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Healing blooms: The medicinal power of orchids

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Abstract

Orchids, traditionally admired for their ornamental beauty, also possess significant medicinal properties. Rich in phytochemicals such as flavonoids, alkaloids, terpenoids, and polyphenols, orchids exhibit therapeutic effects including anti-cancer, anti-inflammatory, anti-microbial, and immune-regulatory actions. Historically used in Ayurvedic and Chinese medicine, they treat various ailments like hormonal disorders, wounds, respiratory issues, and infections. Additionally, orchids serve as bio-indicators of environmental health due to their sensitivity to ecological changes. However, Orchidaceae species are increasingly threatened by deforestation, habitat destruction, overharvesting, and climate change, compounded by their intricate dependence on pollinators and mycorrhizal fungi. Despite conservation efforts like in situ and ex situ strategies, more research is needed to ensure their preservation. The presence of unique phytochemicals in orchids offers promising avenues for novel drug development. Yet, limited pharmacological and toxicological data on their effects in humans underscore the urgent need for further scientific exploration and sustainable conservation of these valuable plants.

Keywords: Orchidaceae, medicinal phytochemicals, therapeutic applications, environmental bio-indicators, conservation strategies

1. Introduction

Orchids have been used for many purposes apart from their aesthetic properties. A plethora of orchids have also been used for their medicinal values including anti-cancer, anti-microbial, immune regulation and other medicinal purposes. They also have been used as bio indicators for checking the environmental health. Orchids are known to be enriched with all phytochemical agents like flavonoids, alkaloids, terpenoids and polyphenols that are able to yield a lot of medicinal properties thus helping as a cure to a lot of medical ailments such as cancer, microbial infections, inflammatory pain in the body and other medical conditions like auto immune disorders, hormonal disorders, gastric disorders, wounds, burns, sexual transmitted diseases, menstrual disorders, infectious diseases, frostbites, fever, cough and colds. Apart from their medicinal values, they are also used as wonderful bio-indicators. They can potential serve as a good source of medication for various ailments through novel drug design of their bio active constituents. A lot of research has been done to investigate their medical properties.

Orchidaceae is a diverse and widespread family of flowering plants of great value in ornamental, medicinal, conservational and evolutionary studies. They are known a lot for their therapeutic properties such as its anti-inflammatory and anti-oxidative effects. They have a lot of the secondary metabolites present in them such as alkaloids, flavonoids, polyphenols which make them a good source of medicinal plants. They are used to cure a lot of ailments such as cough, cold, burns, tumours and frostbites. They were used widely in Ayurvedic medication as well (Zhang *et al*; 2018). They mainly grow at the tropical rainforest, semi deserts, tundra, swamps, mountain tops and desert like environment, as they favour cold climatic conditions (Orchids, Wikipedia). Numerous orchid species are known for their lengthy lifespans, protracted vegetative dormancy, and expenses related to growth, size, sprouting, reproduction, and vegetative hibernation. The range of population growth rates is 0.50 to 2.92 (mean: 0.983 $\pm$ 0.026) (Richard *et al*; 2019) ^[33]. Due to rapid deforestation, anthropogenic activities, extensive use of orchids for Chinese medicines, pollution and reduction of their forest areas, a huge cover of orchids are facing extinction (Khapugin, 2020) ^[31]. These flowers are getting endangered slowly and their population is getting depleted slowly. They are been cited under CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) and listed

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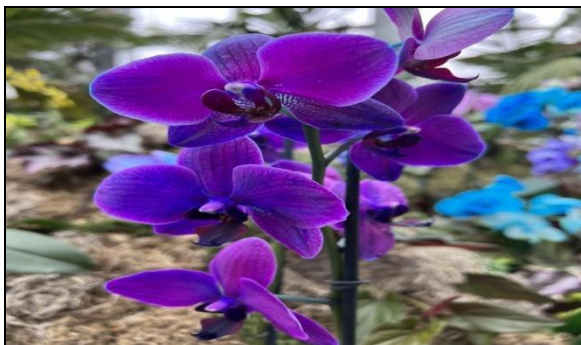
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under the IUCN Red list of the conservation of endangered species. Various methods such as In Situ Conservation and Ex Situ Conservation are used to preserve their seeds and their species, but yet a lot of research is still required in this field of conservation (Zhang *et al*, 2018).



Orchids are impacted by this environmental stress, just like other plant species are, but they are particularly vulnerable because of their complex connections with pollinators, mycorrhizal fungus, and host plants. Furthermore, habitat loss or climate change can represent a greater threat to their existence because they depend on other creatures for survival and reproduction (Goswami *et al*; 2024) ^[30].

They are also used as bio indicators to be able to assess the ecological health and the quality of well-being of the living system and also it is used in rich biodiversity hotspots. It will be used extensively as bio indicators to be able to indicate about the reproductive success, succession, mycorrhizal abundance and biomass accumulation through plants (Newman, 2009) ^[32]. They are also used to check the disturbances and destructions that occur at their habitats.

Orchids most likely first appeared on Earth 120 million years ago. However, the earliest written records that exist date only back to the fourth millennium B.C. China has been using orchids since 2800 B.C. as a source for medicinal treatments. Indians have been using various orchids for their medicinal and aphrodisiac qualities since the Vedic era (2000-600 B.C.) The orchid is referred to as "Vanda" in the Indian Vedic literature. Certain regions of America, Europe, and Salep. Vital phytochemicals found in orchids.



Similar to other plants, orchids generate a wide variety of phytochemicals. The biological function of only a handful of them has been studied; the purpose of the others remains unknown. Generally speaking, alkaloids, flavonoids, carotenoids, anthocyanins, and sterols are the phytochemicals found in orchids. Because of their biological characteristics, flavonoids and alkaloids are the most significant among them. Orchid alkaloids have been studied since 1892, when E. de Wildeman started looking into them in various European

Pharmacological studies of orchid phytochemicals. Despite the fact that orchids have long been used medicinally around the world, there aren't many pharmacological or toxicological research on the effects of orchid phytochemicals on humans, which are necessary before they may be employed in clinical settings. Some research has been done on Animal bodies such as mice, rabbits, frogs, and guinea pigs inspired hope that, if proven, these phytochemicals—like taxol, vinblastine, or quinine—might save lives. Here are some results about the threats to orchids.

One could argue that orchids are the foundation of herbal medicine. Regrettably, due to ruthless collection by a growing number of orchid enthusiasts, over-exploitation as a herbal remedy, habitat destruction through reclamation, shifting cultivation, and deforestation, loss of pollinators, population fragmentation, genetic drift, anthropogenic pressures, and illicit trade, they are among the most threatened of all flowering plants. Undoubtedly, a few orchid species have already gone extinct.

