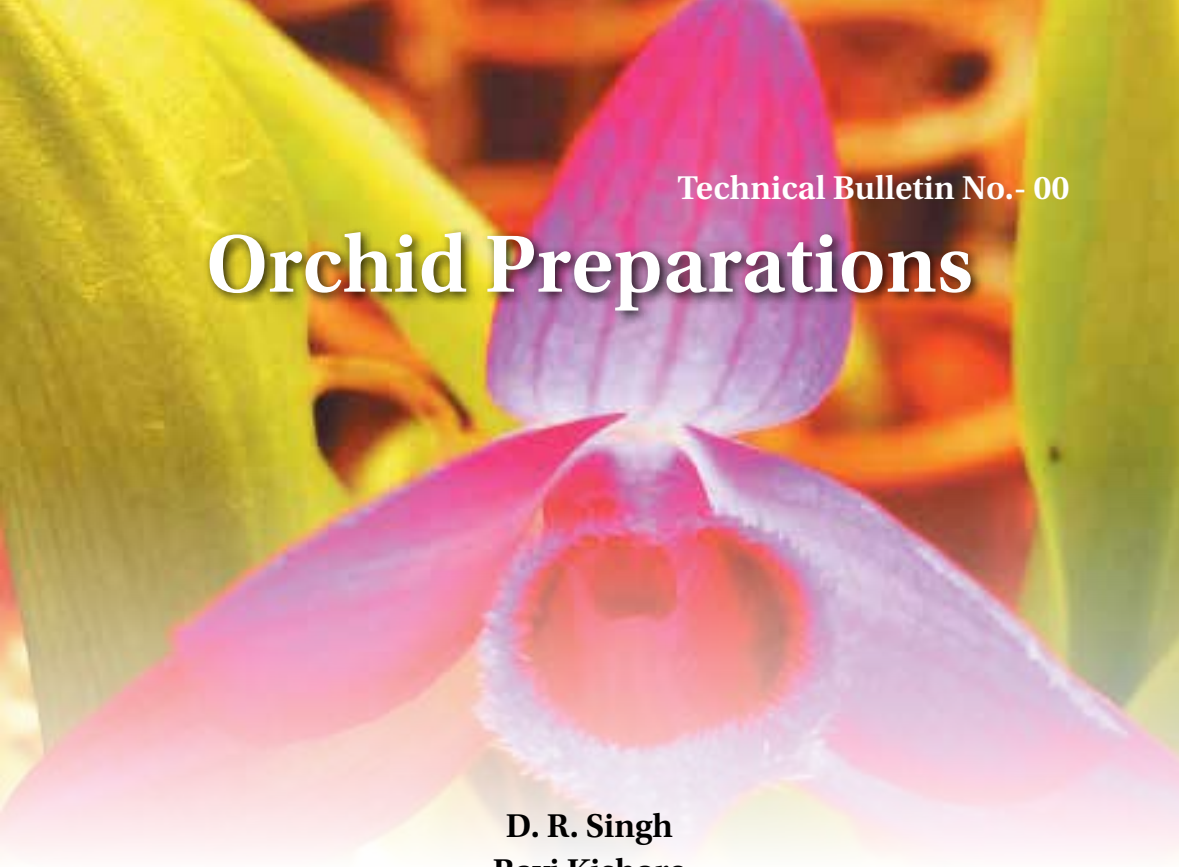

Technical Bulletin No.- 00

Orchid Preparations

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Compiled and Edited by: D. R. Singh, Ravi Kishore,Raj Kumar, Ankita Singh

Published by: Director,
ICAR- National Research Centre for Orchids,
Pakyong,-737106, Sikkim.

Designed and Printed by: Astral International (P) Ltd., New Delhi
mail: info@astralint.com

September, 2016

PREFACE

Orchids, one of the most fascinating creations of the nature are one of the most widely distributed groups of flowering plants on the earth. The bewildering colours, shapes, and sizes of these flowers coupled with a longer self-life (2 – 3 months) made them one of the top ten 'cut flowers' in international market occupying a major share in the global floricultural trade with extremely high returns. Horticulturists worldwide today grow orchids not only because they are curious, but mainly due to their great demand and high price.

The economic importance of orchids lies mainly in their ornamental and therapeutic value. Very little is known about other uses though many orchid species are being used in ethnic food, fragrance and flavour industry, dry flowers, jewellery and many other minor uses.

The present technical publication 'Orchid Preparations' under the project "**National Mission of Himalayan studies"** covers the wide aspects of chemical profiling, economic importance of orchids. The information given in the text is the compilation of secondary sources as indicated in the references.

I hope that it will be a useful handy reference for orchid entrepreneurs, Masters and Ph. D students, economic botanists and global horticulturists.

D. R. Singh
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Ankita Singh

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1

ORCHID PREPARATIONS

Introduction

Orchids, one of the most fascinating creations of the nature are one of the most widely distributed groups of flowering plants on the earth. They are cosmopolitan in distribution and known to occur in a wide range of climatic conditions from the alpine regions to humid climate, except the icy continent of Antarctica to dry sandy African and Australian deserts. They are abundant in tropical regions of the South East Asian countries Like India, China, Malaysia, Laos, Myanmar, Nepal, Bhutan Japan, Philippines, Australia, Europe, South & Central America and South Africa etc. The family Orchidaceae is one of the oldest known and world's largest family of flowering plants comprising of over 800 genera and between 25000 – 35,000 species. R. Govaerts of the Royal Botanic Garden, Kew mentioned in a personal communication that during the project 'World Checklist of Selected Plant Families' a total of 27,230 accepted taxa have been enumerated for the family Orchidaceae. The family exhibits the peak of evolution amongst the Monocots.

The first scientific account of Indian orchids was provided by the then Dutch Governor of Malabar, Von Rheede (1678 – 1703) in his monumental work 'Hortus Malabaricus'. William Roxburgh (1832), the 'Father of Indian Botany', provided a treatment of 57 species in his 'Flora Indica, vol. III'. But the most significant

contribution to Indian orchids was made by Sir J.D. Hooker (1888, 1890) in Flora of British India (Vol. 5 & 6), who described about 1600 species of orchids from the erstwhile British India.

In India, the family Orchidaceae is widely distributed from alpine to coastal regions and islands but their maximum diversity occurs in the Eastern Himalayan and Peninsular regions respectively. According to the reports (Misra, 2007) the family has about 186 genera, 1298 species, 5 subspecies and 28 varieties in India.

The orchids are under cultivation since 500 B.C. in the orient for ornamental and medicinal use. They produces flowers, which are most exotic, amazingly attractive, in bewitchingly curious shapes, colours, longer self-life (2 – 3 months) made them one of the top ten 'cut flowers' in international flower market. Now-a-days they occupy a major share in the global floricultural trade with extremely high returns. Horticulturists worldwide today grow orchids not only because they are curious, but mainly due to their great demand and high price. The orchids are most commonly used for cut flowers and pot plants, except very few in the 'Jewel orchids' group that are used for their very decorative leaf patterns but in addition to ornamental value, orchids have various other commercial uses too.

Indians have one of the oldest, richest and most diverse cultural traditions called 'folk traditions' associated with the use medicinal herbs and it is still a living tradition in India.Oldest references to the use ofmedicinal herbs in India are found in the Sanskrit literatures. There are four Vedas — 'Rig Veda', 'Sama Veda', 'YajurVeda' and 'AtharvaVeda'which formthemain literary source for Vedic era. The 'Rig Veda' and 'Atharva Veda', written between 400 and 1600 B.C. dealing with varied use of plant drugs. It is in the 'Ayurveda' which is considered as an 'Upa Veda' (applied knowledge), that property of plant drugs and their uses is described. The Indian orchids were brought to the notice of the world by Charak, the great Indian medicine man as back as in 125 A.D, who described 'Vanada' and several other orchids in his book - 'CharakSamhita' which provides description of present known orchids like Flickingeria, Malaxis and Eulophia species (Kutumbiah, 1962). Having tremendous horticultural and medicinal value, the family Orchidaceae has been paid adequate attention in many countries throughout the world to study their biology, evolution, taxonomy, cytology, chemistry, hybridization and cultivation etc.

