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THE BUDDING POTENTIAL OF ORCHIDS IN THE COSMECEUTICAL SECTOR: ROLE OF ORCHIDS IN SKINCARE AND HEALTH

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Abstract

Orchids are known for their high ornamental value due to their magnificent and graceful flowers. Apart from their use as decorative materials and cut-flowers, they are being used for various purposes such as herbal medicines as a source of phytochemicals and in aromatic products due to their pleasant fragrance. As orchid extracts are considered a panacea for various ailments, studies have been initiated to explore the biological activities of orchid extracts, especially in cosmetology and cosmeceuticals. These have effective ingredients like retinoids, peptides, antioxidants, hyaluronic acid, and hence have become the foremost skin ageing fighters in the industry. The present review focusses on the cosmeceutical potential of orchids ensuing cognizance for their conservation, thereby raising scope for their flourishment in the cosmeceutical industry and bringing in new developments in skincare health.

Introduction

ORCHIDACEAE IS amongst the largest families of flowering plants in the world. There are around 28,484 currently accepted species, distributed in about 850 genera in the world (Govaerts *et al*., 2017). Orchids are found in most of the regions except icy Antarctica and hot deserts, but they are abundant in tropical regions of SouthEast Asian countries (India, China, Malaysia, Lao, Myanmar, Nepal, Japan, Bhutan), Philippines, Australia, Europe, South Africa *etc*. India houses about 1,256 species belonging to 155 genera, having 388 endemic species (Singh *et al*., 2019). These plants are used to treat wounds, sores, tumors, malaria, menstrual disorders, hepatitis, inflammation *etc*. (Kumar *et al.,* 2017; Kumar *et al.,* 2018; Pathak *et al.,* 2010; Prakash and Pathak, 2019; Prakash *et al.,* 2018). Keeping in view their multiple benefits, these are now being used in the field of cosmetology and cosmeceuticals. Cosmetology is derived from the Greek word *kosmetikos* meaning *skilled in the use of cosmetics* (Singh and Pathak, 2014). Cosmetology is a comprehensive term that is used to embrace a wide range of beauty mediums, including skin, hair, nails, and make-up. Some Indian fragrant orchids like *Dendrobium chrysotoxum, Rhynchostylis retusa,* and *Vanda coerulea* are known for their roles in combating skin ageing, increasing cell and tissue longevity, and restoring skin hydration and radiance by using their plant extract that acts directly upon the cells of the skin or stimulates the enzyme machinery involved in skin ageing and its adjacent factors (Sharma and Pathak, 2018)

Orchids are highly diverse group of plants, many of which are threatened by human activities. When data on orchids from the IUCN Red List was reviewed, it was found that 149 (40%) of the 442 orchid species with threat data were at high risk from tourism and recreation, 98 (22%) species threatened by residential and commercial development, 75 (17%) by intentional collecting with protected areas, and 90 (20%) by human intrusions and disturbances from recreational activities (IUCN, 2017). With so many species at risk, increased awareness, and recreation of these threats combined with improved management to reduce impacts is needed (Wraith and Pickering, 2019). Conservation of orchids can be addressed by both *in situ* and *ex situ* measures but *in situ* conservation (conservation of species in their natural habitats) is considered the most appropriate way. For the propagation of orchids, tissue culture has been deemed as the best technique (Anuprabha and Pathak, 2019; Anuprabha *et al.,* 2017; Arora *et al.,* 2016; Bhatti *et al.,* 2017; Decruse and Gangaprasad, 2018; Gurudeva, 2019; Kaur *et al.,* 2017; Lekshmi and Decruse, 2018; Madhavi and Shankar, 2019; Pathak *et al.,* 2017; Vasundhra *et al.,* 2019). Some fragrant orchids which have been propagated through the tissue culture technique are *Aerides, Anoectochilus*, *Arundina, Dendrobium, Phaius*, *Phalaenopsis, Vanda etc*. We can only expect that shortly, more researches will confirm the beneficial effects of orchids on our health, especially skin health.