Botanical Classification

The family Orchidaceae, order Asparagales, and kingdom Plantae are home to the orchids.

The family is further divided into tribes and subtribes after being split into five subfamilies. Formally speaking, the subtribes are split up into genera. There are divisions within some genera, such as subgenera and sections within some subgenera. Every genera has a minimum of one species. The names of hybrids between various species are assigned using a specific nomenclature.

850 genera, 22 tribes, 70 subtribes, and 5 subfamilies are all present. About 8% of all angiosperm species are represented by orchids. Although hundreds of new species are added each, 29,199 species have been identified and accepted as of this writing. By the end of 2017, assessments for 948 orchid species were included in the IUCN Global Red List of species, of which it is estimated that 56.5% are endangered. Not only are orchids diverse in terms of geography and taxonomy, but they are also widely employed for a wide range of purposes, both officially and illegally, sustainably and unsustainably. Orchids are one of the most well-known plant groupings in the global horticultural and cut flower trades. They are also collected, farmed, and marketed for a number of uses, such as food, medicine, and decorative plants.

Traditional Use

Turkey, Serbia, Bosnia-Herzegovina, Greece, Italy, Great Britain, Hungary, Macedonia, Albania, and South Kosovo, as well as European Russia, Central Europe, and Spain, were all considered to have traditional orchid knowledge. Of the mentioned taxa, four are rhizomatous and 58 are tuberous. All are geophytes. The hypogean apparatus was the section that was quoted the most overall. The collection of tubers for ritual usage and domestic consumption of food and medicine was taken into consideration distinct from the harvesting of tubers for Salep (see below).

Forty species were discovered to have several applications. Only five examples (8.06%) involved the tuber being used in rituals; for 47 taxa, the hypogean portion was noted for Salep production (75.80% of the total examined species); 41 cases involved it being taken as medicinal food (66.13%). Less was said about other organs: foliage/blooming stems were employed in ceremonies in five cases (8.06%) and as medicines in eight cases (12.90%). Four cases involved

harvesting the entire plant and moving it to kitchen gardens for ornamentation, while 16 cases employed the blooming stem as decoration (25.80%). All things considered, *Anacamptis morio* (L.) R.M. Bateman, Pridgeon and M.W. Chase, and *Orchis mascula* (L.) L. are the most frequently cited species.

Chemical Composition of orchids

Reports have indicated that orchids contain a variety of phytochemicals, including flavonoids, phenanthrenes, alkaloids, and derivatives of bibenzyl. These phytochemicals have antiviral, anticancer, antibacterial, and anti-inflammatory properties when present. There have been reports of several additional phytochemicals from orchid species. *Cymbidium* sp. has yielded 2, 6-Dimethoxy-1, 4-benzoquinone, which has been found to cause allergic reactions. *Vanda roxburghii* is the source of heptacosane (C₂₇H₅₆) and octacosanol (C₂₈H₅₈O), which have been discovered to have strong anti-inflammatory effect in carrageenan-induced oedema in rats and mice. *Calanthe discolor* and *Calanthe liukiuensis* have been found to contain Calanthoside, which has been shown to have an activating impact on skin blood flow. *Habenaria repens* is the source of the compound habenariol, which prevents human lipid peroxidation.

Dendrobium densiflorum has yielded scopoletin and scoparone, which demonstrate ant-platelet aggregation activity *in vitro*. *Gastrol* has been extracted from the rhizomes of *Gastodia elata* and is said to exhibit relaxing properties on guinea pig ileum smooth muscle preparations. From *Scaphyglottis livida* and *Nidema boothii*, nidemin and 9,19-Cyclolanosta-24,24-dimethyl-25-en-3 β -yl-trans-p-hydroxycinnamate have been isolated. From *Agrostophyllum brevipes*, agrostophyllinol and agrostophyllinone have been isolated. When alkyl ferulates, The methanolic extract of *Dendrobium moniliforme* has been used to identify alkyl ferulates with antioxidative effects. *Dendrobium* sp. has been used to isolate a number of other antioxidants, including dihydromelilotoside and cis and trans-melilotoside. Isolated from *Cremastra appendiculata*, cirrhopenanthrin has demonstrated 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. *Bulbophyllum kwangtungense* has also yielded compounds with antitumor properties. Cyclobalanone and 5 α -lanosta-24,24-dimethyl-9(11),25-dien-3 β -ol, which induce dose-dependent antinociceptive and anti-inflammatory action from *Scaphyglottis livida*, have also been identified. *Cymbidine A* displays hypotensive and diuretic properties from *Scaphygidium goeringii*. From *Anoectochilus formosanus*, a kinsenoside with notable antihepatotoxic action has been identified.

Medicinal Properties

Orchids used as anti-cancer agents

Orchids has been used for various issues such as to treat to treat cancer mainly breast, lung, kidney, skin, liver and cervical cancer.

Globally, cancer is one of the main causes of premature death. Around 10 million cancer deaths and 19.3 million new cases of the disease were reported globally in 2020. The most frequent were colon cancer (10.0%), lung cancer (11.4%), breast and cervical cancers in women (11.7%). Furthermore, it is anticipated that in 2040 there would be a 47% increase in the number of cancer cases detected annually. Various

medical methods, such as surgery, radiation, and chemotherapy, are used as cancer treatments. (Tomasz Śliwiński *et al.*, 2022)^[23].

However, the development of chemo resistance can cause conventional chemotherapeutic drugs to fail, and this resistance is thought to be the cause of 80-90% of cancer-related fatalities. Drug resistance may be overcome by natural products. Data suggested that almost 60% of anticancer medications in use today are derived from natural ingredients. Of course, plants are a valuable source of bioactive substances that have anticancer properties. (Pant *et al.*, 2021)^[24].

Few medicinal plants like *Vinca Roseus* (Peri winkle) and *Tulsi* plants have proven to have excellent anticancer properties to be able to cure cancer. *Vinca Roseus* contains alkaloids vinblastine and vincristine, which are proven to be able to prevent the mitotic cycle by suppress the karyokinetic spindle and microtubule production during cell division, which causes the cell cycle to stop at the metaphase stage. Vinblastine (VBL) is a chemotherapeutic drug that is marketed under several brand names, including Velban. It is usually taken in combination with other drugs to treat various cancer types. This include testicular, brain, bladder, non-small-cell lung, Hodgkin's lymphoma, and melanoma cancers. It is administered by venous injection. Vincristine is a chemotherapeutic drug that is used to treat a variety of cancers, such as Wilmstumor, leukemia, lymphoma, and neuroblastoma.