Many orchids are known for their wonderful fragrance and it is believed that more than 75% orchids are fragrant species. The orchid fragrance is due to the presence of volatile aromatic oils produced in minor quantities in floral parts like sepals, petals, calluses, basal spurs to petioles. Floral scent emission shows diurnal rhythm and is controlled by internal biological clock. Some scent species emit fragrance at morning while others develop fragrance at late noon, evening or night. Orchid fragrance is a chemical messanger between the plant and its pollinator. Night pollinated flowers have peak emissions at night while the situation is reversed in day pollinated flowers. Orchid flowers have specialized scent glands called osmophores that ooze liquid scent, which evaporates on contact with the air. An orchid fragrance ranges from warm, sweet & highly diffusive notes to stinky and offensive odour. The pleasant scented orchid flowers are often compared to fragrance of other flowers like rose, hyacinth, jasmine, freesia, lily, narcissus, sweet pea or easily identified scents like lemon, chocolate, vanilla, orange, coconut, cardamom, musk, honey, mint etc. On the other hand, the flower of the bee orchid smells and looks, to the male bee, just like a female bee. The duped male bee attempts to copulate with the orchid's petals, and the insect spreads pollen between the deceptive flowers. And flowers don't just imitate bees. A few orchid species smell like female flies, and others replicate the aroma and texture of scarab beetles.

Orchid Preparations consists of a diverse variety of products that has potential application in different fields such as herbal drugs, edible processed and non-processed food products, cosmetics, Essential Oils, Perfumery industry, dry flower products. The use of natural products with therapeutic properties is as ancient as human civilization and for a long time mineral, plant and animal products were the main sources of drugs (De Pasquale, 1984). The Industrial Revolution and development of organic chemistry resulted in a preference for synthetic products for pharmacological treatment.According to the World Health Organization (WHO) nearly 20,000 medicinal plants exist in 91 countries including 12mega biodiversity countries.About 25%of the drugs prescribed worldwide come from plants, 121 such active compounds being in current use. Out of the 252drugs considered as basic and essential by the World Health Organization (WHO), 11% are exclusively of plant origin.Examples of important drugs obtained from

plants are digoxin from *Digitalis* spp., quinine and quinidine from *Cinchona* spp., vincristrine and vinblastine from *Catharanthusroseus*, atropine from *Atropa belladonna* and morphine and codeine from *Papaversomniferum.*It is estimated that, in 1997, the world market for over the- counter phyto-medicinal products was US$ 10 billion, with an annual growth of 6.5%.The WHO considers phytotherapy in its health programs and suggests basic procedures for the validation of drugs from plant origin in developing countries.The use of herbal medicines in Asia represents a long history of human interactions with the environment. Plants used for traditional medicine contain a wide range of substances that can be used to treat chronic as well as infectious diseases. Due to the development of adverse effects and microbial resistance to thechemically synthesized drugs, men turned to ethno-pharmacognosy.

Numerous orchid species have been and are being used in different countries for therapeutic properties. A good number of research papers, popular articles and books have been published on medicinal uses of orchids throughout the world. Orchids, besides their identity as commercial ornamental crop are also well known for their multipurpose uses including traditional medicines such as antibiotics, antimalarial, rejuvenating and many other purposes. Orchids contains a wide range of bioactive compounds viz. alkaloids, flavonoids, glycosides, benzyl derivatives, phenanthrenes, terpenoids etc. used for the treatment of various diseases.Only a few of orchids have been investigated for their biological function, others are still unknown.*Dendrobium* species are known to produce a variety of secondary metabolites such as phenanthrenes, bibenzyls, fluorenones and sesquiterpenes and alkaloids and are used for their wide variety of medicinal properties.Nearly 145 bioactive molecules have been isolated from various orchid species, which are used for the treatment of different diseases and ailments like tuberculosis, stomach disorders, jaundice, eczema, inflammations, menstrual disorder, diahorrhea, muscular pain, rheumatism, malaria, wounds and sores etc. *Chyavanprash*, which is a well-known immune booster widely used in Indian households is prepared with various herbs including four orchid species, viz.,*Habenariaintermedia (Riddhi), Habenariaedgeworthi (Vriddhi), Malaxismuscifera (Jivaka) and Malaxisacuminata (Rishbhaka)* asimportant components. In Chinese herbal medicine industry, orchids

like*Dendrobiumnobile,Gastrodiaelata*, and *Bletillastriata* are used in large quantities and are cultivated on commercial scale by the growers. The bioactive compounds like Dendrobine, Nobilonine, Gastrodin, Vanillin, Batatasin, Blespirol, Blestriarine, Blestrin which are available in these plants are used for preparation of commercial Chinese herbal medicines like *Shi-Hu, Tian-Ma, Bai-Ji*etc(Bulpitt et al, 2007).

The recent popularity of traditional herbal medicines in western countries is also creating a new niche market. Linking of the indigenous knowledge to the modern research activities will help to discover new drugs in addition to contemporary synthetic medicines. However, such large scale demand for medicinal orchids is posing serious threat to orchids in natural habitats due to pressure of collection and sale of whole uprooted plants. Before recommending any orchid species for medicinal use, extensive research on its bio-efficacy is essential. This will be helpful to fully exploit the potential of medicinal orchids in livelihood security of the growers.

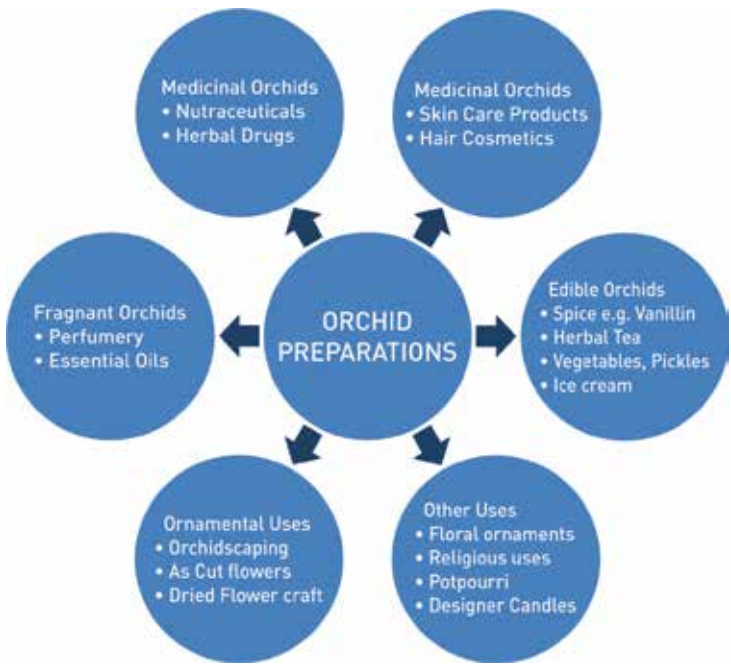


Fig. 1.1:-Pictorial Representation of different orchid preparations.

2

EDIBLE ORCHIDS

Orchids are used as flavouring agent in food, salad, main courses as deserts and to prepare teas. Vanilla is the most famous orchid for its flavour and has been used to flavour food & beverages and tobacco (in Cuba). Recently has been discovered by the Europeans that orchids have been used in Africa as food for hundreds of years.A recent expedition of botanists revealed that over 77 species of orchids are used as food in Africa.Not only are orchids edible, but also it is a source of fibre and vitamin C. Itstaste isreported to be somewhat sweet; others say it tastes like tannin or raw chives.

Orchid Ice Cream

Food product made from salep is called Dondurma which is also known as Turkish orchid ice cream. This particular ice cream is not like normal ice cream instead it is very chewy and resistance to melting. The ice cream is made with milk, sugar, salep, and mastic (provides the chewy texture) and is kneaded either

(Source of Photographs: Internet)

Fig. 2.1. Preparation of Turkish Icecream

by hand or in a mixer. The ice cream is very commonly seen in Turkey and also in Greece, where it's referred to as Dudurmas or Kaimaki.

Salep

Salep is a Turkish word (Greek 'salapi' Arabic word 'sahlab') refers to the tubers of terrestrial orchids. It is flour, made from grinding dried tubers of *Orchis mascula*, *Orchis militaris* and related species of orchids, which contain a nutritious starch-like polysaccharide called glucomannan. The tubers used for preparing salep are taken up at the close of the summer, when the seed-vessels are fully formed. At this time the tubers contain the largest amount of starchy matter and are full and fleshy. After the tubers string, these are immersed for a short time in boiling water or milk. This scalding process destroys their vitality, remove the bitterness of their fresh state and make them dry more readily. The outer skins are then rubbed off and the tubers are dried, either by exposure to the sun, or to a gentle artificial heat in an oven for ten minutes and heated to about bread-making temperature. On removing from the oven, their milky appearance is changed to an almost transparent and horny state, though the bulk will not be reduced. They are then placed in the fresh air to dry and harden for a few days, when they are ready for use, or to be stored for as long as desired. The dried tubers are generally ground to powder before use; Salep powder has a yellowish colour. The powder is used to produce beverages and desserts and is available in many Greek, Middle East and Iranian markets. Turkey is the foremost and best quality salep producer that exports it to many European countries mainly in Germany. Around 120 taxa belonging to the genera *Ophrys, Orchis, Himantoglossum, Serapias, Anacamptis, Compreria, Barlia, Dactylorhiza, Aceras,* and *Neotinea* are used to obtain salep in Turkey (Sezik E., 2002). In the East, Salep was mainly made from *Orchis morio*, but it could be made in the UK from *Orchis mascula* (the early purple orchid) or from *O. maculata* or *O. latifolia*. As beverage, salep was very popular in Europe, before coffee and tea were introduced. As desserts we know "salep pudding" and "salep ice cream" which is popular in Greece and Turkey. Salep was dispensed in London in Oliver Cromwell's time, and hot drinks of salep were sold at stalls in the streets of London before the introduction of coffee (Bulpitt CJ., 2005).

