract was found to significantly suppress melanin production and cellular tyrosinase activity of melanoma cells in a concentration and time dependent manner without cytotoxicity. Moreover, Cumin extract was reported to have strong scavenging capacity on DPPH, hydroxyl and superoxide anion radicals. Hence, these strongly suggest that Cumin is a potential skin-whitening agent for the cosmeceutical industry.[79]

Cumin has a good antioxidant activity. The essential oils present in it have high antioxidant activity and its non-volatile extracts also have potential inhibition properties against the free radicals.[80] It was found that the methanolic extract of Cumin have higher antioxidant activity when compared with that of the aqueous extract.[81] In another study, the antioxidant activity of Cumin ethanol and aqueous extracts were measured in DPPH and 2,2′-azino-bis-(3-ethylbenzothiazoline-6-sulfonic) acid (ABTS) radical scavenging reaction systems. The aqueous extract of Cumin showed higher DPPH radical scavenging activity while in ABTS reaction system the ethanol extract exhibited higher activity than the aqueous extract.[82]

***Vidanga* (*Embelia ribes* Burm. f.)**

Its leaves, roots and fruits are used to cure several diseases. It has a rich history of usage in Ayurveda in various forms such as *Asava, Aristha, Churna, Lauha* and *Taila*. The traditional formulations of this plant includes *Kushthgna*, which is useful in treating skin disorders.[83]

Embelin is reported from aqueous extract of its fruits, which has anti-bacterial and antiprotozoal activities. Its ethanolic extract and embelin both have significant wound healing potential.[84] Free radical scavenging potential of embelin was evaluated and it was reported that embelin scavenges DPPH radical efficiently. Further studies on the mechanism and kinetics of reactions of embelin indicate that embelin can act as a suitable antioxidant in physiological conditions.[85]

Its aqueous extract significantly reduces the levels of catalase, glutathione and pancreatic superoxide dismutase. This antioxidant potential further protects from the loss of pancreatic β-cells.[86] Ethanolic extract of ribes has significant antioxidant potential and also protects the pancreatic cells. It is reported that it reduces the total glutathione activity in pancreatic tissue.[87]

Licorice (*Glycyrrhiza glabra* L.)

Its phyto-constituents and extracts possess a wide range of potentially useful activities beneficial in dermatologic and cosmetic products.[88]

Glycyrrhizin, found chiefly in licorice root, is a saponin that displays antimicrobial and anti-inflammatory properties. It has been traditionally used for treating of wounds. Its root extract protects the skin from oxidative stress injuries and also accelerates wound healing process.[89] It shows skin depigmentation activity and is used in topical products produced specifically for that purpose.[90]

In general, licorice root promotes healthy skin by its emollient, anti-acne, anti-ageing, anti-microbial and anti-oxidant properties.[91] The antioxidant potential of its phytoconstituents, namely, flavonoids, saponins and triterpenes is chiefly responsible for its beneficial effects on skin.[92] The secretion of melanin in skin can be controlled by glycyrrhizetic acid, which reduces dark pigmentation and thus makes the complexion better.[93] Tyrosine inhibition activity of more than 75% has been recorded by the methanolic extract of its rhizome.[94]

Indian Sarsaparilla (*Hemidesmus indicus* (L.) R.Br. ex Schult.)

It is a popularly used plant in Ayurveda, Unani and Siddha system of medicine. It is useful against a wide array of diseases, including several skin diseases.[95] Its leaves possess wound healing activity and are effective for the treatment of wound, especially chronic wounds.[96] The roots show strong inhibition against acne formation.[97] It has flavonoids and nutrients such as copper, iron, manganese, zinc and

vitamins, which makes it a good anti-ageing ingredient for skin.[98]