Vincristine is a medication that is part of the vinca alkaloids class, which works by preventing cancer cells from dividing normally. These two properties of vinblastine and vincristine have proven to be marvellous anti cancerous properties. The component of eugenol from tulsi leaves will have a certain bio active constituent called to be as phenolic monoterpenoid that has a wide range of biological activities, including: antimicrobial, anti-inflammatory, antioxidant, anticancer, analgesic, antifungal, antiviral, and antispasmodic. They are usually found to be yellow in colour and will be found at the areal part of the plant like leaves, bark and flowers. They will also be used for as food colouring agents and as kitchen spices. However through recent studies on various cell lines that is the following:

- HeLa (Cervical cancer)
- MCF-7 and B16-F10 (Breast Cancer)
- Hep-G2 and SMMC-7721, BEL-7404 (Liver Cancer)
- SCC-25 (Skin Cancer)
- Dalton's lymphoma (DL), a murine transplantable T-cell lymphoma
- A549 and NCI-H460. (Lung Cancer)
- 86-O, ACHN, CAKI-1, A498, RXF393, UO-31, TK-10, and SN12C. (Kidney Cancer)

Orchids such as *Acampepraemorsa*, *Aeridisodarata*, *Eulophianuda*, *Luisiazeylanica*, *Vanda Tessellata* and *Dendrobium candidum* have been used exclusively for curing breast and cervical cancer which are very much prevalent in women worldwide. The leaves, tubers and roots contain amazing bio active constituents like Phenolics, Flavonoids, beta carotene coumarins, flavonoids, glycosides, phenols, saponins, tannins, and terpenoids which have good anti-cancer properties to cure breast and cervical cancers. *Vanda Tessellata* and *Dendrobium candidum* extracts is also used to cure liver cancer as well.

Other orchid species like *Anoectochilus formosanus* contains methanol which contains steroids, triterpenoids, alkaloids, saponins, flavonoids, tannins and carbohydrate that will be

used to cure skin cancer. Leaves, stem and roots from *Dendrobium crepidatum* orchid contained the following extracts like terpenoid and phenolic compounds that could cure Dalton Lymphoma. *Dendrobium* tonic could cure kidney and lung cancer as well. (Shukla *et al.*, 2022) ^[22].

In comparison to periwinkle and tulsi plants, Orchids have proven to have a plethora of bio active anti- cancer fighting agents which have also nominated them to be the best anti - cancer drug in place of chemotherapy.

Orchids used as anti-microbial agents

Orchids has been used a lot extensively as a cure for various microbial causing diseases like bacterial, fungal and viral infections like cholera, candida infections and against HIV as well. They have phytochemicals in them which will make them to behave like anti-microbial agents that will have inhibitory effect on bacteria, fungal and viral infections in the body.

Table 1: Here is a table depicting the list of orchids that have an effect on a particular microbe and its mode of action.

Name of the Orchid	Part of the plant	Type of extract	Active compounds	Action against which microorganism	Mode of action
Gastrodia elata	Whole plant	Gastrodianin	Epipactishelleborine mannose-binding protein	fungi	<i>in vitro</i> antifungal activity. This establishes the gastrodianin-like proteins (GLIPs) as a novel class of antifungal proteins. (Wang <i>et al.</i> , 2001)
Spiranthes mauritanica	Leaves	methanol	steroids, triterpenoids, alkaloids, saponins, flavonoids, tannins and carbohydrate	Gram Positive Bacteria	It has been used to inhibit bacteria growth ((Matu & van Staden, 2003) ^[19])
Galeola foliata	Leaves and stem bark	methylene chloride	Chlorine	Gram positive and gram negative bacteria	Anti-bacterial activity. (Khan & A.D Omoloso, 2004) ^[20]
Vanilla planifolia	Whole plant	Vanillin	alcohol, aldehyde, and ether	Escherichia coli, Lactobacillus plantarum and Listeria innocua	It has managed to inhibit the respiration of these microbes and by dissipation the flow of potassium ions channels influx into the ion gradient and thus inhibiting respiration. (Fitzgerald <i>et al.</i> , 2004) ^[21]
Bletilla striata	herb extract	Ethanol	t DPPH, ABTS, FRAP (full form) and tyrosinase inhibitory activities	Anti Microbial and Anti Inflammatory Capacity	Through the study of the use of zebra fish model it was able to determine the anti inflammatory and anti melanogenic effect through molecular docking of stelbenoid towards tyrosine kinase and adenylate cyclase (He <i>et al.</i> ; 2017)
Cypripedium macranthos	seedlings	Ethanol from the plantlets	n-hexane, EtOAc, butanol, and aqueous soluble fractions. EtOAc fraction showed the strongest antifungal activity.	Anti Fungal	This was shown to be able to have an inhibition in the growth of fungus, ETOAc is found out to be able to bind to the ergosterol synthesis of the fungi cell wall and inhibiting its growth. (Shimura <i>et al.</i> ; 2007)
Acanthophippium bicolor	leaves	methanol	Steroids, triterpenoids, alkaloids, saponins, flavonoids, tannins and carbohydrate	Staphylococcus aureus, Streptococcus faecalis, Bacillus cereus, Proteus vulgaris, Proteus mirabilis, Pseudomonas aeruginosa, Klebsiella pneumoniae, Shigella dysenteriae, Escherichia coli, Microsporidium audouinii, Microsporidium fulvum, Candida albicans and Trichophyton rubrum. the gram positive bacteria showed more Sensitivity towards this Compound than for gram negative bacteria	This sensitivity was determined by disc diffusion method in which the zone of the inhibition of the bacteria when exposed to the extract from this plant was been measured. It was been shown that maximum species of gram positive bacteria had a maximum radius to prove their sensitivity Than gram negative bacteria. (Kala S and Senthilkumar S; 2010) ^[17]
					This was shown to be able to have an inhibition in the growth of fungus, ETOAc is found out to be able to bind to the ergosterol synthesis of the fungi cell wall and inhibiting its growth. (Shimura <i>et al.</i> ; 2007)

<i>Acanthephippium bicolor</i>	leaves	methanol	alkaloids, saponins, flavonoids, tannins and carbohydrate	<i>Staphylococcus aureus</i> , <i>Streptococcus faecalis</i> , <i>Bacillus cereus</i> , <i>Proteus vulgaris</i> , <i>Proteus mirabilis</i> , <i>Pseudomonas aeruginosa</i> , <i>Klebsiella pneumoniae</i> , <i>Shigelladysenteriae</i> , <i>Escherichia coli</i> , <i>Microsporium audouinii</i> , <i>Microsporium fulvum</i> , <i>Candida albicans</i> and <i>Trichophyton rubrum</i> . the gram positive bacteria showed more	This sensitivity was determined by disc diffusion method in which the zone of the inhibition of the bacteria when exposed to the extract from this plant was been measured. It was been shown that maximum species of gram positive bacteria had a maximum radius to prove their sensitivity
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Overall it's been shown that a plethora of orchids have a lot of bio active phyto-active constituents that will be able to have effective anti-microbial action.