In England, the drink was known as 'saloop' was very popular in the 17th and 18th centuries. In England its preparation required that the salep powder be added to water until thickened, whereupon it would be sweetened then flavoured with orange flavour or rose waters. Substitution of British orchid roots, known as 'dogstones', were acceptable in the 18th century for the original Turkish variants (Davidson A., 1987). The Ancient Romans also used ground orchid bulbs to make drinks, which they called by a number of names, especially 'Satyrion' and 'Priapiscus'. It is considered to be a powerful aphrodisiac. The Salep of the Indian markets, known as Salib misri, is derived from certain species of *Eulophia*, *Orchis* and *Satyrium*.

The constituents of Salep are subject to great variation, according to the season of collection and orchid species. The most important constituent of salep is mucilage, amounting to 48% and also contains sugar (1%), starch (3%), nitrogenous substance (5%), and traces of volatile oil. It is used in the diet of convalescents and children, being boiled with milk or water, flavoured and prepared in the same way as arrowroot. The mucilage form, made by shaking 1 part of powdered salep with 10 parts of water, boiling and agitated until it is uniformly diffused will give for treatment of irritation in gastrointestinal tract. This preparation is also recommended as an article of diet for infants and invalids suffering from chronic diarrhoea and bilious fevers. The mucilage of salep widely appears as an official preparation in the German Pharmacopoeia.

Vanilla

The pods of the climbing orchid *Vanilla planifolia* is used for the commercial production of the prized vanilla flavour, consisting of vanillin and other numerous flavouring compounds, with the use of a curing process. Other few species of Vanilla as *V. pompona*, and *V. tahitensis* also contain vanillin, but it is of low quality. It is the second most expensive flavouring spice after saffron. (Sachan D., 2005).Vanillawas introduced to Europe by theSpanish Conquistadores in 1520, but commercial production ofvanilla started about 300 hundred years later. Vanillin was firstisolated from Vanilla beans in 1858 by Gobley and its structurewas established by Carles in 1870. Goris was the first to show that vanillin is formed from glucovanillin, during the curing process of Vanilla beans (Goris

MA.,1924). Other glycosyl and phenolics conjugates to mannose, galactose and rhamnose are also found in trace amounts in the developing pods. Studies on the botany of Vanilla beans revealed that flavour precursors, glucovanillin are found in the bean interior, where they are secreted onto the placental region around the seeds. The hydrolytic or other degradative enzymes (viz. β-glucosidase and glycosyl hydrolases), which catalyse the flavour precursors to flavour compounds, are localized mostly in the outer fruit wall region.(Frenkel DH., *et al* 2004). Now a day, due to scarcity of Vanilla pods and high production cost vanillin is largely produced synthetically by the chemical route using lignin fromwood or other petro-products.Natural vanillin, extracted fromVanilla beans cost between US$ 2000 and US$ 3000 per kg compared to synthetic vanillin costing between US$ 5 and US$ 15 per kg. In 2004 the world vanilla production was 5400 million tonswhich increase on anaverage 4% in the recent years (Sachan D.,2005)

(Source of Photographs: Internet)

Fig. 2.2. Vanillin from Vanilla pods

Vanilla is chiefly used in ice creams, dairy products, biscuits, cakes, beverages, perfumery and cosmetics as flavouring agent. Vanillin is the active compound found in this orchid and has the medicinal value. The Vanilla capsules are very cordial, cephalic, stomachic, carminative, attenuating viscous humours, provoking urine, improves food intake, reduces nausea and menstrual discharge. It is also used as blood purifier, diuretic, vermifuge, aphrodisiac, antispasmodic, stimulant and childbirth accelerator (Arditti J., 1992).Vanillin is compliant to European Pharmacopoeia, US Pharmacopoeia NF and Food chemical codex.

Chikanda

In Zambia, the tubers from the orchid genera Disa, Habenaria and Satyrium are the main ingredients of "chikanda", a popular meatless sausage;a brown jelly, also sold at roadsides in the form of slices. It is prepared by pounding the orchid tubers to remove the skins, after that grinding to produce the "yellowish flour" which is mixed with water, soda, salt to enhance the taste and peanut flour to adjust the thickness. The mixture is poured into a suitable container and left for settle down and cool. The growing appetite for "Chikanda" had a dramatic impact on orchid populations in the whole of East Africa.

Chinaka

According to local peoples, it is not only a delicacy, but also used as a medicine that protects people from various diseases and also acts as source energy. *Satyrium cursonii* is the preferred species; however, other species used are *Disa englerian, Disa robusta, Disa zombica, Habenaria clavate, Satyrium ambylosaccos, Satyrium buchanii,* etc. The tubers are cleaned, pounded in a mortar and cooked preferably with a locally produced "baking powder" called "Chidulo". If Chidulo is not available, sodium bicarbonate can be used in its place. In a few minutes, a "cake" mixture is produced, which is poured into a container and left to cool and solidify. To finish, the "cake" is cut into small pieces and cooked with groundnut sauce or tomatoes.

(Source of Photographs: Internet)

Fig. 2. 3. Chikanda, a popular dish in Zambia

Olatshe: It is a popular Bhutan dish, part of the local diet. The preferred orchid for this dish is *Cymbidium hookerianum*. The flowers (open or not) are removed from the flower stalk, then washed and boiled in water until soft. The orchid flowers add bitterness and the additional spices are added to offset that bitterness.After removing the water; a mixture of spices, melted cheese and salt are added. Five minutes cooking, the dish is ready. Olatshe can be served with rice, noodles or simply used as a dip.


(Source of Photographs: Internet)

Fig.2.3. Preparation of Chinaka

Olachoto

It is another Bhutan delicacy which uses *Cymbidium* flowers.Cut into pieces boiled, strained (optional) and cooked with meat (optional), chilli& cheese or stir-fried as well.



(Source of photographs: Internet)

Fig. 2.4. Preparation of Bhutanese traditional dish Olachoto

Dendrobium as an edible orchid:

The genus *Dendrobium* is famous in the US as food-orchid. *Dendrobium* hybrid (bigibbum type) flowers are sold inthe US as edible decorations for food. Mature canes of many "soft-cane" *Dendrobiums* are being stir fried in many Asian countries, also being used for making sauces in Japan and Singapore. In Thailand, *Dendrobium* flowers are served by dipped in butter and deep fried, while many Europeans garnish desserts and cakes by using Dendrobium flowers. The pseudo-stems of*Dendrobium kingianum* have been used as food by the aborigines in Australia since long time.

Dendrobium chrysotoxum flowers and *Dendrobium cathenatum* canes are dried and consumed as tea. *Dendrobium longicornu* flowers are pickled by the "Tamang" community people of Nepal. In Hawaii, locals use orchids to prepare salad dishes, sugar coated candies, and main dishes orchids cooked with scallops.The fragrant leaves of *Dendrobium salaccense* are used as a condiment for rice in Malaysia.In China many *Dendrobium* species are used to prepare healing teas. *Dendrobium cathenatum* canes are boiled for tea to regain strength after sex or illness.

(Source of photographs: Internet)

Fig.2.5. *Dendrobium chrysanthum* use as herbal tea

Other Miscellaneous Uses:

In China, Orchid Wine is popular and has been noticed in the International Wine Exhibition in Shanghai, 2016 and it is allegedly looks like dark coffee. The

Brazilians employ the seed capsules of *Leptotes bicolor* to flavor ice cream and other species of orchids are valued locally throughout the tropics as condiments. *Anoectochilus* leaves are used as vegetables in Indonesia and Malaysia.

A tea known as **"Bourbon tea"**, was used 200 years ago as a sedative. It was made out of an infusion of certain fragrant orchids. In Mauritius and Isle de Reunion, off the coast of Africa the fragrant orchid *Jumellea fragrans* is used to prepare the **"faham tea"**.