It is commonly used for various skin problems and as a blood purifier.[99] It improves energy and helps in curing diseases caused by impure blood.[100] Methanolic extract of its root bark is known to have antioxidant activity.[101] Its root extract has good tyrosinase inhibitory potential of about 14.80%.[102] It is also reported that its root extract has 2-hydroxy-4-methoxybenzaldehyde as principal fragrant phenolic compound having inhibitory activity against tyrosinase enzyme, hence contributing to skin whitening effect.[103]

***Kutaja* (*Holarrhena antidysenterica* Wall. ex A. DC.)**

It is used in classical formulations of Ayurveda and is popularly known for curing *Kustha* (skin disorder). Its stem bark is used to cure skin diseases by certain indigenous tribes of India.[104]

In a study, it was reported that its aqueous extract showed the maximum quenching ability of DPPH radical when compared to the aqueous extract of other medicinal plants. And among the ethanolic extracts of the studied medicinal plants, the ethanolic extract of *Kutaja* had the strongest DPPH radical inhibition activity. Its extracts were found to have the superior efficiency in radical scavenging activity for all the solvent systems. The percentage inhibitions of DPPH radical by aqueous and ethanolic extracts of *Kutaja* were found to be almost in similar range.[105]

Methanolic extracts of its leaf were found to scavenge superoxide and hydroxyl ions, in a study. Further, the efficiency of such effects was reported to be proportional to the extract concentration.[106] Hydro-methanolic seed extracts of the plant is also reported to possess the potential for inhibition of deoxyribose degradation, inhibition of nitrite formation, degradation of H_2O_2 and inhibition of lipid peroxidation, all by the ethyl acetate fraction.[107] It was found that the greater amount of phenolic compounds is responsible for the more potent radical scavenging effect as shown by its leaf extracts.[108]

Black cumin (*Nigella sativa* L.)

It is useful against acne vulgaris, wounds and injury.[109] It has anti-inflammatory potential and skin pigmentation effect.[110] Its oil promotes collagen formation and epithelialization process, and is also known to possess moisturizing effect on skin.[111]

essential oil is known to possess possible antioxidant activity. Thymoquinone and the components carvacrol, t-anethole and 4-terpineol showed respectable radical scavenging property. These four constituents and the essential oil have variable antioxidant activity.[112] Also, on evaluation of its antioxidant power, which was tested using the method of trapping the free radical DPPH, it was found that its methanol extract has an antioxidant activity higher than that recorded in the ascorbic acid.[113] Black cumin oil and its components are known to show inhibition activity against mushroom tyrosinase and melanin formation. In an assay, it controlled melanin production up to 86% at a concentration of 10mg/mL without cytotoxicity. Its oil and its components inhibit the expression of tyrosinase protein in a dose-dependent manner. Thus, black cumin is a potential ingredient for whitening cosmetics.[114]

In a study, the most potent antioxidant activity was found in the ethyl-acetate fraction of the plant's extract, which significantly reduced the scavenging activity. In addition, the best whitening effect in terms of inhibitory activity of tyrosinase was reported from the chloroform and n-hexane fractions of its extract. These confirm that the antioxidants of such natural origin can reduce free radicals and help with the whitening effects.[115]

Its seed extract is known to improve dermatological conditions. Hence a chemically standardized Black cumin seed extract was evaluated for its potential anti-aging properties associated with glycation modulation, cross-linking of collagen, collagenase and elastase activities, and anti-melanogenic effect in melanoma cells. The results from the study suggest that its extract has significant anti-aging and anti-melanogenic activity and is a suitable ingredient for skin care products.[116]

Scarlet Leadwort (*Plumbago indica* L.)