Orchids used as anti-inflammatory effects

Prosthechea karwinskii (Mart.) J.M.H. Shaw is a Mexican orchid used in traditional medicine by some indigenous communities to treat issues related to inflammation (cough, wounds, burns, and diabetes). A Mexican orchid, in their traditional medicine to treat inflammation-related conditions such as burns, wounds, coughs, and diabetes.

Pharmacological studies on this orchid may confirm its medicinal applications and show how well it can treat other illnesses that are highly prevalent in Mexico, such as inflammation and oxidative stress-related diseases like diabetes, cancer, atherosclerosis, and hypertension by lowering reactive oxygen species singlet oxygen to prevent inflammation to happen.

This flower has a good source of all anti-inflammatory properties that would be good against bronchitis, asthma, nephritis, migraines, urinary tract infections and systematic

lupus erythematosus. These phyto-chemical constituents are very good as they have good secondary metabolites which help in the immune regulatory effect on the immune system, by controlling the activity of T cells and B cells. The bronchial lining tissues which is mucous laden and the urogenital tract also contains squamous epithelium cells which are mucous laden that will be able to have a direct entry of microbes that will cause inflammation due to secondary immune response, Nephritis and Systemic lupus erythematosus are labelled as type 2 and 3 hypersensitivity reactions and also an autoimmune disorders that can affect the kidneys and other organs like skin, brain, heart and digestive system (in the case of SLE) which can be detrimental for the patient. Migraines due to inflammation of the brain caused by the gram negative bacteria *Neisseria Meningitidis* has also lead to utmost discomfort accompanied by painful headaches in patients. Orchids have also proven to have effective and marvellous anti-inflammatory properties that has the potential to solve several anti-inflammatory issues in the body.

Table 2: Orchid extracts and medicinal applications

Name of the Orchid	Part of plant been used	Type of extract	Active compounds	Mode of action
<i>Vandaro xburghii</i>	Root	Methanol	alkanes and alkanols (ranging C-27 to C-32) which are ubiquitous in plants	This has been used to treat bronchitis and rheumatism. It has potent anti-inflammation property due to its methanolic extract. (Josim Uddin <i>et al</i> ; 2015) ^[10]
<i>Anoectochilus formosanus</i>	Leaves	Ethanol	Alkaloids, terpenoids, steroids, flavonoids, tannins and saponins.	There was an observable effect mainly on the inflammatory infiltration of the lymphocytes and the Kupffer cells around the central vein. (Lin <i>et al</i> ; 2000)
<i>Dendrobium moniliiforme</i>	Whole plant	Dendroside vanilloside	A, C and 7-hydroxy-5,6-dimethoxy-1,4-phenanthrenequinone	They were found to be having a stimulation effect on the B cells and inhibit the proliferation of the T Lymphocyte cells. (Fu <i>et al</i> ; 2022)

Treatment for other diseases

Orchids have been used extensively for various medical ailments such as respiratory ailments, infectious diseases, skin problems, wounds, gastro intestinal issues, burns, frostbites, sexually transmitted diseases, miscarriages during pregnancy, hormonal disorders like diabetes, thyroid and menstrual issues in women.

Table 3: Orchid species with therapeutic uses.

Name of Orchid and its common name	Part of the plant being used	Type of extract	Active Compounds	Diseases	Its use as a cure for a disease/disorder
<i>Acampe ciliaris</i> (keeled Acampe)	Roots	Root paste	scoparone, gigantol, moscatilin, and scopoletin.	Stomach Disorders	Taken with Garlic will help in curing various stomach disorders (Vibha <i>et al</i> ; 2019) ^[13]

<i>Acampepraemorsa</i> (Banded Button Orchid)	Root	Root paste	scoparone, gigantol, moscatilin, and scopoletin.	Arthritis	The root paste of <i>Asparagus racemosus</i> is taken to cure arthritis and rheumatism. (Hossain, 2011) ^[14]
<i>Dendrobiumherbaceum</i> (Grassy Dendrobium)	Leaves	Leave paste	Alkaloids, phenaphtharenes, terpenoids and bibenzyl derivatives	Syphilis	Leaves paste is used in case of syphilis. (Hossain, 2011) ^[14]
<i>Seidenfiarheedii</i> (Mitrata Orchid or Seidenfadenia Orchid.)	Root	Ethanolic extracts	Phenols, Alkaloids, Phenanthrenes, Bibenzyls, Phenylpropanoids, Flavonoids, Terpenoids, Steroids and Glycosides.	Cholera	They will be able to have anti-bacterial property and will work against <i>Vibrio cholerae</i> to be able to cure Cholera (Xavier & Sentilkumar, 2005) ^[17]
<i>Geodorumdensiflorum</i> (Dense-flowered Orchid)	pseudobulbs	Pseudobulbs Extracts	It will be able to have glycosides, phenolics and alkaloids in them	Menstrual Disorders	The pseudobulbs of this plant will be used to cure mainly irregular menstrual cycles in women. (Rashid, 2013) ^[15]
<i>Geodorumdensiflorum</i> (Dense-flowered Orchid)	pseudobulbs	Pseudobulbs Extracts	It will be able to have glycosides, phenolics and alkaloids in them	Diarrhoea	Ethanomedically it will be used to treat diarrhea (Choudhary <i>et al</i> ; 2023)
<i>Rhynchostylisretusa</i> (Foxtail Orchid or Retusa Orchid.)	Leaf	Leaf extracts will be able to contain methanol, ethanol	It will be having chemicals that will be able to have anti microbial activities like hexane chloroform	Blood dysentery	This will be used to have an inhibitory effect on the <i>Shigella</i> bacteria species (Saxena; 2020)
<i>Vandatestacea</i> (Maravazha in Malayalam)	Whole plant	Plant Extract called Rasna	Pharmacological active compounds	Hepatitis	It has been discovered that <i>Vanda</i> species contain bioactive substances such as derivatives of eucomic acid, derivatives of phenanthrene, and other phenolic compounds. Numerous pharmacological actions, such as those that are neuroprotective, anti-aging, antibacterial, anti-inflammatory, antioxidant, membrane stabilizing, wound healing, and hepato-protective, have been assessed for various extracts thus far. Haroon khan <i>et al</i> ; 2018) ^[16]