In Nepal, pseudobulb of *Coelogyne ovalis* and tuber of the *Peristylus constrictus* are eaten to reduce thirst by countryside people(Bhakta B Raskoti, The Orchids of Nepal).Tender leaves of *Cypripedium cordigerum* are cooked as vegetable, young leaves and shoots of *Dactylorhiza hatagirea* are eaten as a vegetable.Ethnic community of Chepangs eat boiled roots of *Epipactis royleana* or *Habenaria intermedia*, the leaves of the *Habenaria* are also cooked as vegetable. Villagers in Jumla district of Nepal boil the pseudobulbs of *Satyrium nepalensis* or eat the tender leaves as vegetable.

In India, where the tubers of *Eulophia,Orchis*, and *Satyrium* may all be used as salep, it is used like sago and arrowroot and is prepared from a large variety of species.

Jumellea Frangrans

Faham Tea

Cypripedium cordigerum (Tender leaves used as vegetable)

Satyrium nepalensis (Pseudobulbs &leaves are used as vegetables)

Peristylus constrictus (Edible part:Tubers)

Dactylorhiza hatagirea (young leaves and shoots of are eaten as a vegetable)

(Source of photographs: Internet)

Fig.2.6.Other edible orchids and their uses

3

PHYTOCHEMICALS IN ORCHIDS

Orchids, like other plants, produce a large number of phytochemicals. Only a few of them have been investigated for their biological function, others are still unknown. Orchid phytochemicals are generally categorized as alkaloids, flavonoids, carotenoids, anthocyanins and sterols. Among them alkaloids and flavonoids are most important for their biological properties. Studies of orchid alkaloids date back to 1892, when E. de Wildeman had begun investigation of orchid alkaloids in some European orchid species and identified 104 species in 78 genera for medicinal use.

The first alkaloid isolated from orchid was dendrobine in the year 1932 from a Chinese drug 'Chin-Shi-Hu' prepared from *Dendrobium nobile*(Bhattacharjee SK., 2006).Among orchids, Dendrobium is the leading genus for phytochemical content. Zhang *et al*. reviewed 100 compounds from 42 Dendrobium species, including 32 alkaloids, 6 coumarins, 15 bibenzyls, 4 fluorenones, 22 phenanthrenes and 7 sesquiterpenoids (Zhang HJ *et al*., 2003). Williams together with Harborne conducted a major survey of leaf flavonoids at the Plant Science Laboratories of the University of Reading in UK. They surveyed 142 species in 75 genera and found that the most common constituents were flavone C-glycoside and flavonols. (Williams CA., 1979).Dendrobium species are known to produce a variety of secondary metabolites such as phenanthrenes, bibenzyls, fluorenones and sesquiterpenes, and alkaloids and are responsible for their wide variety of medicinal properties.Last

three decades, additional studies on Dendrobium orchids have been carried out and a number of phenanthrenes compounds isolated as dihydrophenanthrene, ephemeranthoquionone, shihunidine, shihunine, dendrophenol, moscatilin, moscatin, moscatilin, denfigenin, defuscin, amoenumin, moscatilin, crepaditin, rotundatin, cumulatin, and gigantol (Li Y *et al*., 2008).

Various other phytochemicals has been reported from orchid species. 2, 6-Dimethoxy-1, 4-benzoquinone which is reported to have allergic reaction has been isolated from *Cymbidium sp*.(Hausen BM *et al*., 1984). Calanthoside, which showed an activating effect on skin blood flow has been isolated from *Calanthe discolor* and *Calanthe liukiuensis* (Yoshikawa M *et al*., 1998). Habenariol has been isolated from *Habenaria repens* which inhibits the lipid peroxidation of human low density lipoprotein. (Johnson MK *et al*., 1999). Scopoletin and scoparone which exhibit invitro ant-platelet aggregation activity has been isolated from *Dendrobium densiflorum* (Fan C *et al*., 2001).Gastrol which is reported to have relaxant effects on smooth muscle preparations of guinea pig ileum has been isolated from the rhizomes of *Gastrodia elata* (Hayashi J *et al*., 2002).Nidemin and 9,19-Cyclolanosta-24,24-dimethyl-25-en-3-yl-trans-p-hydroxycinnamate has been isolated from *Scaphyglottis livida* and *Nidema boothi*. (Estrada S *et al*., 2002). Cirrhopetalanthrin which has shown cytotoxicity against human colon cancer (HCT-8), human hepatoma (Bel7402), human stomach cancer (BGC-823) human lung adenocarcinoma (A549), human breast cancer (MCF-7) and human ovarian cancer (A2780) cell lines is isolated from *Cremastraappendiculata* (Xia WB *et al*., 2005). Compounds with anti tumor activities have also been isolated from *Bulbophyllum kwangtungense*.(Wu B *et al*., 2006). Structure of cymbidine A, a monomeric peptidoglycan-related compound with hypotensive and diuretic activities, isolated from a higher plant, *Cymbidium goeringii* (Orchidaceae). (Chemical Pharmaceutic Bulletin 55: 780-783)and Cyclobalanone and 5-lanosta-24,24-dimethyl-9(11),25-dien-3-ol which produces dose dependent antinociceptive and anti-inflammatory effect from *Scaphyglottislivida* has also been isolated (Déciga-Campos *M et al*., 2007).Kinsenoside with significant antihepatotoxic activity has been isolated from *Anoectochilus formosanus* (Wu JB *et al*., 2007).

Table 3.1. Secondary Metabolites isolated from Orchids

S.No.	Source	Compound(s)	Secondary Metabolite	Mechanism of action	References
1	*Anoectochilus roxburghii*	kaempferol-3-*O*-β-D-[glucopyranoside; Kaempferol-7 β-D-[glucopyranoside; Isorhamnetin-3- β-D-[rutinoside]; 8-C-p-hydroxybenzylquercetin; Quercetin-7-*O*- β -D-[6''-*O*-(*trans*feruloyl)]-glucopyranoside; 5-Hydroxy-3',4',7-trimethoxyflavonol-3-β-D-[rutinoside]; Isorhamnetin-3-*O* β-D-[glucopyranoside; Isorhamnetin-7-*O*-β-D-glucopyranoside	Flavonoid	Antioxidative activity	24,28
2	*Bulbophyllum kwangtungense*	Cumulatin & Densiflorol A	Bibenzyl derivative	Anti tumor activity	60
3	*Cymbidium goeringii*	Gigantol	Bibenzyl derivative	Inhibits the LPS-induced iNOS and COX-2 expression	56
4	*Cypripedium macranthos*	Chrysin	Flavonoid	Antifungal activity	52
5	*Dendrobium amoneum*	Isoamoenylin	Bibenzyl derivative	Antioxidative & antibacterial activity	54
6	*Dendrobium chrysotoxum*	Erianin	Bibenzyl derivative	Antiangiogenic activity	20
7	*Dendrobium densiflorum*	Homoeriodictyol	Flavonoid	Anti-platelet aggregation activity	15

S.No.	Source	Compound(s)	Secondary Metabolite	Mechanism of action	References
8	*Dendrobium loddigesii*	Shihunidine, Shihunine	Alkaloid	Inhibits Na+-K+ ATPase activity of rat kidney	37
		Moscatilin, Moscatilin diacetato	Bibenzyl derivative	Inhibition of rabbit Platelets aggregation induced by arachidonic acid and collagen. Moscatilin suppresses mutagenicity and Moscatilin diacetato acts as anticancer agent.	26
9	*Dendrobium moniliforme*	Dendromoniliside A; Dendromoniliside B & Dendromoniliside C	Terpenoid	Stimulation of proliferation of B cells and inhibition of proliferation of T cells	67
		Alkyl ferulates	Bibenzyl derivative	Antioxidative activity	39
		Dendrobine	Alkaloid	Antipyretic action	9
10	*Dendrobium nobile*	Dendrobine	Alkaloid	Reduces the β-alanine and taurine induced depolarizations of primary afferent terminals and have little effect upon GABA- and glycine induced depolarizations.	36
		Dendroside A;Dendroside D; Dendroside E; Dendroside F; Dendroside G & Dendronobiloside A	Terpenoid	Proliferation of murineT and B lymphocytes; Immunomodulator activity	62,68
		Nobilin D, Nobilin E	Bibenzyl derivative	Antioxidative activity	66

