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Chemical ingredients of important 75 medicinal orchids

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Abstract
Orchids are one of the largest families of flowering plants which are best-known plant groups in the global horticultural and cut flower trades, including as ornamental plants, medicinal products and food. The medicinal orchids belong mainly to the genera namely *Calanthe, Coelogyne, Cymbidium, Cypipedium, Dendrobium, Ephemerantha, Eria, Galeola, Gastrodia, Gymnadenia, Habenaria, Ludisia, Luisia, Nevilia, Orchis, Thunia, Vanda and Vanilla.* In the Ayurvedic system of medicine, there is one rejuvenating herbal formulation 'Astavarga' that is prepared from orchid species i.e. Jivak (*Microstylis wallichii*), Rishbhaka (*Malaxis muscifera*, Riddhi *(Habenaria intermedia*) and Vriddhi (*H. edgeworthii*) are orchids. Orchid are enriched with phytochemicals such as stilbenoids, anthraquinones, pyrenes, coumarins, flavonoids, anthocyanins and anthocyanidins, chroman derivatives, lignans, simple benzenoid compounds, terpenoids, steroids, alkamines, amino acids, mono- and dipeptides, Alkaloids and higher fatty acids which play vital role for immunity development and curing other critical diseses of individuals.

Keywords: medicinal orchids, ayurvedic medicines, phytochemicals, immuniy

Introduction
Orchids are one of the largest families of flowering plants and are globally distributed. Till date, 29, 199 species have been accepted [1]. One of the best-known plant groups in the global horticultural and cut flower trades, orchids are also grown and traded for a variety of purposes, including as ornamental plants, medicinal products and food. The medicinal orchids belong mainly to the genera: *Calanthe, Coelogyne, Cymbidium, Cypipedium, Dendrobium, Ephemerantha, Eria, Galeola, Gastrodia, Gymnadenia, Habenaria, Ludisia, Luisia, Nevilia* and *Thunia* [2]. They are commercially used in Chinese and South Asian traditional medicine systems [3]. The most prominent orchid used in traditional Chinese medicines are various *Dendrobium* spp used to make the drug Shi-hu [particularly *D. catenatum* Lindl. (including *D. officinale* Kimura & Migo), *D. loddigesii* Rolfe, *D. moniliforme* (L.) Sw. and *D. nobile* Lindl.)] [4, 3]. Inaddition, tubers of *Gastrodia elata* Blume, rhizomes of *Bletilla striata* (Thunb.) Rchb.f.), the rhizomes and stems of *Anoectochilus* spp and the corms of *Cremastra appendiculata* (D.Don) Makino, *Pleione bulbocodioides* (Franch.) Rolfe and *P. yunnanensis* (Rolfe) Rolfe are all used [4, 3]. They are also popular to be utilized in some African traditional medicine (e.g. *Vanilla madagascariensis* Rolfe in Madagascar [5], North American folk medicine (e.g. *Cypripedium acaule* Aiton and *C. parviflorum* Salisb. [6] and the Unani medicine system [e.g. *Dactylorhiza hatagirea* (D.Don) *Soó Vanda tessellata* (Roxb.) Hook. ex G.Don, *Cymbidium bicolor* Lindl. and *Ipsea speciosa* Lindl. [7, 8, 9].