Clinical Evidence of orchids

In cancer studies, A slightly modified version of the standard MTT (3-[4, 5-dimethylthiazole-2-yl]-2, 5-diphenyl-tetrazolium bromide) colorimetric test was used to assess the extracts' cytotoxic potential. HeLa and U251 human cervical cancer cells were grown in EMEM medium with 10% FBS, 1% penicillin/streptomycin, and 1% L-glutamine added. The cells were then incubated at 37 °C in an incubator with 5% CO₂ supplementation (Mosmann, 1983). A 96-well plate containing 10⁴ to 2 × 10⁴ cells per well was seeded with cells in 100 µl media, and the cells were incubated for 24 hours at the specified conditions. After that, the cells were incubated for 48 hours with various doses of plant extracts (50 µg/ml, 100 µg/ml, 200 µg/ml, and 400 µg/ml). The supernatant was then replaced with 150 µl of DMEM containing 50 µl of MTT in every well. After incubating for 4 hours, purple formazan crystals of living cells were formed. To dissolve them, 100 µl of DMSO (0.1%) was added. A microplate reader was used to measure the absorbance at 595 nm. The positive control was a cisplatin medication that is available for purchase. Using the following formula, the percentage of the cytotoxic activity was determined.

% of cytotoxic action = $\frac{\text{Abs}_1 - \text{Abs}_2}{\text{Abs}_1} \times 100$

Abs1: 100% absorbance of cells containing all components other than plant extracts
Abs2: 100% absorbance of cells containing all components including plant extracts

With the use of GCMS-QP2010 Ultra (Shimadzu Europe GmbH, Germany), the bioactive components of the methanol extracts of *D. transparens* and *V. cristata* were determined. An electron ionisation device with an ionisation energy of 70 eV

was employed in GC-MS. With a column-flow rate of 0.95 ml/min, the carrier gas was 99.99% pure helium. After being held for around ten minutes, the temperature was raised at a rate of three degrees Celsius per minute. At a final pace of 10 °C per minute, the temperature was increased to 300 °C. One splitless microlitre of 1% extract dissolved in methanol was injected. The chromatogram's peak area served as an indicator of the relative amount of each chemical in the extract.

The software on computers was employed to match the spectra with standard values and determine the chemicals based on GC retention durations.

The MTT assay was used in this study to screen eight methanol extracts of seven wild orchids at different concentrations (50, 100, 200, and 400 µg/ml) for potential cytotoxicity against two cancer cell lines (HeLa and U251). None of these extracts had been previously reported on in terms of cytotoxicity. The commercial medication cisplatin and these orchid extracts' cytotoxic effects on cancer cell lines are.

The current investigation discovered that *D. transparens* stem (DTs) extracts formed upon the addition of MTT dye, and that extract-killed cells did not form crystals. *P. articulata* and *P. uniflora* showed little efficacy against the cancer cell lines. *G. distichus*, *E. graminifolia*, and *O. albus* were the least susceptible of the chosen species in opposition to these cancer cell lines.

Extracts of *O. albus*, *G. distichus*, and *E. graminifolia* did not exhibit any cytotoxicity against HeLa cells. At the highest concentration (400 µg/ml), *V. cristata*, *D. transparens*, *P. articulata*, and *P. uniflora* showed substantial cytotoxic

activity of 49.56%, 54.56%, 23.76%, and 27.20%, respectively. The HeLa cell line extracts of the chosen orchids were used to calculate the 50% cell growth inhibition concentration (IC₅₀) using a linear regression equation of the percentage inhibition curve. With IC₅₀ values of 317.23 µg/ml, 382.14 µg/ml, 673.04 µg/ml, and 723 µg/ml, the extracts of the entire plant of *V. cristata*, the stem of *D. transparens*, the leaf and pseudobulb of *P. articulata*, and the whole plant of *P. uniflora* were all effective cell growth inhibitors.

D. transparens and *V. cristata* were found to be highly effective in inhibiting the growth of U251 glioblastoma brain tumour cells. Their respective IC₅₀ values were 75.84 µg/ml and 163.66 µg/ml, and their percentage inhibition was 71.05% and 61.86%. Table 1 shows that no other extracts exhibited significant cytotoxic activity against U251 cells.

GC-MS was used to identify and detect the bioactive chemicals found in the extracts taken from the whole plant and the stem (*D. transparens*) of the plants. The remaining extracts' GC-MS analysis findings are not displayed here because they exhibited negligible or no inhibitory activity. Compounds' base mass-to-charge ratio (m/z) and percentage content were used to determine the elution time of such compounds additionally decided.

Palmitic acid (23.51%), 9-methyl-octadecanoate (53.43%), 10-octadecenoic acid, methyl ester (34.32%), and 14-methyl-pentadecanoic acid methyl ester (12.86%) were found to be the main constituents. As minor components by abundance were identified: 15-methyl-hexadecanoic acid methyl ester (6.43%), as well as below 5%, 1,2-di-palmitin; hexadecane; 1,10 -hexadecylidenebis-cyclopentane; 6-ethyl-3-trimethylsilyloxydecane; 9-octadecenoic acid; and 1,2,3-propanetriyl ester, which all of them were found to have various biological activities, including cytotoxic activity (Asghar and Choudahry, 2011; Belakhdar *et al.*, 2015; Lee *et al.*, 2007; Hsouna *et al.*, 2011; Panigrahi *et al.*, 2014). In addition to these, Table 2 identified alpha-bisabolol, 2-methyl-(Z, Z)-3,13-octadecadienol, hexadecanoic acid, docosenoic acid, 15-methyl-hexadecanoic acid methyl ester, and 10-octadecenoic acid and its methyl ester. There are already 27 identified compounds in *D. transparens*.