S.No.	Source	Compound(s)	Secondary Metabolite	Mechanism of action	References
11	*Ephemerantha lonchophylla*	Lonchophylloid A & Lonchophylloid B	Terpenoid	Sensitization of cells that express multi drug resistance phenotype to the toxicity of anticancer drug doxorubicin	42
		3-Methylgigantol	Bibenzyl derivative	Anti-aggregation activity	8
12	*Gastrodia elata*	N6-(4-hydroxybenzyl) adenine riboside	Alkaloid	Prevents PC12 cell apoptosis induced by serum deprivation through suppression of JNK pathway	27
13	*Nidema boothi*	Aloifol	Bibenzyl derivative	Spasmolytic activity	25
14	*Scaphyglottis livida*	Gignatol	Bibenzyl derivative	Inhibits the LPS-induced iNOS and COX-2 expression	12
15	*Spiranthes australis*	(2S)-5,2',6'-trihydroxy-6-lavandulyl-4"-(β, β-dimethylallyl)-2",2"-dimethylpyrano- [5",6": 7,8]-flavanone	Flavanoid	Antitumor activity	46

Table 3.2. Phenanthrenes isolated from Orchids

S.no	Source	Compound(s)	Mechanism of action.	Reference(s)
1	*Agrostophyllum brevipes*	Callosinin		48
		Imbricatin; Flaccidin		51
2	*Agrostophyllum callosum*	Callosuminin; Agrostophyllin; Callosumin		51
3	*Bletilla formosana*	4-Methoxy-9,10-dihydrophenanthrene- 1,2,7-triol; 1-(4-Hydroxybenzyl)-4,7-dimethoxy-9,10-dihydro phenanthrene-2-ol; 1,3,6-tri(4Hydroxybenzyl)-4-methoxydihydro phenanthrene-2,7-diol		
4	*Bletilla striata*	3,3'-Dihydroxy-2',6'-bis(p-hydroxybenzyl)-5-methoxybibenzyl; 3',5-Dihydroxy-2-(p-hydroxy benzyl)-3-Methoxy bibenzyl; 1-(p-Hydroxy benzyl)-4,8-dimethoxy phenanthrene-2,7-diol; 2,7-Dihydroxy-1,3-bis (phydroxybenzyl)-4methoxy -9,10-dihydrophenanthrene; Blestriarene B; Blestriarene C;Blestrianol A	inhibitory effect of tubulin polymerization	54
5	*Bulbophyllum kwangtungense*	Plicatol B	Anti tumor activity	74
6	*Bulbophyllum Odoratissimum*	3,7- Dihydroxy- 2,4,6-trimethoxyphenanthrene	cytotoxicity activity	12
7	*Coelogyne cristata*	Coeloginanthridin, Coeloginanthrin	Activities of phytoalexins and endogenous plant growth regulators	50
8	*Coelogyne flaccida*	Callosinin		48
9	*Coelogyne ochracea*	Ochrone A		4
10	*Cremastra appendiculata*	Cirrhopetalanthin; 2,7,2',7',2'-Pentahydroxy-4,4',4'',7''-tetramethoxy-1,8,1',1''-triphenanthrene	Cytotoxic activity	76

S.no	Source	Compound(s)	Mechanism of action.	Reference(s)
11	*Cypripedium macranthos*	Lusianthrin	Anti-fungal activity	65
12	*Dendrobium chrysotoxum*	Dendrochrysanene	Anti-inflammatory activity	77
13	*Dendrobium loddigessi*	Moscatin	Inhibition of rabbit Platelets aggregation induced by arachidonic acid and collagen; Anticancerous	32
14	*Dendrobium moniliforme*	Moniliformin; 2,6-Dimethoxy-1,4,5,8-Phenanthradiquinone; 7- Hydroxy-5,6-dimethoxy-1,4-phenanthrenequinone	Antiinflammatory activity; Inhibition of VHR dual-specificity protein tyrosine phosphatase (DSPTPase) activity	3
15	*Ephemerantha lonchophylla*	Ephemeranthone; Erianthridin	Antioxidative activity; Anti aggregation activity	10
16	*Epidendrum rigidum*	2,3-Dimethoxy-9,10-dihydrophenathrene- 4,7-diol; 3,4,9-Trimethoxyphenanthrene-2,5-diol	Inhibited radicle growth of *Amaranthus hypochondriacus*	
17	*Gymnadenia conopsea*	Gymconopin A; Gymconopin B; Gymconopin D; Dihydroxy-2,6-bis(4-hydroxybenzyl)-5-methoxybibenzyl	Inhibition of antigen-induced degranulation	52
18	*Maxillaria densa*	2,5-Dihydroxy-3, 4-Dimethoxyphenanthrene; 9,10-Dihydro-2,5-dihydroxy-3, 4- Dimethoxyphenanthrene; Nudol; Gymnopusin; Erianthridin; Fimbriol A	spasmolytic activity; inhibition of the tone and amplitude of the spontaneous contractions of the rat ileum; antiinflammatory activity	18
19	*Nidema boothii*	Lusianthridin		51

S.no	Source	Compound(s)	Mechanism of action.	Reference(s)
20	*Pholidota yunnanensis*	2,4,7-Trihydroxy-9,10-Dihydrophenanthrene; 3,7-dihydroxy-2,4,8-Trimethoxyphenanthrene; Coelonin; 3,7-Dihydroxy-2,4-dimethoxyphenanthrene	antioxidant activity	26

Habenaria intermedia

Malaxis muscifera

Gymnodenia orchidis

Dendrobium nobile

Habenaria edgeworthii

Flickingeria fugax

Fig.3.1. Medicinal Orchids

4

ORCHID PRODUCTS USED AS NUTRACEUTICALS/HERBAL DRUGS

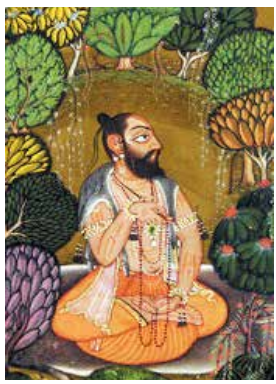
Nutraceutical is a food that provides health benefits in addition to basic nutritional value. This term was coined by Stephen L. De Felice in 1989 by combining two words, nutrition and pharmaceutical.A Nutraceutical is any substance that may be food or part of food, which provides medical or health benefits, including the prevention and treatment of disease. Such products may range from isolated nutrients, dietary supplements, herbal products and processed foods such as cereals, soups and beverages (Prasad et al, 2010). Although the concept of nutraceuticals is gaining more popularity more recently, its roots can be traced to the ancient Indian system of medicine, 'Ayurveda'.

The concept of 'Aajasrik Rasayana' (general rejuvenation) deals with food products that can be consumed daily for improving quality of life by offering protection from external and internal stress. The commonly used nutraceuticals in Ayurveda include Chyavanprasha (for general health and prevention of respiratory disorders) that comprises of orchid species as its vital constituents, Brahma Rasayana (for protection from mental stress), Phala Ghrita (for reproductive health), Arjuna Ksheerapaka and Rasona Ksheerapaka (for cardioprotection), Shatavari Ghrita (for general health of women during various physiological states).

Chyawanprash

It is a very popular herbal product in India.According to Ayurvedic Pharmacopeial Index (API), Chyawanprash is a polyherbal formulation with a semisolid and sticky in nature. It is a chocolate brown coloured having sweet taste

with non-specific pleasant odour. (Ayurvedic Pharmacopeia., 2007). In Ayurvedic texts, Chyawanprash is classified under the group of Rasayana, where the main purpose is to maintain the body's integrity for delaying the ageing process, enhance longevity and improves digestion (Parle M., 2003).



Maharshi Chawyvan (Founder)

Chyawanprash

(Source of Picture: Internet)

Fig.4.1 Chyawanprash – Poly herbal paste

Chyawanprash is a polyherbal formulation comprising of more than 50 medicinal plants ingredients (Parle M., 2011). Among these, four (4) of them are orchids namely **Jivak (*Malaxis muscifrea*), Rishbhaka(*Malaxis acuminata*), Riddhi (*Habenaria intermedia*) and Vriddhi (*Habernaria edgeworthii*)**.All these ingredients have been well scientifically validated individually for their health care benefits (Rastogi S *et al.*, 2004).It contains high percentage of Vitamin C, many essential fatty acids, high bioflavonoids, carotenoids and a large amount of bioactive phytochemicals that acts as an immune modulator. It is the main source for the treatment of the respiratory tract system such as bronchial spasm, cough, asthmatic breathing, and tuberculosis and is also useful as immunomodulator and memory enhancer (Ojha J K., 1975).It is an antioxidant, blood purifier, a tonic for rejuvenation, a mild laxative, an adaptogenic, anti-aging and anti-stress tonic for old age people. It has a special effect for relieving cough and asthma, enhancing fertility, keeping menstruation regular and strengthening the immune system. The ingredients of Chyawanprash today are unlike to the older one.