It is a commonly used medicinal plant in India. Its extract possesses good antibacterial potential and its roots have potential anti-acne activity.[117]

The acetone and methanolic extracts of its root have been studied for their in-vitro antioxidant potential. The methanolic extract was found to have good DPPH radical scavenging activity, which increased proportionately with increase in extract concentration, implying that the extract has significant free radical scavenging activity. The extract also had good hydroxyl radical scavenging activity, which increased in parallel to the increase in extract concentration. The extract was also reported to have potential reducing capacity, with increase in reducing power as the concentration increased. The study revealed that its extract can efficiently scavenge ROS and can be a potential source of natural antioxidant. The antioxidant activity of its extracts shall be attributed to the pharmacological actions of its phytochemicals such as alkaloids, flavonoids, glycosides, phenols, saponins, steroids and tannins present in the extract.[118] In another study, DPPH free radical scavenging potential was used to evaluate the antioxidant activity of the plant. Its ethanolic extract was found to possess higher antioxidant potential by scavenging activity of DPPH free radical. The greater value of free radical scavenging activity in polar

solvent extracts compared to the less polar solvents is due to the polyphenolic and flavonoids content.[119]

***Bakuchi* (*Psoralea corylifolia* L.)**

It is a well-known plant in the field of traditional herbal medicine. It has anti-vitiligo, anti-inflammatory, anti-oxidant properties, etc., which can be attributed to the presence of its phytochemicals. It has been largely beneficial in the treatment of various skin ailments, including eczema, leprosy, psoriasis and vitiligo.[120]

Bakuchiol, the main active ingredients from its seeds, possesses antioxidant, anti-aging, free radical-scavenging and whitening activities. The antioxidant activity of bakuchiol was studied based on the ABTS free radical scavenging activity and ferric reducing antioxidant power. Thus, it confirms the significant tyrosinase inhibitory activity of bakuchiol.[121] Bakuchiol is of major interest for skin photoaging treatments. Tyrosinase inhibition by bakuchiol, by real-time oxygen sensing and UV–vis monitoring had revealed good competitive inhibition. Bakuchiol is proven to be a potent tyrosinase inhibitor with good antioxidant activity having major potential as a natural agent against oxidation.[122]

Six compounds, bakuchiol, corylin, corylifolin, isopsoralen, psoralen and psoralidin have been isolated from the herb and their antioxidant potentials were investigated individually and compared. The results revealed that bakuchiol, corylin, corylifolin and psoralidin have strong antioxidant activities.[123] The antioxidant activity of its methanolic extract was evaluated by total phenolic contents (TPC), DPPH radical scavenging activity (RSA), reducing power (RP), etc. and the results implied that the extract could be a potential candidate for antioxidant benefits.[124] Also, a meroterpene and four flavonoids have been isolated from the its seeds as antioxidative components. The compounds were found to be efficient in protecting biological membranes against oxidative stresses.[125]

Chopchini (*Smilax china* L.)

It is well known for its good anti-acne activity. Its rhizome has been used in Siddha and Ayurvedic system of medicine for the treatment of Psoriasis and various other skin diseases.[126,127]

In a study, its aqueous and ethanolic extracts had shown about 77.6% and 40.2% tyrosinase inhibition at a concentration of just 1,000µl. The 70% ethanol extract was found to possess cytotoxicity of 89% at a concentration of 100µg/ ml in melanoma cells. The results indicate that the Chopchini extract has great potential as an ingredient with whitening effects.[128] Also, ethyl acetate fraction of its methanolic extract was found to have the strongest inhibition of tyrosinase activity. Two compounds were isolated from a final active fraction, namely, dioscin and oxyresveratrol. Among the two, oxyresveratrol, a known tyrosinase inhibitor, was found to possess strong tyrosinase inhibitory activity.[129]

Antioxidant potential of *Chopchini* root extract was evaluated and its methanolic extract was found to have high DPPH free radical scavenging activity and protective property for cell viability of cells. Fractions using several solvents and relevant assays showed high levels of free radical scavenging activity in butanol, ethyl acetate and water extracted fractions. The results revealed that its root extracts contains antioxidant activity.[130] And, antioxidant activity of its leaf extracts using acetone, ethanol, methanol and water were investigated. Antioxidant activity was studied by the DPPH radical scavenging activity, ABTS radical scavenging activity, total phenol content (TPC), and reducing power (RP). The highest DPPH, ABTS radical scavenging activity, TPC and RP were recorded in the ethanol extract. These results implied that its ethanol extract possessed antioxidant potential and it can be applied into cosmetic industry.[131]