Among them, the principal elements the two most abundant were: 14-methyl-pentadecanoic acid methyl ester (12.86%) and 10-octadecenoic acid methyl ester (34.32%). The following were minor components: 6.43% of 15-methyl-hexadecanoic acid methyl ester. In addition to these, *V. cristata* whole plant (VCw) contained the following additional compounds: 1, 2-di-palmitin, hexadecane, 1, 10-hexadecylidene-bis-cyclopentane, and 6-ethyl-3-trimethylsilyloxydecane. These compounds demonstrated the greatest cytotoxicity towards both HeLa and U251 cancer cell lines, with the lowest IC₅₀ values when compared to cisplatin the live cells' formazan crystals. Additionally, it has been discovered that chemicals extracted from *Dendrobium* exhibit a range of neuroprotective, antioxidant, and anticancer properties (Chand *et al.*, 2016; Ng *et al.*, 2012). Alkaloids, flavonoids, phenolic compounds, and tannins make up the bulk of plant-based secondary metabolites (Farzaneh and Carvalho, 2015; Wong *et al.*, 2006; Gupta *et al.*, 2004). These natural compounds have a variety of pharmacological qualities, such as cytotoxic and chemopreventive effects against cancer.

Because of their antioxidant qualities and capacity to scavenge free radicals, flavonoids, triterpenoids, and steroids in particular have a variety of biological impacts (Farzaneh *et al.*, 2018; Gupta *et al.*, 2004).

Numerous types of chemicals, including polyphenols,

flavonoids, and catechins, have been linked in studies to exhibit cytotoxic and antioxidant properties (Uddin *et al.*, 2009) [10]. Moreover, practically all orchids suppress surface saprophytes, endophytic fungi, at some point in their existence, latent pathogens and mycorrhizal fungi (Petrini and Fisher, 1990; Rasmussen and Rasmussen, 2009; Pant *et al.*, 2016). Alkaloids, benzopyranones, chinones, flavonoids, phenolic acids, quinones, steroids, terpenoids, tetralones, and xanthenes are only a few of the diverse range of bioactive secondary metabolites that endophytes offer. Each has its own distinct structure (Tan and Zou, 2001; Shah *et al.*, 2019). Agrochemicals, immunosuppressants, antibiotics, anti-inflammatory, anti-parasitic, antioxidants, and anti-cancer agents are just a few of the many uses for bioactive compounds found in plants (Farzaneh and Carvalho, 2015; Gunatilaka, 2006; Kharwar *et al.*, 2011; Schulz *et al.*, 2002; Strobel *et al.*, 2004). Although the exact mechanism underlying the observed biological activity is unknown, the following mechanisms could be imagined. Enzymes that break down xenobiotics may be able to suppress cancer cells through polyphenol chemicals.

Some flavonoids may change hormone production to stop the growth of cancer cells, while others may change the metabolic activation of possible carcinogens (Chen *et al.*, 2007; Gali-Muhtasib *et al.*, 2015).

Conversely, phenolics have the potential to interfere with cellular division in the telophase of mitosis. According to Li *et al.* (2001), Wu *et al.* (2006), Paudel *et al.* (2019), phenolics also decrease the amount of cellular protein, the mitotic index, and colony formation during cell proliferation. An antioxidant's activity increases with the number of hydroxyl groups in it. The flavonoid molecule's anticancer action is facilitated by the presence of the 4-carbonyl group (Cragg and Newman, 2013) [32]. Furthermore, a flavonoid molecule's 2,3-double bond has been linked to mitochondrial damage and the death of cancer cells.

Orchid extracts should be studied further to identify such potentially beneficial medications since they may produce beneficial antioxidants and anticancer chemicals that could result in the creation of expensive pharmaceuticals (de la T. Particularly *D. transparens* and *V. cristata*, two wild orchid species found in Nepal, shown notable cytotoxic activity against brain tumour and cervical cancer cell lines in methanol extracts. Our findings lay the groundwork for more research into these orchid species to determine its possible head the search for novel compounds with effective anti-cancer properties attributes. Clarifying the mode of action from which these anticancer characteristics of the chemicals found are derived, and their improvement in the direction of a drug-like safety and effectiveness profile is of vital importance in the future.

The 50% ethanolic extract of *E. macrobulbon* roots and its separated components demonstrate significant favourable changes in the secretion profile of anti-inflammatory (IL-6, TNF-α) and pro-inflammatory (IL-10) cytokines, as well as in the production of iNOS in an LPS-stimulated macrophage model *in vitro*. *In vitro*, free radical scavenging activity was observed for EME and the majority of fractions. Moreover, this plant's and its constituents' cytotoxic effects on the three distinct cancer cell lines MCF-7 and HeLa cell lines.

Challenges and Sustainability of orchids

There is growing pressure on habitats and the animals that live in them worldwide. For instance, Brooks *et al.* (2002) found that 25 "hotspots" of biodiversity, each with at least 1500 unique plant species, are home to approximately 50% all vascular plant species. However, more than two-thirds of

these hotspots' original habitat has been lost.

The scientists hypothesised that many of the endemic species in these hotspots would either go extinct soon or face extinction threats as a result of this habitat degradation. VogtSchilb *et al.* (2016) reported evidence of a high turnover in species composition of orchids in communities due to changes in land use in a study on a Mediterranean island. Additionally, there is growing proof that the benefits and drawbacks of assisted migration and translocations to climatically suitable locales are increasingly being discussed in relation to orchids (e.g. Ramsay and Dixon 2003; Swarts and Dixon 2009a) and more generally (Pearman and Walker 2004; Ricciardi and Simberloff 2009). Global change may also be affecting species distributions (e.g. Fay 2015b)^[37]. Orchid species are impacted by these pressures, just like all other plant species are. However, because of their intricate relationships with pollinators, mycorrhizal fungus, and host trees, orchid species are probably more vulnerable since they depend on other organisms that are also impacted by habitat loss and climate change. Orchids, however, pose more of a challenge than many other plant families. Unsustainable harvesting is another area where orchids are threatened, and only slowly is the full consequence of this becoming clear. A number of orchid species, including those of *Cattleya*, *Laelia*, *Renanthera*, and some slipper orchids (*Cypripedium*, *Paphiopedilum*, and *Phragmipedium*), have been shown to be severely impacted by indiscriminate collection for horticultural collections. In certain instances, these orchids have been methodically removed from the wild to the point of (near) extinction. Cribb *et al.* (2003) and Fay (2015a)^[37] are two examples of how many orchids are either not gathered for horticulture or are collected in such little quantities that there is unlikely to be much of an influence.

All orchids were included to the appendices of the Convention on International Trade in Endangered Species (CITES), mostly in an effort to prevent the illicit smuggling of these attractive orchids and because to alleged identification issues (e.g. Cribb *et al.* 2003), and more than 70% of the species listed on CITES are orchids.