Cosmeceuticals as The New Face of Health and Personal Care Industry

Raymond Reed, the founding member of the United States Society of Cosmetic Chemists, coined the term *Cosmeceutical* in 1961 (Preetha and Karthika, 2009). In 2000, D. Klingman described that a cosmetic product is the one whose active ingredient is meant to have a

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Table 1. International status of orchids as cosmeceuticals.

Species	Cosmeceutical relevance/remarks	Reference
Acampe papillosa (Lindl.) Lindl.	Showed the presence of alkaloids, saponins, tannins, glycosides, flavonoids, and steroids which makes it a potent ingredient of cosmeceutical preparations.	Marjoka *et al*. (2016)
Anacamptis morio (L.) R.M. Bateman, Pridgeon & M.W.Chase	Wound healing.	Bazzicalupo *et al*. (2019)
Ansellia africana Lindl.	Anti-inflammatory effect by the inhibition against COX-1.	Kanlayavattanakul and Lourith (2020)
Anoectochilus formosanus Hayata	Aqueous leaves extract showed antioxidant properties and were capable of scavenging free radicals in a dose-dependent manner.	Gutiérrez (2010)
A. roxburghii (Wall.) Lindl.	The ability to scavenge free radicals suggests that it may be a promising anti-oxidant in cosmeceutical products.	Gutiérrez (2010)
Brassocattleya Marcella Koss	Orchid extract (5%) showed skin clarity, complexion luminosity, and complexion homogeneity improved significantly; whitening effects on Japanese female skin, without any adverse effects; attenuate skin spots or hyper-pigmented skin areas.	Archambault *et al*. (2013); Tadokoro *et al*. (2010)
Bulbophyllum scaberulum (Rolfe) Bolus	Ethanolic extract of the root of the orchid show anti-inflammatory properties.	Kanlayavattanakul and Lourith (2020)
Calanthe discolor Lindl. and *C. liukiuensis* Schltr.	Hair restoring and skin blood flow promoting activities.	Yoshikawa *et al*. (1998)
Coeloglossum viride var. *bracteatum* (Muhl. ex Willd.) A.Gray	Showed anti-ageing effects on senescent model mice induced by D-galactose and sodium nitrite.	Gutiérrez (2010)
Dendrobium chrysotoxum Lindl.	Proved beneficial for preventing or delaying the appearance of the signs of intrinsic and/or extrinsic aging of the skin, or for slowing down the effects thereof.	Leplanquais *et al*. (2012)
D. denneanum Kerr	Exhibits a powerful scavenging effect on hydroxyl radicals and DPPH radical, which may be comparable to Vitamin C	Fan *et al*. (2009)
D. cv. Khao Sanan	Stem polysaccharide is an important phytochemical for skin dryness treatment. Hydrating and/or moisturizing of skin accumulating in inflammation and aging of skin preventions.	Kanlayavattanakul *et al*. (2018)
D. Sabin Blue	Anti-ageing and anti-wrinkle properties due to the presence of phenols as dominant anti-oxidant components. Treats photo-induced aging.	Abu (2016)
D. tosaense Makino	Rich in polyphenols and flavonoids and displays antioxidant and inhibition on mushroom tyrosinase and melanogenesis properties.	Chan *et al*. (2018)
Epipactis helleborine (L.) Crantz	Wound healing.	Bazzicalupo *et al*. (2019)
Grammatophyllum speciosum Blume	Ethanolic extract of the pseudobulb of *G. speciosum* exhibited a potent elastase inhibitory activity and a protective effect against free radicals at 10 $\mu g ml^{-1}$ in human fibroblast cells. The pseudobulb extract with a known amount of gastrodin, utilized as an active quality control marker, was further developed into a cosmetic product as a stable serum.	Chowjarean *et al*. (2018)
Himantoglossum robertianum (Loisel.) P. Delforge	The flower extract is very rich in flavonoids, scopoletin, and phenolic acids. If used at proper doses, could support skin redox balance processes, thus contributing to prevent or counteract oxidative-related dysfunctions, especially those leading to skin ageing.	Bazzicalupo *et al*. (2019)

Table 1. International status of orchids as cosmeceuticals (contd.).