Orchids in ayurvedic system of medicine
In the Ayurvedic system of medicine, there is one rejuvenating herbal formulation 'Astavarga' is derived from a group of 8 herbs and some of these herbs i.e. Jivak (*Microstylis wallichii*), Rishbhaka (*Malaxis muscifera*), Riddhi *(Habenaria intermedia*) and Vriddhi (*H. edgeworthii*) are orchids [10, 11]. *Flickingeria macraei* is used in 'Ayurveda' in the name of 'Jeevanti' which is effective as astringent, aphrodisiac and in the treatment of asthma and bronchitis [12]. Other commonly used orchid drugs in the Ayurvedic system are Salem (*Orchis latifolia* and *Eulophia latifolia*), Jewanti (*Dendrobium alpestre*), Shwethuli and Rasna (*Acampe papillosa* and *Vanda tessellata*). In 'Sushruta Samhita' it is stated that the underground tuber of *Orchis latifolia* is used in the drug 'Munjatak' which relieves cough. The leaves of *Vanda roxburghii* have been prescribed in the ancient Sanskrit literature for external application for the treatment of rheumatism, ear infections, fractures and diseases of nervous system. Nepal's Ayurvedic trade has been reported to include 94 orchid species [13, 14], including *Crepidium acuminatum* (D.Don) Szlach., *Habenaria intermedia* D.Don, *Herminium edgeworthii* (Hook.f. ex Collett) X.H.Jin, Schuit., Raskoti & Lu Q.Huang and *Malaxis muscifera* (Lindl.) Kuntze [15, 16, 9]. *Eulophia* spp. are also widely used medicinally in different parts of India [*E. dabia* (D.Don) Hochr, *E. spectabilis* Suresh in D.H. Nicolson, C.R.Suresh & K.S.Manilal (= E. nuda Lindl.) [17] and *D. hatagirea* is used to treat a range of diseases [18].
In some regions of Malaya, the women boil the leaves of *Nervilia aragoana* and drink the liquid immediately after childbirth as a precaution against possible post natal problems. *Corymborchis longiflora*, *Tropidia curculigoides*, and *Acriopsis javanica* are found as febrifuges in treating malaria.

Chemical ingredients in orchids

Orchid phytochemicals can be classified as Stilbenoids (Stilbene, Bibenzyls, Phenanthrenes, 9,10-Dihydrophenanthrenes, Phenanthraquinones, 9, 10-Dihydrophenanthraquinones, Phenanthropyrans and pyrones, 9,10-Dihydrophenanthropyrans and pyrones, Fluorenones), Anthraquinones, Pyrenes, Coumarins, Flavonoids, Anthocyanins and anthocyanidins, Chroman derivatives, Lignans, Simple benzenoid compounds, Terpenoids (Monoterpenes, Sesquiterpenes, Diterpenes, Triterpenes), Steroids, Alkamines, Amino acids, mono- and dipeptides, Alkaloids and higher fatty acids. Dendrobium species are known to produce variety of secondary metabolites such as phenanthrenes, bibenzyls, fluorenones and sesquiterpenes, and alkaloids and are responsible for their wide applications in medicines. Besides, a number of phenanthrenes compounds isolated from Dendrobium species are dihydrophenanthrene, ephemeranthoquionone, shihunidine, shihunine, dendrophenol, moscatilin, moscatin, denfigenin, defuscin, amoenumin, crepaditin, rotundatin, cumulatin, and gigantol. Some other orchid genera like *Eulophia*, *Cypripedium*, *Gastrodia*, *Bletilla*, *Bulbophyllum*, *Anoectochilus*, *Arundina*, *Eria*, *Malaxis*, *Habenaria*, *Vanda*, and *Vanilla* are packed with different important phytochemicals [19] (Table 1).