But it's becoming more and more obvious that a lot of orchid species are still being harvested and sent across international borders, not only for the horticultural trade but also for use as food or medicine, without the necessary CITES licenses (see, for example, Fay 2015a and Hinsley *et al.* 2018)^[37, 38]. Although it is difficult to determine the exact scope of the illegal trade, efforts are being made to gauge the degree of CITES regulation non-compliance (e.g., Ghorbani *et al.* 2014; Hinsley *et al.* 2017)^[38, 39]. Notable instances of poorly documented trade include orchids that were harvested in East Asia for traditional medicinal purposes and in the Middle East and eastern Mediterranean regions to produce the food product sold there (e.g. Kreziou *et al.* *et al.* 2016; de Boer *et al.* 2017)^[40, 41] and chikanda in southeast Africa (e.g. Veldman *et al.* 2014); the emergence of innovative DNA-based methods is now making it possible to identify the species of orchid present in these processed foods, which will make trade documentation and enforcement more and more practical (e.g. de Boer *et al.* 2017)^[40]. One unforeseen result of all orchid species being listed on CITES has been a decrease in orchid collections for scientific objectives, such as conservation studies, in addition to not stopping the illegal trade (Roberts and Solow 2008)^[36].

Because of their unique life cycle—which includes a specialised way of living, reliance on pollinators for pollination, lack of stored food material in the seed, and

reliance on mycorrhizal fungi for seed germination—as well as human intervention, orchids are extremely vulnerable to loss or erosion even in their natural habitat. Every species has unique adaptation needs, and some have extremely narrow distribution ranges. Any alteration to its natural habitat that goes beyond what is acceptable puts its survival in jeopardy. Globally protected species are included in Appendix I of the Convention on International Trade in Endangered Species (CITES), while domestically protected species are classified in Schedule VI of the Wild Life (Protection) Act of 1972. The Botanical Survey of India's Red Data Book of Indian Plants has a list of plant species that are threatened in different categories demand prompt attention. According to recent estimates, around 250 species of native orchids are threatened by a number of different factors. India is no longer home to several species, including *Pleione lagenaria*, *Aphyllorchis gollanii*, *Coelogyne truetleri*, *Anoectochilus rotandifolius*, *Paphiopedilum charlsworthii*, *Paphiopedilum wardii*, and *Vanda wightiana*. There are 352 indigenous orchids in the nation; 40 are classified as "endangered," and 72 as "vulnerable."

According to the Convention on Biodiversity, the nation has the sovereign right to preserve its biodiversity, hence the loss of these species would be irreversible. Plants can die even in orchidariums as a result of inadequate growing environments, careless housing, and frequently untrained workers. Populations of some orchid species have been rapidly falling as a result of ongoing overexploitation and habitat loss. According to the Global Action Plan for Conservation of Biodiversity, 60 percent of vulnerable plant species must be preserved under protected areas, ideally in their nation of origin.

Preservation of orchid biodiversity

In order to conserve orchids, its natural environment must be preserved. Additionally, orchid biodiversity must be promoted and the survival of unique orchid species must be guaranteed. There are two ways to conserve orchids: in-situ and ex-situ.

Conservation in situ

The loss of their habitats puts thousands of orchid species in risk of going extinct. The orchids have a unique way of life, and they need particular pollinators to successfully fertilise. Because that is their preferred habitat, orchids only grow in that specific area.

The orchids must adjust to a completely new habitat when they are removed and moved, one in which they could not thrive as well. For orchids, in-situ conservation of the species is ideal since it guarantees their organic growth, multiplicity, and continuation, which permit the ongoing evolutionary process within a natural ecosystem. India has a sophisticated Protective Area Network (PAN) that includes 480 animal sanctuaries and 86 National Parks, representing roughly 4.66% of the nation's total land area. This network is predicted to grow in the future. The species that live in those forests are protected by this network. Regretfully, a number of significant and threatened orchid species are found outside of the PAN. These include *Renanthera imscottiana* in Arunachal Pradesh, *Vanda coerulea* in Meghalaya, *Paphiopedilum druryi* and *P. specerianum* in Assam, and *Paphiopedilum wardii* in the Aghasthyimalai hills of Kerala. Under the Wildlife Protection Act, 1972 (as amended in 1992), a few state governments, including West Bengal, Arunachal Pradesh, Sikkim, Karnataka, and others, have classified the ecosystems rich in orchids as "Orchid Sanctuaries." Additionally

poaching or smuggling should be applied to any attempt to remove them from their native habitat. Locals may be made aware of the importance of these conservation actions for forest regions close to human habitats, and community involvement may be encouraged in the activities.

But in those sanctuaries, risks like forest fires could even cause rare and endemic species to go extinct. Therefore, suitable ex-situ conservation measures should be used in addition to in-situ conservation measures.

Actions to preserve

The three main strategies for preserving the genetic resources of orchid species are legislative actions, in situ preservation in sanctuaries and reserves, and ex situ preservation in orchidaria and botanical gardens.

Action by the Government

The IUCN manages a program to safeguard wild plants and animals that are classified as CITES. This agreement recognises orchids as threatened species. Appendix I contains a list of threatened and extinct species, and it expressly forbids the commerce in wild flora. On the other hand, trade in cultivated and artificially propagated plants is permitted with the right documentation. The Appendix II species list could be in danger if trade is not properly controlled. The Orchidaceae family has almost all of its members listed in. The Wildlife Protection Act (1972) was passed in India. Includes *Vanda coerulea* (Blue Vanda) and *R. imschottiana* (Red Vanda) in Schedule VI. Illegal wild orchid gathering has been greatly aided by the laws.

Preservation of the In Situ

The goal of in situ conservation is to preserve all living things in their native habitat, with a focus on wild plants, animals, and endangered species. The first country to have a national strategy in place to protect genetic diversity in its native environment is Turkey. National parks, sanctuaries, and biosphere reserves are a few examples of in situ preservation. A biosphere reserve is a sizable protected area set aside for the conservation of plant and animal resources, where certain activities are strictly forbidden, including planting, farming, grazing, felling trees, hunting, and poaching. The United States' "Man and Biosphere" effort the idea of biosphere reserves was first presented by the United Nations Educational, Scientific, and Cultural Organisation (UNESCO) in 1971. In 1979, the world's first biosphere reserve was created [27]. There are now 134 countries with 738 biosphere reserves, including 22 transboundary sites. Agasthyamalai, Kachchh, Cold Desert, Great Nicobar, Manas, Sundarbans, Similipal, Dibru-Saikhowa, Panna, Seshachalam highlands, Achanakmar Amarkantak, Nanda Devi, Nilgiri, and Nokrek are among the eighteen biosphere reserves in India that safeguard rare, endangered, and vulnerable orchid species. Similipal, the tenth biosphere reserve in India, is home to 96 UNESCO-listed species of orchids. In Odisha, it acts as a reservoir for both terrestrial and epiphytic orchids. The Similipal Biosphere Reserve is the only habitat for endemic orchid species *Eria meghasaniensis* and *Tainia hookeriana*.