Crepidium acuminatum
(Syn: *Malaxis acuminata*)

Habenaria intermedia

Malaxis muscifera

Platanthera edgeworthii
(Syn: *Habernaria edgeworthii*)

[Source of Photographs: Internet (1st& 2nd – Internet, 3rd – Chauhan et al, 2008, 4th – Dr. Balkar Singh, 2012)]

Fig. 4.1. Chyawanprash Orchids

Shi-Hu

Shi-Hu is a commonly used preparation in Chinese medicine(Chinese pharmacopoeia), which is derived from different species of *Dendrobium* but the widely used specie is *Dendrobium nobile*. It is commonly used for the treatment for kidney disorders, lung diseases, stomach diseases, low grade fever, red tongue, dry mouth, swelling, hyperglycaemia, atrophic gastritis and diabetes (Bulpitt CJ *et*

(Source of Photographs: Internet)

Fig. 4.1 Chyawanprash of popular Indian brands Patanjali, Dabur & Baidyanath

al., 1977). It is also supposed to impart longevity, promote the secretion of acid in the stomach, and serve as an aphrodisiac. The extract prepared from stems is used to alleviate thirst, calm restlessness, accelerate convalescence, and reduce dryness of the mouth. Other properties are; stomachic, pectoral, antiphlogistic, analgesic, and antipyretic medication. It is also used to treat rheumatism, excessive perspiration, weakness brought about by thirst, impotence, entropion, leucorrhea, and menstrual pain.Alkaloids isolated from the *Dendrobium* species, such as dendrobine, are a weak antipyretic and analgesic and these extracts may increase immunity, decrease the oxidant stress in aging and have anti-cancer activity. In case of Diabetes, it reduces the level of blood glucose, promotes the secretion of insulin and increase the insulin sensitivity (Shi H *et al.*, 2004).

Tian-Ma

As per Chinese Materia Medica, Tian- Ma herbal preparation prepared from the tubers of *Gastrodia elata,*Which isused for curing headaches, dizziness, blackouts, numbness of the limbs,hemiplegia, epilepsy, limb cramps, spasms, migraine, expulsionof poisonous effluvia, rheumatism, vertigo, neuralgia,facial paralysis, dysphrasia, infantile convulsions, lumbago,fever, hypertension and other nervous afflictions (Kong JM *et al.*, 2003). Gastrodin is the main effective compound of this preparation (Zhang HJ *et al.*, 2003) and has anti-delirium and anti-convulsive effects. It may lower blood pressure and protect the central nervous system by modulating the expression of excitatory amino acids and the

nitric oxide system (Sun XF *et al.*, 2004). It is also reported to increase glutamine, reduce gamma amino butyric acid, increase asparagine and act as a vasodilator (Bulpitt CJ *et al.*, 2007).

Bai-Ji

Tubers of *Bletilla striata* are most commonly used for the preparation of this Chinese traditional medicine.It is used for the treatment of tuberculosis, hemoptysis, gastric, duodenal ulcers, as well as bleeding and cracked skin of feet & hands. In other countries like China, Mongolia and Japan, used for purification of blood,strengthening & consolidation of lungs, treatment of pus, boils, abscesses, malignant swellings, ulcers and breast cancer. (Kong JM *et al.*, 2003). Additionally it is also used for treatment of flatulence, dyspepsia, dysentery, fever, malignant ulcers, gastrointestinal disorders, hemorrhoids, anthrax, malaria, eye diseases, tinea, ringworm, tumors, necrosis, silicosis, traumatic injuries, coughs, chest pain,gastrorrhagia, enterorrhagia,internal bleeding, inflammation, and chopped skin.

Table. 4.1. Active ingredients found in the traditional Chinese drugs.

S. No.	Chinese drug	Orchid Species	Active ingredients	Uses
1	Shi-Hu	*Dendrobium nobile*	Dendrobine, Nobilonine, Dendrine, Dendroxime	Swelling Impotence Menstrual pain Hyperglycaemia
2	Tian-Ma	*Gastrodia elata*	Gastrodin Vanillin [extract of fungus-Armillaria mellea]	Headache Dizziness Epilepsy Cramps Migraine Hemiplegia Tinnitus
3	Bai-Ji	*Bletilla striata*	Batatasin III Blespirol Blestriarine A-C Blestrin A-D	Bleedings Tuberculosis Ulcers

Table.4.2. List of some orchid dietary supplements and drugs

S. No.	Species Used	Plant Part used	Product Name	Product Image	Uses	Referances
1	*Cymbidium goeringii* Rchb.f.	Whole plant extract	Dynamic Formulas Formula-1		As dietary supplement	85
2	*Cypripedium pubescens*	Rhizome/Root extract	OMIDA® homöopathische Schlafchügeli für Kinder		It is for children and infants, suffering from insomnia, Night walking	86
3	*Dendrobium chrysotoxum*	Stem	Shi hu ye guang wan		Herbal supplement for cataracts, conjunctivitis, glaucoma and hypertension.	87
		Stem	Ning Sou Wan		Resolves Phlegm, Alleviates Cough. Lung heat, dryness, chronic cough.	88

S. No.	Species Used	Plant Part used	Product Name	Product Image	Uses	Referances
4	*Dendrobium nobile*	Stem	Super Freak® Sf		As dietary supplement.	89
		Whole plant extract	Ritual, Icy Blue Freeze		As dietary supplement.	90
		Stem	Shi Hu Ming Mu Jin Shi Wan		Used for Pseudomyopia, red eyes and centricity keratitis, cataract, glaucoma.	91
		whole plant extract	Kunbao Wan		Menopausal syndrome, Nourishing liver and kidney function, calm and soothe the nerves, insomnia, Joint pain	92

S. No.	Species Used	Plant Part used	Product Name	Product Image	Uses	Referances
5	*Gastrodia elata*	Rhizome, Tubers	Gastrodia (Tian Ma) Kopfschmerzen Kapsel		Epilepsy, tetanus, hemiplegia, neurasthenia, convulsion in children, cervical spondylosis, Meniere's syndrome etc	93
		Rhizome, Tubers	Tian Ma Shou Wu Pian		Herbal Supplement capsules.	94
6	*Habenaria intermedia* D.Don	Rhizome, Tubers	Ayurvedic formulations: Dasamularishta		Antioxidant, antimicrobial and anti-inflammatory properties. Anti-arthiretic and analgesic.	95
7	*Malaxis acuminata* D. Don	Pseudo-bulb, Roots	Valiya narayana thailam		In Rheumetoid arthiritis, Body Pain, Inflammations etc.	96

S. No.	Species Used	Plant Part used	Product Name	Product Image	Uses	Referances
8	*Pleione bulbocodioides* (Franch.) Rolfe	Pseudo- bulb	Plaster of hypertension		cardiovascular and cerebrovascular diseases. hypertension, hyperlipemia.	97
9	*Vanda tessellata* (Roxb.) Hook. ex G.Don	dried root	Auromère Ayurveda Massage Oil		Massage oil.	98

5

ORCHIDS AS COSMETICS

Orchids are widely used as cosmetics in European and South-Asian countries for different purposes due to its antioxidants, moisturizing and emollient constituents.

Moisturizing activity

Orchid use in medicine was widely described a long time ago in the *Chinese Materia Medica*. Mucilaginous content of orchid makes it ideal as a moisturizing and emollient agent, due to the large number of links formed by hydrogen bonding, thus maintaining optimal water levels of the stratum corneum. Orchids are now being touted for moisturizing, fighting free radicals, increasing skin immunity and reducing the appearance of fine lines.

Anti-oxidant activity

The flowers of orchids are used as antioxidants and soothing agents, due to the presence of anthocyanin pigment. Scavenging activity of free radicals also leads to its inclusion in hair products, to protect hair from hair fall.Therefore the Orchid is useful in the formulation of antioxidant and soothing cosmetic products. The recommended dose ranges from 0.5-5%. They are also used in frequent-use shampoos, after-sun screen products and in treatment products for sensitive skin.

In Japan, the extract prepared from different parts of *Vanda roxburghii* is used as oestrogenic agent for the treatment of skin aging (Japanese Patent Application JP2006-257056). Extracts prepared from *Vanda caerulea* have skin hydrating properties, which improves the water transport within the epidermis. The inventors have shown that the extract of *Vanda caerulea* increases the expression of two biological markers involved in the mechanisms of skin hydration, aquaporin 3 (AQP3) and the LEKTI protein (lympho-epithelial Kazal type related inhibitor).