Table 1: Chemical constituents and uses of 75 medicinal orchids

Sl. No	Name	Chemical constituents	Ethnomedical Uses
1.	*Acampe praemorsa*	Praemorsin	Used as tonic and to cure arthritis
2.	*Aerides crispum*	Aeridin	Used in ear problems
3.	*Agrostophyllum brevipes*	Agrostophyllin	Jaundice treatment
4.	*Agrostophyllum callosum*	Agrostonin, Agrostonidin, Callosin, Callosumin Callosmin, Imbricatin, Orchinol	Used in inflammation, diabetes, wounds and skin disorders
5.	*Anoectochilus formosanus*	Kinsenoside	Chest and abdominal pains, diabetes, fever, nephritis, hypertension, impotence, liver spleen disorders, and pleurodynia, antiinflammatory agent
5.	*Anoectochilus roxburghii*	Kaempferol-7β-D-glucopyranoside, Isorhamnetin-3-O β-D-glucopyranoside, Quercetin	Treatment of fever, pleurodynia, snake bike, lung and liver disease, hypertension, and malnourished children
6.	*Arundina graminifolia*	Arundinin, Isoarundinin-I, II, Arundin	Antibacterial and used for treatment of bodyache
7.	*Bletilla striata*	Blestrianol A, Blestrianol B, Blestrianol C, Bletilol-A, Bletilol-B, BlestrinA, B,C,D	Treatment of sores, ulcers and chapped skin, heal wounds, reduce swelling, and promote regeneration of tissue. Have been used to treat pulmonary tuberculosis and as haemostatic agent
8.	*Bulbophyllum gymnopus*	Gymnopusin	
9.	*Bulbophyllum kwangtungense*	Cumulatin, Densiflorol A, Plicatol B	Treat pulmonary tuberculosis and as hemostatic agent, promote the production of body liquid and reduce fever
10.	*Bulbophyllum leopardinum*	Bulbophyllanthrin	Burns
11.	*Bulbophyllum odoratissimum*	Bulbophythrin A, Bulbophythrin B, 3,7-Dihydroxy-2-4-6-trimethoxyphenanthrene, Chrysin, Pinobanksin	Treatment of tuberculosis, chronic inflammation and fracture
12.	*Calanthe discolor*	Calanthoside, Isatin, Indican, Glucoindican	hair restoring
13.	*Calanthe puberula*	Aurantinamide	Used as tonic
14.	*Coeloglossum viride*	Dactylorhin B	Memory deficits
15.	*Coelogyne cristata*	Coeloginanthrin Coeloginanthridin Combretastatin C-1,Coelogin	Used as aphrodisiac and to cure wounds, boils, sores and constipation
16.	*Coelogyne flaccida*	Flaccidin, Flaccidinin, Oxoflaccidin, Isooxoflaccidin	Treatment of headache, fever and indigestion
17.	*Coelogyne flavida*	Flavidin, Flavidinin	Traditional medicines
18.	*Coelogyne ochracea*	Ochrone-A, B Ochrolic acid,	Used in fractured bones