***Khus-khus* (*Vetiveria zizanioides* (L.) Nash)**

Its essential oil is popular for its usage in regeneration of skin cells and for promoting new cell growth. It helps in wound healing, and efficiently reduces scars by removal of dead skin cells of the body and thus imparts a lustrous skin. Its essential oil can potentially reduce the production of melanin.[132]

It is popularly used as such for various health ailments, but its essential oil has extensive usage in the cosmeceutical market.[133] About 150 phytocompounds have been separated from its oil so far.[134] Vettiver essential oil has good antioxidant potential and controls melanin production by inactivation of tyrosinase and by suppressing oxidative stress in B16 melanoma cells.[135] Hence, it is a suitable candidate for usage in hypopigmentation cosmetics.

Wild Ginger (*Zingiber zerumbet* (L.) Roscoe ex Sm.)

Traditionally, its rhizome is used to cure sore spots, cut and bruises. Its extract is used for moisturizing and softening the skin and hair. It has potential anti-inflammatory as well as antioxidant activity on skin.[136]

In a study, a cream formulation containing Wild Ginger active component- Zerumbone was evaluated for its skin whitening effects. The administration of the cream was found to significantly reduce the melanin levels, and no adverse effects were observed in the group using the cream.[137]

The antioxidant potential of ethanolic extract of its rhizome was evaluated. Both DPPH and hydroxyl radical scavenging assays revealed significant radical scavenging potentials. The extract was found to be rich in flavonoids and polyphenol, and was reported to be cytotoxic at higher concentrations. Based on the

results, it was confirmed that the rhizome extract may be used as a potential antioxidant agent.[138] Also, the optimal extraction condition for antioxidant activity from its oleoresin was evaluated. Analysis of variance and response surface methodology were used to obtain the optimal processing parameter. It was found that all the independent parameters influenced oleoresin yield as well as the antioxidant activity significantly. The optimal processing parameter for the yield of oleoresin and antioxidant activity were found to be 12 h extraction time, ethanol used as the solvent and untreated nature of the sample.[139]

DISCUSSION

Due to the large demand for herbal cosmetics and skin-whitening products across the globe, the need for utilisation of natural means for fair and healthy skin is increasing. Skin complexion improvement is not just social or psychological issue, but it represents the general health as well, hence it should be addressed with modern scientific as well as traditional interventions. Antioxidant potential and tyrosinase inhibition are the chief mechanisms for skin lightening, and Ayurvedic herbs with such properties need to be chosen as natural means for depigmentation in skin. According to Ayurveda, *Pitta* (heat energy) and *Rakta* (blood vitiation) are prime factors for skin health and colour, hence herbs that reduce these two can be considered as skin whitening agents. The herbs reviewed herewith for their effective role in skin whitening are broadly defined as *Varnya* drugs in Ayurveda. Some of them act indirectly as *Varnya* by reducing *Pitta* and *Rakta dosha*, and through their scientifically proven tyrosinase inhibition and antioxidant potential.

CONCLUSION

This review effectively compiles the skin benefits and complexion improvement properties of the Ayurvedic herbs, by means of both Ayurvedic and recent scientific perspectives. Certain drugs studied here are defined with *Varnya* attributes in Ayurveda, but are being used chiefly for general ailments rather than for skin improvement. Some herbs act as *Varnya* indirectly by inhibiting tyrosinase enzyme and by their antioxidant activity. These herbs can be significantly used as efficient skin complexion improvement agents and also for treating high pigmentation in cosmeceutical industry. There are several other herbs and polyherbal preparations mentioned in the Ayurvedic literatures, whose *Varnya* properties should be explored through modern scientific investigations.

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