Species	Cosmeceutical relevance/remarks	Reference
Phalaenopsis amabilis (L.) Blume	Orchid callus extract increases the expression levels of COL1A1, COL1A2, ELN, and HAS3 genes of skin cells, and thus, is effective in promoting synthesis and secretions of collagen, elastin, and hyaluronic acid and also increase the expression levels of antioxidant genes of skin cells, and thus, is effective in enhancing the capability of skin cells.	Lin *et al.* (2018)
Vanda coerulea Griff. ex Lindl.	Three active components of imbricatin, methoxycoelonin, and gigantol, exhibit anti-oxidant activity, thus enabling them to neutralize ROS and reduce oxidative stress.	Hadi *et al.* (2015); Simmler *et al*. (2009)
V. teres (Roxb.) Lindl.	The extract of this plant reduces oxidative stress by exhibiting free radical scavenging activities and enhancing the synthesis of collagen type-1 fibers and fibronectin fibers which constitute the extracellular matrix of the skin; eucomic acid derived from its stem has anti-aging effects in immortalized keratinocyte cell line of human origin (HaCaT). Eucomic acid and vandateroside II increased the activity of cytochrome c oxidase, in this way activating cellular respiratory function, and as a result, reducing the signs of epidermal ageing.	Hadi *et al.* (2015); Simmler *et al*. (2011)

beneficial physiologic effect resulting from an enhanced pharmacologic action when compared with an inert cosmetic. The term *Cosmeceutical* is a hybrid combination of cosmetics and pharmaceuticals.

Table 2. Status of orchids as cosmeceuticals in India.

Species	Cosmeceutical relevance	Reference
Aerides multiflora Roxb.	Aqueous and ethanolic extracts of leaves and petals of this plant showed an SPF (Sun Protection Factor) higher than 30 in both leaves and petals.	Sharma and Pathak (2019)
A. odorata Lour.	Leaf extracts showed that the compounds, Ethyl α-D glucopyranoside, Nerolidol, Hexadecan-1-ol *etc*. have anti-oxidant, skin moisturizing, and skin healing properties.	Katta *et al*. (2019)
Agrostophyllum callosum Rchb.f	Tubers used to treat skin disorders.	Tsering *et al*. (2017)
Arundina graminifolia (D.Don) Hochr.	Root/stem extracts can be applied on foot-heels to treat cracks.	Tsering *et al*. (2017)
Coelogyne cristata Lindl.	Possess adaptogenic, anti-aging, and anti-stress properties. Juice of the pseudobulb is applied to the boils and also put in wounds of domestic as well as wild animals.	Pramanick (2016)
Crepidium acuminata (D.Don) Szlach.	Methanolic leaf and stem extracts showed promising inhibitory activity against major skin aging-related enzymes and anti-inflammatory potential.	Bose *et al.* (2017)
Dendrobium densiflorum Lindl. and *D. monticola* P.F.Hunt & Summerh.	The pulp of the pseudobulbs used in boils, pimples, and other skin eruptions.	Tsering *et al*. (2017)
Rhynchostylis retusa (L.) Blume	It contains compounds that largely inhibit the growth of gram-positive and gram-negative bacteria along with the fungal organism like *Staphylococcus aureus* and *Bacillus subtilis*; gram-negative: *Vibrio cholerae, Escherichia coli,* and *Klebsiella pneumonia* and three fungus species (*Penicillium* sp., *Rhizopus* sp., and *Aspergillus niger*) known to cause skin infections.	Bhattacharjee and Islam (2015)
Vanilla planifolia Jacks. ex Andrews	It has been reported to reduce chromosomal damage caused by X-ray and UV light 28, Vanillin's antimicrobial properties against yeasts and other microorganisms have been evaluated. 34- 35 Vanillin has also been reported to possess aphrodisiac activity 37, 38 and anti-oxidant activity 39.	Menon and Nayeem (2013)

Cosmeceuticals have medicinal benefits (but not just used for beautification), which affect the biological functioning of the organ concerned, depending upon the type of functional ingredients or bioactive molecule, they contain. These are cosmetic products containing bioactive molecules that have therapeutic benefits (*e.g.*, cream, lotion, and ointment containing botanical, animal, and marine extracts like antioxidants, vitamins, peptides, essential oils, waxes, oils, natural colour, natural fragrances, parts of plants like leaves). Many plants

Table 3. Fragrant orchids and their potential as cosmeceuticals.