		Ochrolon	
19.	*Coelogyne ovalis*	2,7- dihydroxy 3,4,6 - trimethoxy 9,10- dihydrophenanthrne	Used as aphrodisiac and to cure cough, urinary infections and eye disorders
20.	*Cremastra appendiculata*	Cirrhopetalanthin	Associated with the liver, Spleen and stomach meridians. Its can be used internally, to fight tumors and cancers of the breast, cervix and uterus in women. Externally, it treats boils and skin lesions, and can be applied to affected parts of the body as part of poultice or paste
21.	*Cymbidium aloifolium*	Aloifol-I, Cymbinodin-A, B	Used as purgative and tonic and to cure rheumatisms, nervous disorders, wounds, sores, boils and fevers.
22.	*Cymbidium giganteum*	Gigantol	Used in blood clotting
23.	*Cymbidium goeringii*	Cymbidine A	Used as hypotensive and in diuretic activities
24.	*Cymbidium spp.*	Agglutinin	Antiviral
25.	*Cypripedium macranthum*	Annoquinone, Cypripedin Cryptostylin	Used for skin diseases
26.	*Dendrobium aduncum*	Aducin	Used as tonic and in treatment of fever
27.	*Dendrobium amoenum*	Amotin, Isoamoenylin Amoenylin, Amoenin	Treatment of burnt skins and dislocated bones
28.	*Dendrobium auranticum var. denneanum*	Defuscin, Dendroflorin, Dengidsin, Kaempferol, Naringenin, Taraxerol	Diabetes
29.	*Dendrobium candidum*	Dendrocandin A, B, C, D, E, F, G, H, I	Diabetes
30.	*Dendrobium chrysanthum*	Cis-Dendrochrysine, Trans-Dendrochrysine, Hygrine, Erianin	Antipyretic, eyes-benefiting, Immunoregulatory purposes,skin diseases
31.	*Dendrobium chrysotoxum*	Dendrochrysanene, Erianin	Used as tonic and anti-pyretic
32.	*Dendrobium crepidatum*	Crepidine, Crepidamine, Dendrocrepine	Used as tonic, in arthritis and rheumatisms and dislocated bones
33.	*Dendrobium densifiorum*	Homoeridictyol, Scoparone, Dendroflorin	Promotes the production of body fluid
34.	*Dendrobium farmeri*	Ayapin, Dengibisin	Antibacterial
35.	*Dendrobium fimbriatum*	Denfigenin, Diosgenin, Fimbriatone, Crepidatin, Confusarin, Ayapin	Promotes the production of body fluid. Paste applied on fracturated area to set bone
36.	*Dendrobium gibsonii*	Dengibsin, Dengibsinin	Improvement of immune systems, diarrhea, eye sight etc.
37.	*Dendrobium loddigesii*	Shihunine, Shihunidine	Used as a tonic to nourish the stomach, replenish body fluid, and reduce fever and anticancer agent
38.	*Dendrobium monoliforme*	Dendromoniliside A, Dendromoniliside B, Dendromoniliside C, Moniliformin	Tonic and antipyretic, longevity and as an aphrodisiac, stomachic and analgesic
39.	*Dendrobium moschatum*	Moscatin, Moscatilin	Used in body weakness, fractured and dislocated bones and earache
40.	*Dendrobum nobile*	Dendrobine, Denbinobin, Dendrobinobine, Dendroside A, Dendroside D, Dendroside E, Dendroside F, Dendroside G, Dendronobiloside A, Nobilin D, Nobilin E, Nobilone	Yin tonic to nourish stomach, promote production of body fluid and reduced fever
41.	*Dendrobium primulinum*	Dendroprimine, Hygrine	Immune system enhancer