Table.5.1. List of some popular orchid Cosmetics & Perfumery

S.No.	Botanical name	Parts used	Product Name and image		Uses	References
1	*Bletilla striata*	Root extract	Herborist T'ai Chi Weisse Maske		As Cleansing face mask & Moisturisor	99
2	*Brassocattleya marcella*	Leaf/ Stem Extract	Orchidée Impériale		Bleaching, emollient, skin-conditioning and skin-protecting component of cosmetic products.	100
3	*Calanthe discolor*	Whole plant extract	Mosbeau White Evolution Platinum		As skin conditioning agent	101
4	*Cycnoches cooperi*	Flower; Leaf extract	Lierac Paris Premium CRÈME		Antioxidant and emollient component of cosmetic products.	102
5	*Cymbidium grandiflorum*	Flower; Root	Extrême Lift Crème Anti-Rides à l'Orchidée		Skin-conditioning component of cosmetic products.	103

S.No.	Botanical name	Parts used	Product Name and image		Uses	References
6	*Cymbidiumgreat flower* Marie Laurencin	Flower extract	Sapò Orchidea Olio Doccia Corpo		Hair-conditioning component of cosmetic products	104
7	*Cymbidium kanran*	Whole plant extract	Innisfree Orchid Day Cream		Antioxidant, astringent, emollient and skin-conditioning component of cosmetic products.	105
8	*Cypripedium pubescens*	Root extract	La Prairie Switzerland Anti-Aging Stress Cream		Antioxidant, astringent, emollient and skin-conditioning component of cosmetic products.	106
9	*Dendrobium chrysotoxum*	Stem extract	Orchidée Impériale Eye and Lip Cream		Anti-aging agent	107
10	*Dendrobium nobile*	whole plant extract	MISA GEUMSUL SKIN TONER		Skin conditioning component of cosmetic products.	108

S.No.	Botanical name	Parts used	Product Name and image		Uses	References
11	*Dendrobium phalaenopsis*	Flower extract	Alissi Bronte Serenity Orchid Cream		Skin-conditioning component of cosmetic products.	109
12	*Gastrodia elata*	Rhizome extract	TianDe® Bio Rehab Shampoo Haarwachstum-Aktivator		Hair growth activator shampoo with ginger rhizome and gastrodia rhizome as its active components.	110
13	*Neofinetia falcata*	Callus Culture Extract	BIOXIDEA MIRACLE48™ Excellence Diamond		Skin-conditioning component of cosmetic products	111
14	*Orchis maculata*	Flower/Leaf/ Stem Extract	SO'BIO etic® Divine Jeunesse Soin intense fermeté		Masking and perfuming component of cosmetic products.	112

S.No.	Botanical name	Parts used	Product Name and image		Uses	References
15	*Orchis mascula*	Root/Flower/ whole plant Extract	Herbal Essences Hello Hydration Moisturising Shampoo		Hair-conditioning and skin-conditioning component of cosmetic products	113
16	*Orchis morio L.*	Flower extract	EVER SINCE ELIXIR - Dead Sea Salt Scrub		Soothing (helps lightening discomfort of the skin or of the scalp) component of cosmetic products.	114
17	*Paphiopedilum Maudiae.*	Flower Extract	Organic Orchid & Jojoba Hair Conditioner		Skin-conditioning component of cosmetic products.	115
18	*Phalaenopsis amabilis*	Whole plant Extract	Mary Cohr Paris Lait Démaquillant Douceur		Humectant component of cosmetic products.	116

S.No.	Botanical name	Parts used	Product Name and image		Uses	References
19	*Phalaenopsis lobbii*	Whole plant Extract	Manhattan Supersize Waterproof Mascara		Bleaching (lightens the shade of hair or skin) component of cosmetic products.	117
20	*Vanda coerulea* Griff. ex Lindl.	Whole plant Extract	Gesichtsöl Huile Orchidée Bleue - feuchtigkeitsarme Haut		Antioxidant component of cosmetic products.	118

6

FRAGRANT ORCHIDS

Orchid flowers exhibit high ornamental value due to variety in shapes, colours and fragrance. Even though, the economic importance of orchids lie mainly in their ornamental, a little is known about other uses like ethnic food, fragrance and flavour industry, dry flowers, jewellery and minor uses.

Many orchids are known for their wonderful fragrance and it is believed that more than 75% orchids are fragrant species. The orchid fragrance is due to the presence of volatile aromatic oils produced in minor quantities in floral parts like sepals, petals, calluses, basal spurs to petioles. Floral scent emission shows diurnal rhythm and is controlled by internal biological clock. Some scent species emitfragrance at morning while others develop fragrance at late noon, evening or night. Orchid fragrance is a chemical messenger between the plant and its pollinator. Night pollinated flowers have peak emissions at night while the situation is reversed in day pollinated flowers.

Orchid flowers have specialized scent glands called osmophores that ooze liquid scent, which evaporates on contact with the air.Orchid fragrance ranges from warm, sweet & highly diffusive notes to stinky and offensive odour. The pleasant scented orchid flowers are often compared to fragrance of other flowers like rose, hyacinth, jasmine, freesia, lily, narcissus, sweet pea or easily identified scents like lemon, chocolate, vanilla, orange, coconut, cardamom, musk, honey,

mint etc. Now-a-days fragrance in orchids is achieving a new importance as this characteristic adds to the aesthetic appeal of flower spikes besides determining the consumer choice as well as market price.

Zygopetalums are highly fragrant orchids and their fragrance can often fill an entire room.*Zygopetallum intermedium*is one of the beautiful species that strongly smell of hyacniths. They are easy to grow terrestrial orchids, flowering in winters, can be grown indoors or in greenhouse.*Coelogyne ochracea*is a popular spring flowering species from India that has a beautiful sweet fragrance aswell as very pretty white and yellow flowers.Coelogyne comprises about 196 species (World Checklist of Monocotyledons, 2009). Most of the species are easy to grow and produce long-lasting, fragrant flowers.*Aerides multiflora*

Extraction of volatile oils from orchids:

The extraction methods utilised to capture aromatics from orchids are Hydro & Steam distillation, Maceration & Supercritical fluid extraction and Headspace technology.

Table.6.1. List of various fragrant orchid products

S.No.	Name	Economic parts	Brand name	Product image	Uses	Referances
1	*Dendrobium moniliforme*	Leaf/ Stem, Callus Culture Extract	Osafume		Perfume	119
2	*Red Cattleleya*	floral extract	Red Cattleleya Perfume		Perfume	120
3	*Phalaenopsis javanica*	floral extract	Javanica Perfume		Scent	121

S.No.	Name	Economic parts	Brand name	Product image	Uses	Referances
4	*Ludisia discolour*	Jewel orchid oil	Joya-Designer candles		Scent candles	
5	*Dendrobium species*	Flowers, leaves, seeds and roots.	Potpourri		Essential oils	

Table.6.2. List of Fragrant orchids in India

S.No.	Name	Time of Flowering	Occurrences	Altitude (meters)	Habitat
	Acampe longifolia	April to May	Tropical Sikkim and Upper Assam	500-1200	Epiphytic
	Acampe papillosa	Aug. to Sept.	Khasi Hills, Assam and Eastern Himalaya	500-1500	Epiphytic
	Acampe rigidia	April to May	Tropical Sikkim and Upper Assam	500-1000	Epiphytic
	Acanthephippium striatum	July to Aug.	Khashi Hills, Sikkim, Upper Assam and Chota Nagpur	300-1000	Terrestrial lithophytic or epiphytic
	Acanthehippium sylhetense	April to May	Khashi Hills	700-1300	Terrestrial lithophytic or epiphytic
	Aerides crassifolium	April to May	Assam	800	Mostly epiphytes
	Aerides fieldingii	May to June	Khasia & Jaintia Hills and Sikkim	1000-2300	Mostly epiphytes