Species	Scent	Phytochemicals present	Plant part(s) used	Cosmeceutical use	Reference
Acampe papillosa (Lindl) Lindl.	Hyacinth	Tannins, Flavonoids and glycosides	Leaves	Used for Skin issues and wound healing	Marjoka *et al*. (2016)
Aerides multiflora Roxb.	Dewy sweet	Flavonoids, Phenols	Flowers	Photoprotectant	Sharma and Pathak (2019)
A. odorata Lour.	Spicy, ribbon candy, cloves	Ethyl acetate extract (α-Selinine, Hexadecan-1 -ol) Methanolic extract (ethyl-α-D)	Leaves	Antioxidant	Katta *et al*. (2019)
Arundina graminifolia (D.Don.) Hochr	Floral	Stilbenoids	Stem	Used for healing cracks and wounds	Singh *et al*. (2016)
Bletilla striata (Thunb.) Rchb.f.	Slightly floral	Terpenoids, phenolic acids, flavonoids	Root extract	Used for healing cracks and wounds, Cleansing mask and as moisturizer	Kanlayavattanakul and Lourith (2019)
Calanthe discolor Lindl.	Mildfloral fragrance	Calanthoside, glucoindican, tryptanthrin, and many more	Leaf/Stem extract	Hair and skin conditioning	Yoshikawa *et al*. (1998)
Dendrobium chrysotoxum Lindl.	Pineapple- like, melon- like, mango- like	Dendrochrysanene	Stem extract	Anti-ageing	Leplanouais *et al*. (2012)
D. moniliforme (L.) Sw.	Flavonoids, Rosy floral	Polyphenols	Whole plant	Anti-oxidant and cytotoxic	Paudel *et al*. (2018)
D. nobile Lindl.	Fragrant honey to musk by day and mown hay at night scented	Bibenzyl derivative (nobilin D, nobilin E)	Whole plant	Skin conditioning	Singh *et al*. (2016)
Himantoglossum robertianum (Loisel.) P. Delforge	Strong and pleasant	Polyphenols	Flowers	Photo protectant, anti-wrinkle	Bazzicalupo *et al*. (2019)
Phalaenopsis amabilis Blume	Rose	Phenolic compounds	Whole plant	Humectant, anti-oxidant, skinmoisturizing, skin tenderness	Lin *et al*. (2018)
P. lobbii (Rchb.f.) H.R. Sweet	Floral	Phenolic compounds	Whole plant	Bleaching component	Singh *et al*. (2016)
Rhynchostylis retusa (L.) Blume	Citrusy	Alkaloids, flavonoids, tannins, terpenoids	Whole plant	Used for various skin issues	Bhattacharjee *et al*. (2015)
Vanda coerulea Griff. ex Lindl.	Pleasing sweet smell	Three Stilbenoids (imbricatin, methoxycoelonin, gigantol)	Whole plant	Anti-ageing, skin-moisturising, photoprotectant	Hadi *et al*. (2015)
V. teres (Roxb.) Lindl.	Creosote	Vandaterosoides woody smell	Whole plant	Skin hydration	Hadi *et al*. (2015)
V. tessellata (Roxb.) Hook. ex G.Don	Grapes	Petroleum ether extract	Leaves	Anti-oxidant	Khan *et al*. (2018)
Vanilla planifolia Jacks. ex Andrews	Sweet and pleasing	Vanillin	Beans	Used in making fragrant soaps, perfumery, powder	Singh and Agrawala (2019)

possess a vast and complex arsenal of bioactive phytochemicals (*e.g.*, vitamins, antioxidants, oils, essential oils, hydrocolloids, proteins, and terpenoids) that can calm or smooth, clean, restore, heal, and protect the skin, hair, and other parts of the body. Many of these chemicals are used as active ingredients of different cosmetic formulations for skin problems (like hyper-pigmentation, skin wrinkling, skin ageing, rough skin texture), hairspray, shampoo *etc*. The various other terms by which cosmeceuticals can be substituted are active cosmetics, performance cosmetics, functional cosmetics, and dermaceuticals. Today's cosmeceuticals as well as nutricosmetics are serving as a bridge between personal care products and pharmaceuticals. The cosmeceuticals are topical agents that lie somewhere between pure cosmetics (lipstick and rouge) and pure drugs (antibiotics and corticosteroids) (Alamgir, 2017). These are broadly categorized into the skin (lotion, anti-ageing creams), hair (gel, hair creams, shampoos, and serums), and others such as lipstick, nail paint, and perfume.