42.	*Dendrobium thyrsiflorum*	Denthyrsin, Denthyrsinone, Denthyrsinine, Denthyrsinol, Hircinol	Immune system enhancer
43.	*Ephemerantha lonchophylla*	Ephemeranthrone, Lonchophylloid A, B, 3-Methylgigantol	Used as a tonic to nourish the stomach, promote the production of body fluid, and reduce fever
44.	*Epidendrum Mosenii*	Pholidotin, 24-methylenecycloartenol	Analgesic activity
45.	*Epidendrum rigidum*	Batatasin III, 2,3-Dimethoxy-9,10-dihydrophenanthrene-4,7-diol	Replenish body fluid
46.	*Epipactis helleborine*	Gastrodianin	Used as aphrodisiac
47.	*Eria carinata*	Erianin, Erianthridin	Used as tonic and in treatment of digestive systems
48.	*Eria flava*	Flavanthridin	Used as tonic and in treatment of digestive systems
49.	*Eria stricta*	Erianthrindin	Used as tonic and in treatment of digestive systems
50.	*Eulophia nuda*	Nudol, Eulophiol	Used in tuberculosis, tumours and bronchitis
51.	*Gastrodia elata*	Parishin, Parishin B, Parishin C, Gastrol	Treatment of convulsive diseases such as epilepsy
52.	*Goodyera schlechtendaliana*	Goodyerin	Tonic for internal injuries and to improve circulation
53.	*Gymnadenia conopsea*	Gymconopin A, B, D	Used as aphrodisiac
54.	*Habenaria repen*	Habenariol	Used as aphrodisiac
55.	*Listera ovata*	Luteolin	Used in Stomach disease. Externally as skin tone
56.	*Luisia volucris*	Luisiasin,	Wound healing
57.	*Malaxis muscifera*	Malaxin	Used in Ayurvedic medicines
58.	*Maxillaria densa*	9,10-Dihydro-2,5-Dihydroxy-3, 4-dimethoxy-phenanthrene, Erianthridin, Fimbrinol A	Treatment of painful complaints. Relaxant agent
59.	*Nidema boothii*	Lusianthridin	Relaxant agent
60.	*Orchis latifolia*	Loroglossin	Used as expectorant, astringent and in diarhhoea, intestinal irritations
61.	*Otochilus fuscus*	Otochilone, Flavidin, Isoflavidinin	Used as tonic
62.	*Phalaenopsis mannii*	Phalaenopsine	Antioxidant
63.	*Phaius wallichii*	Tryptanthrin, Brevicornin, Indirubin	Wound healing, inflammations and diarhhoea
64.	*Pholidota articulata*	Flavidin, Isoflavidinin	Used as tonic and in skin diseases and dislocated bones
65.	*Pholidota chinensis*	Cyclopholidonol, Cyclopholidone, Pholidotol A Pholidotol B	Taken for scrofula, feverish stomachache and toothache, chronic bronchitis, and duodenal ulcer
66.	*Pholidota imbricata*	Imbricatin	Used as tonic and in abdominal and rheumatic pain
67.	*Rhyncostylis retusa*	p-hydroxyphenyl propionic acid	Used in rheumatism, constipation, gastritis, wounds and arthritis
68.	*Spiranthes australis*	Panlongcen	Used for urinary problems and diabetes mellitus. Treatment of bacterial and inflammatory diseases, cancer, blood, and chest disorders
69.	*Spiranthes sinensis*	Sinensol A, B, C, D, E, F, Spirasineol B, Spiranthol-C, Spiranthoquinone	Aphrodisiac, treatment of hemoptysis, epistaxis, headache, chronic dysentery and meningitis
70.	*Thunia alba*	Thunalbene	Treatment of dislocated bones
71.	*Vanda cristata*	Laburine acetate	Used as expectorant and in bronchitis, cuts, wounds, boils and dislocated bones
72.	*Vanda parviflora*	Parviflorin	Used to treat rheumatism, disorders of

			nervous system, and also as anticancer and antiviral agent
73.	*Vanda roxburghii*	Heptacosane, Octacosano	The paste is applied to the body to bring down fever. The juice is dropped in the ear for the treatment of otitis. The roots are used in dyspepsia, bronchitis, rheumatim and siatica
74.	*Vanda tessellata*	Tessalatin	Treatment of certain inflammatory conditions. It is also instilled into the ear as a remedy for otitis. Paste is applied to the body to bring down fever. The roots are used in rheumatism, nervous problems, bronchitis, dyspepsia and fever, laxative and tonic to the liver, aphrodisiac and given for impotence and barrenness.
75.	*Vanilla planifolia*	Vanillyl methyl ether, Piperidinic acid	Used as for the treatment of hysteria, fever, impotence, rheumatism, and to increases the energy, of muscular system

Pharmacological properties of orchids

Antimicrobial: *Vanilla planifolia, Galeola foliata, Cypripedium macranthos var. rebunense, Spiranthes mauritianum, Bletilla striata*

Anti-inflammatory: *Anoectochilus formosanus, Gastrodia elata, Dendrobium moniliforme, Pholidota chinensis, Vanda roxburghii*

Anti-oxidant: *Anoectochilus formosanus, Anoectochilus roxburghii, Dendrobium moniliforme, D. nobile, Gastrodia elata.*

Antidiabetic: *Anoectochilus formosanus, Dendrobium candidum*

Antihepatotoxic: *Anoectochilus formosanus, Goodyera* species

Neuroprotective*:* *Coeloglossum viride, Gastrodia elata*

Anti-viral: Cymbidium hybrid, *Epipactis helleborine, Listera ovata, Gastrodia elata*