S.No.	Name	Time of Flowering	Occurrences	Altitude (meters)	Habitat
	Aerides maculosum	June-July	Orissa, Chota Nagpur, Western ghats, Ramandurg	1200	Mostly epiphytes
	Aerides multiflorum	June to July	Assam, Meghalaya, tropical forest of Eastern Himalayan range, outer range of Western Himalaya and Orissa, Andaman and Nicobar islands, Chota Nagpur, North Bengal, Vizagapatam, Rumpa Hills.	700	Mostly epiphytes
	Aerides odoratum	June to July	Sikkim, Khashi Hills, West Bengal, Orissa, Chota Nagpur, DehraDun, Garhwal and Kumaon hills	1000	Mostly epiphytes
	Aerides ringens	March to May	Nilgiri Hills, Andaman islands		Mostly epiphytes
	Arachnis cathcartii	March to April.	Sikkim	1000-1500	Terrestrial, lithophytic or epiphytic
	Bulbophyllum hirtum	Oct. to Jan.	Khasia Hills and Sikkim	1000-2000	Epiphytic
	Bulbophyllum leopardinum	Oct. to Nov.	Meghalaya	2000	Epiphytic
	Bulbophyllum leptanthum	July	Sikkim and Khasia Hills	1000-1700	Epiphytic
	Bulbophyllum odoratissimum	July	Sikkim, Meghalaya	1300-2000	Epiphytic
	Calanthe angusta	April	Meghalaya, Manipur, North Bengal, Duars	300-1000	Terrestrial
	Calanthe griffithii	April to May	Sikkim	1300-2000	Terrestrial

S.No.	Name	Time of Flowering	Occurrences	Altitude (meters)	Habitat
	Camatotis rostrata	June to July	Khasia Hills	2000-3000	Terrestrial
	Coelogyne barbata	October to November	Meghalaya, Nagaland and Manipur	1300-1700	Mostly Epiphytic
	Coelogyne corymbosa	April to May	Khasi Hills and Sikkim	2000-3000	Mostly Epiphytic
	Coelogyne cristata	March to April	Sikkim, Meghalaya and Kumaon hills	1700-2300	Mostly Epiphytic
	Coelogyne oculata	July	Sikkim	2000-2300	Mostly Epiphytic
	Coelogyne ochracea	May to June	Sikkim and Assam	1700-2000	Terrestrial or lithophytic
	Coelogyne viscosa	April to May	Meghalaya	800- 1000	Terrestrial or lithophytic
	Coelogyne longipes	May to June	Arunachal Pradesh, Nagaland, Meghalaya, Manipur and Sikkim	2000- 2300	Terrestrial or lithophytic
	Coelogyne ovalis	Oct. to Dec.	Sikkim and Meghalaya	1300	Mostly Epiphytic
	Corymborkis veratrifolia	March to May	Assam, Andaman and Nicobar islands	300-600	Terrestrial
	Cymbidium cyperifolium	November	Meghalaya, Nagaland, Manipur and Garhwal	1000 -2000	Terrestrial, lithophytic or epiphytic
	Cymbidium dayanum	March to April	Sikkim and Meghalaya	300 -1700	Terrestrial
	Cymbidium hookerianum	February	Sikkim	1700 -2500	Terrestrial
	Cymbidium iridiodes	Oct. to Nov.	Sikkim, Meghalaya and Kumaon	1300 -2000	Terrestrial
	Cymbidium munronianum	May	Sikkim and Darjeeling	500	Terrestrial
	Cymbidium simonsianum	August	Assam and North Bengal	400	Terrestrial

S.No.	Name	Time of Flowering	Occurrences	Altitude (meters)	Habitat
	Cyperorchis mastersii	Oct. to Nov.	Meghalaya and Manipur	500	Epiphyte
	Dendrobium amoenum	June	Sikkim, Meghalaya, Orissa, Kumaon and Garhwal hills.	1000	Epiphytic
	Dendrobium bellatum	Feb. to Apr	Himalayan ranges		Epiphytic
		May to June	Manipur, Sikkim , Meghalaya and Kumaon	1000 - 2000	Epiphytic
	Dendrobium cariniferum	May to June	Manipur	1800	Epiphytic
	Dendrobium chrysotoxum	April to May	Manipur, Sikkim, Assam and Meghalaya	400-1000	Epiphytic
	Dendrobium cretaceum	April	Assam, Meghalaya, Garhwal, Dehra Dun and Mussourie	400-800	Epiphytic
	Dendrobium crystallinum	April to June	Sikkim	1000 - 1700	Epiphytic
	Dendrobium densiflorum	April to May	Sikkim and Meghalaya	1300	Epiphytic
	Dendrobium falconeri	Feb. to May	Meghalaya and Manipur	800-1200	Epiphytic
	Dendrobium gibsonii	July to August	Assam, Sikkim, and Meghalaya	700 -1700	Epiphytic
	Dendrobium hookerianum	September	Assam, Sikkim, Meghalaya	1000- 2000	Epiphytic
	Dendrobium lindleyi Steud and *D.aggregatum*	March to May	Sikkim and Assam	1000-2000	Epiphytic
	Dendrobium longicornu	Sept. to Nov.	Sikkim, Meghalaya, Arunachal Pradesh and Nagaland	1400 - 2400	Epiphytic
	Dendrobium macrostachyum	June-August	Chota Nagpur, Orissa, West Coast and Western ghats	Upto 2300	Epiphytic

S.No.	Name	Time of Flowering	Occurrences	Altitude (meters)	Habitat
	Dendrobium microbulbon	December to Jan.	Western ghats, Karnataka, Nilgiri Hills, Annamalai		Epiphytic
	Dendrobium moschatum	May to July	Assam, Manipur, Sikkim and Meghalaya	1300	Epiphytic
	Dendrobium nobile	April to May	Assam, Manipur, Sikkim and Meghalaya	1000 -1700	Epiphytic
	Dendrobium ochreatum	February to April	Meghalaya	1000	Epiphytic
	Dendrobium palpebrae	April to May	Sikkim	1000-2000	Epiphytic
		March to May	Manipur, Sikkim, and Meghalaya	1500	Epiphytic
		February to April	Sikkim, Meghalaya, Arunachal Pradesh, Nagaland and Manipur	2200	Epiphytic
		February to March	Meghalaya	300-500.	Epiphytic
		February to April	Meghalaya and Assam	600-1000	Epiphytic
		May	Sikkim, Assam, Meghalaya and Manipur	1000	Epiphytic
		July to August	Meghalaya	1000- 1300	Epiphytic
		November	Sikkim and Meghalaya	1600- 2000	Epiphytic
		April to June.	Tropical valley of Sikkim	1000-2000	Epiphytic
		May	Tropical valley of Sikkim	1000-2000	Epiphytic
		Nov. to Dec.	Eastern Himalayan Range;	1000- 2000	Epiphytic

S.No.	Name	Time of Flowering	Occurrences	Altitude (meters)	Habitat
		April to July	Assam, Manipur and Meghalaya	500	Terrestrial
		May	Sikkim and Meghalaya	1300- 2600	Epiphytic
		March to April	Meghalaya	330-660	Epiphytic
		May	Sikkim, Assam, Meghalaya, Arunachal Pradesh and Nagaland,	400- 1300	Terrestrial
		July to August	Meghalaya and Sikkim.	2000 -3000	Terrestrial
		July to August	Sikkim	4000	Terrestrial orchids
		February to April.	Sikkim and Meghalaya	1300- 1700	Epiphytic
		June to August	Sikkim, Meghalaya and Manipur	700- 1300	Epiphytic
		May to August	Assam, Sikkim and Meghalaya	1600	Epiphytic
		March to April	Sikkim, Meghalaya and Manipur	1500- 2000	Terrestrial
		September	Meghalaya, Arunachal Pradesh, Nagaland and Manipur	400-800	Terrestrial
		April	Meghalaya	600-1000	Terrestrial
		March to April	Sikkim and Meghalaya.	1700 - 2000	Terrestrial
		May	Assam, Sikkim and Meghalaya	500-1000	Mostly epiphytic,
		July	Sikkim	3000 - 4000	Terrestrial
		Sept. to Nov.	Sikkim	2000- 3000	Terrestrial, lithophytic or epiphytic

S.No.	Name	Time of Flowering	Occurrences	Altitude (meters)	Habitat
		Oct. to Nov.	Assam	400-1000	Terrestrial, lithophytic or epiphytic
		Oct. to Nov.	Sikkim, Meghalaya, and Assam	1300 - 1700	Terrestrial, lithophytic or epiphytic
		Nov. to Dec.	Manipur, Sikkim and Meghalaya	1600 - 2000	Terrestrial, lithophytic or epiphytic
		Sept. to Oct.	Meghalaya andManipur.	2700- 3000	Terrestrial
		June to July	Sikkim and Meghalaya	1200 to 1700	Mostly epiphytic
		March to May	Assam	300-600	Epiphytic
		April to May	Assam	400-800	Terrestrial, lithophytic or epiphytic
		Sept - Nov	Sikkim	1200-1500	Terrestrial

Aerides multiflora

Acampe rigida

Dendrobium parishii

Dendrobium moschatum

Dendrobium primulinum

Rhynchostylis retusa

(source: Internet)

Fig. 6.3. Fragrant orchids

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