Orchids as Cosmeceuticals

Orchids are not only ornamental but have immense therapeutic importance too. These are traditionally used in many parts of the globe for their anti-oxidant, anti-microbial, anti-inflammatory, anti-rheumatic, anti-ageing, wound healing, hypoglycemic, anti-tumour, anti-cancer, and many other beneficial properties. The family Orchidaceae is also known for its exotically scented flowers. Along with the pleasant fragrance, they offer therapeutic qualities for the skin, hair, nails *etc*. The medicinal and aromatic importance of orchids has been known since antiquity. Several compounds have been isolated from different parts of orchids which possess medicinal properties and could be potent for being used in the cosmeceutical industry**.** Literature studies reveal the reports of the extraction of a wide range of important phytochemicals such as alkaloids, flavonoids, stilbenoids, anthocyanins, triterpenoids, orchinol, hircinol, cypripedium, bibenzyl derivatives, phenanthrenes, *etc*. from different species of orchids (Jhansi *et al.,* 2019; Joseph *et al*., 2018), which can be potentially used in cosmeceutical formulations; these phytochemicals are present in leaves, pseudobulbs, roots, flowers, or in the entire plant (Sharma and Pathak*,* 2018). Some fragrant orchids being used in cosmeceutical formulations are *Aerides multiflora, Bletilla striata*, *Cymbidium grandiflorum*, *Dendrobium nobile, Himantoglossum robertianum, Orchis maculata, Phalaenopsis amabilis, Rhynchostylis retusa, Vanda coerulea etc.* A perusal of literature reveals that most of the fragrant components are monoterpenes and simple aromatic compounds *e.g.* alpha-pinene, beta-pinene, myrcene, alpha-phellandrene, cineole, ocimene, p-cymane, citronellal, linalool, geraniol, methyl benzoate, alpha-terpineol, benzyl acetate, pipertone, d-carvone citronellol, methyl salicylate, nerol, 2-phenylathyl acetate, 2-phenyl ethanol, methyl cinnamate, eugenol, vanillin, and skatole (Anuprabha and Pathak, 2014). Table 1 highlights the status of orchids being used in cosmetics and skincare internationally and Table 2 highlights the same in India. Table 3 showcases some fragrant orchids and their uses as cosmeceuticals.

Conclusion

Orchids have long served as therapeutic herbs in several traditional recipes, worldwide. These medicinal herbs do not only have health benefits, but also bear beautiful flowers, hence cultivated for both medicinal and floriculture purposes. Antioxidant activities of orchids contribute towards suppression or down regulation of adverse effects of oxidative stress in dermal cells surplus with diminishing overproduction of skin melanin pigments. Some of the orchid species are being commercialized in the cosmetic industry. Thus, the researchers both in academic and industrial sections need to be encouraged to categorize the multi-functional orchids based on supported experimental evidence into higher value cosmeceutical ingredients; and subsequently turn them into finished products. Despite the fact that a few orchid species are being commercialized, the scientific-based available information still seems inadequate. Hence, it may be concluded that orchids have high potential in cosmeceuticals as various active components found in orchids are capable of exerting anti-ageing, anti-inflammatory, anti-melanogenic, and skin moisturizing activities. These properties tend to be more appealing nowadays because as the trend of the present society is more aligned towards eco-friendly products with natural ingredients. Hence, there is an urgent need to extensively explore the family Orchidaceae for species that may provide benefits like anti-ageing and have skin rejuvenating properties, mass propagate the selected species *in vitro* using different explants releasing the commercial collection pressures on the ever declining natural populations due to natural calamities and anthropogenic pressures which will result in enhancement of their commercial use and give boost to the cosmetic and cosmeceutical industry.

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