Antipyretic: *Dendrobium moniliforme*

Anti-cancer/Anti-tumor: *Anoectochilus formosanus, Bletillastriata, Bulbophyllum kwangtungense, Dendrobium chrysanthum, Dendrobium fimbriatum, Dendrobium nobile, Ephemerantha ionchophylla, Gastrodia elata, Spiranthes australis, Bulbophyllum odoratissimum*

Epilepsy: *Gastrodia elata*

Antibacterial*:* *Arundina graminifolia, Spiranthes mauritiana,*

Wound healing: *Vanda roxburhii*

Anti-allergic: *Cymbidium spp.*

Orchids with immunomodulatory action

***Bletilla striata*:** Tuber is used to treat tuberculosis and haemorrhage. In China and Japan, it is used in wound healing, ulcers, inflammation, haemostatic and as immunomodulator [20].

***Corallorhiza maculata*:** Dried stems are used to restore blood in pneumonia patients in America and Europe [19].

***Corymborchis longiflora*:** In Malayasia, it is used as febrifuge in treating malaria [19].

***Dactylorhiza hatagirea*:** Tuber is used in burning sensation during urination, general debility, cough and cold, while decoction of tuber mixed with sugar is used as a drink in tuberculosis and effective against impotency [21].

***Dendrobium aurantiacum*:** In China, herb is used as antipyretic, immunomodulatory, anti-ageing and in eye disorders.

***Dendrobium candidum*:** Herb is used to strengthen stomach capacity, promote body fluid; used in the treatment of cataract, throat inflammation and immune boosters [22].

***Dendrobium chrysanthum*:** Powdered dry leaves are used to treat eye related problems, skin diseases, as immunomodulator and antipyretic [23].

***Dendrobium denudans*:** In Tibet, Amchi people used the stem for cough, cold, nasal block and tonsillitis. The Nepali folk healers used it as tonic to increase the strength of old people and children [21].

***Dendrobium nobile*:** Sesquiterepenes glycosides with alloaromadendrane, emmetin and picrotoxane types aglycones are isolated from stems of *Den. nobile*. These compounds show immunomodulatory activity [24].

***Eulophia ochreata*:** Tubers are used to combat general fatigue, to boost immunity, to treat constipation, fever, skin diseases, wounds, tumours, boils, sunburns, cuts, injury and abdominal pain.

***Habenaria edgeworthii*:** Leaves and tubers are used in blood and skin diseases, coughs, cold, asthma, leprosy, gout, general debility and as brain tonic and rejuvenator [25].

***Malaxis muscifera*:** Powdered bulbs are used in treating male fertility while decoction is used in fever [21].

***Satyrium nepalense*:** In Sikkim, tubers are used for reducing cold, cough and fever and mixed with yak ghee, used as aphrodisiac. Plant is used to proper child development and growth [21].

Conclusions

Pharmacological studies on orchids indicate the immense potential of these plants in treatment of a number of neurodegenerative disorders, anticonvulsive, anticancer, antidiabetic, viral diseases etc. However, gaps in studies carried out are apparent which need to be bridged in order to exploit full medicinal potential of orchids. Orchids have recently been proved to be a rich storehouse of chemical constituents with promising anti-tumor, anti-cancer and anti-inflammatory activities as revealed in modern biology based studies. Investigations in progress can identify new biomolecules that confirm usefulness of traditional remedies to develop new therapeutics. Orchid's species have recently been targeted for many investigations related to their chemical, biological, pharmacological, and medical properties. Traditional use of orchids preparation of Yin tonic in the Chinese, Tibetian and Ayurvedic medicine needs to be revised in the light of modern science of health and diseases. It is true that many people of developing countries from rural now preferring traditional medicines over synthetic ones because of least side effect, low production cost, easy availability and wide effectiveness. Meanwhile, consumers in developed countries are becoming disillusioned with modern health systems and are seeking alternatives. Since herbal medicines serve the health needs of about 80% of the world's population, and orchids contain a large number of bioactive phytochemicals can be used as a promising source of medicine.

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