A national park is an extremely important place has breathtaking scenery that the government maintains and protects to preserve the wildlife and plants. To protect the parks' natural regions, human activity like mining, hunting, and fishing are forbidden. India's first national park was the Jim Corbett National Park, created in 1936. There are currently 106 national parks in India that are open for visitors,

including Mount Harriett, Papikonda, Indravati, Khirganga, South Button Island, and Rani Jhansi Marine as well as the Great Himalayan, which together occupy 44,402.95 km² (National Wildlife Database 2023). The Similipal National Park in Odisha is home to 96 distinct orchid species, whilst the Buxa Tiger Reserve in West Bengal is home to 150 different orchid species [27]. The largest orchid national park is Kaziranga Orchid National Park, which has about 600 different species of wild orchids that were collected from northeastern India.

Sacred groves are little places with sacred significance that are used to protect a variety of plant and animal species that are used for food, medicine, and other uses [30].

Sacred groves can be found in several Indian states, such as Himachal Pradesh, Karnataka, Maharashtra, West Bengal, and Chhattisgarh. Of India's 13,270 recognised sacred groves, 5627 are found in the country's Himalayan region. As for Arunachal Pradesh, The first and only protected area in the nation dedicated to the preservation of naturally grown orchids is Sessa Orchid Sanctuary. *Calanthe tricarinata*, *Epipactis helleborine*, and *Herminium lanceum* were noted by Hadimba Devi (Kullu District, Himachal Pradesh), whilst *E. helleborine*, *Habenaria edgeworthii*, and

H. lanceum were reported by Rupasana Devi. *H. edgeworthii*, *Goodyera repens*, *E. helleborine*, and *Spiranthes sinensis* inhabit the sacred woods of Jamdagni Rishi, whereas *C. tricarinata* and *H. edgeworthii* inhabit the sacred groves of Shangchul Rishi.

Preservation of Ex situ.

The practice of conserving species (plants or animals) outside of their natural habitat is known as ex situ conservation. It entails moving genetic material from its original site so that germplasm can be easily accessed for study and application. It is thought to be the most useful, popular and reasonably priced method of conservation.

Three National Orchidaria and Experimental Gardens—one each in Yercaud, Howrah, and Shillong—are cared for by the Botanical Survey of India. Ex situ conservation is carried out by the State Forest Research Institute of Arunachal Pradesh by maintaining a range of orchid species at the Orchid Research Centre, which is located in Tipi, Itanagar, Dirrang, Jenging, and Sessa.

A botanical garden, *in vitro* propagation, cryopreservation, gene banks, and seed storage are among the most widely used ex situ conservation methods. A collection of live plants, a botanical garden, often called a botanic garden, is important for conservation. Living orchid collections are maintained and continuing research projects are carried out by institutions such as the New York Botanical Garden and the Royal Botanic Garden (Kew). There are currently 13 botanical gardens in India that protect different varieties of orchids. There are forty-three species of gathered orchids at the Lloyd Botanical Garden in Darjeeling, West Bengal.

There are 419 orchid species from 94 genera at the Botanical Garden and National Orchidarium, which is around 22 kilometres from Shillong and situated next to Umiyam Lake in Barapani. The orchids were collected from different states in North-east India. Every species has a record that includes its botanical name, collecting site, blooming/fruiting season, habitat, and IUCN classification. The main genera of orchids that are still present in the garden include *Paphiopedilum*, *Oberonia*, *Coelogyne*, *Dendrobium*, *Bulbophyllum*, and *Cymbidium*. Moreover, the orchid database included species from the following intriguing families: *Anoectochilus*

brevilabris, *Acanthephippium sylhetense*, *Armorum senapatianum*, *Cymbidium dayanaum*, *Neogyna gardeneriana*, *Paphiopedilum venustum*, and *R. imschootiana*.

A seed bank is designed to safeguard and maintain the genetic variety of seeds. The biggest seed bank is called the Millennium Seed Bank, and it's in Sussex. The Royal Botanic Gardens, Kew, runs and oversees it. Many seeds are produced by orchids in a single capsule. But these seeds don't have a viable endosperm in the wild, and they need a certain mycorrhizal connection to germinate. As a result, orchid seeds normally have a low germination rate. To retain their high viability, the orchid seeds (*Dactylorhiza*, *Dendrobium*, *Eulophia*, and *Paphiopedilum*) are stored at -70°C . Excellent potential for long-term storage at low temperatures has been demonstrated by these seeds.

Plant organs and reproductive components can be preserved by a process called cryopreservation, which involves keeping them in liquid nitrogen at a temperature of -196°C . Make-believe preservatives very helpful for keeping seeds that contain a lot of moisture. Cryoprotectants and plant vitrification solutions can be used to successfully cryopreserve orchid tissues and explants in liquid nitrogen cylinders. The national bureau of plant genetic resources in India built cryobank facilities, which store 2.5 lakh germplasm lines. This approach has evolved into a cost-effective strategy for protecting threatened species. The *in vitro* approach is a biotechnology method used for secondary metabolite generation, virus eradication, and mass propagation.

Different orchid species have been micropropagated using a variety of explant forms, such as seeds, shoots, roots, leaf apices, nodal segments, rhizomes, and pseudobulbs [33]. Large-scale, disease-free plant production is made possible by this technology. It's extremely successful in preserving biodiversity and the gene pool. The only practical way to conserve and reintroduce genetic material under threat into the ecosystem is through *in vitro* culture. It is thought to be the most effective method for preserving uncommon or threatened orchids that have therapeutic and aesthetic value.

Challenges and Sustainability

The National Research Centre for Orchids has worked to conserve the nation's orchid biodiversity ever since it was founded. At its campuses in Pakyong and Darjeeling, the Centre has preserved 350 species of orchids that were gathered from tropical to temperate regions of the nation. A variety of horticultural qualities are being assessed in accessions of preserved species, and elite germplasm lines are being registered with the National Bureau of Plant Genetic Resources (NBPGR). In order to mitigate the impact of collection on natural ecosystems, the Centre is creating production and propagation guidelines and organising the cultivation of rare, endangered, and threatened (RET) species. The protective effects of molecular methods on genotypes against biopiracy are noteworthy. A program is being conducted to identify orchid species by their DNA fingerprints.

It would aid in preventing unauthorised usage of the orchid biodiversity. The living specimens that are conserved *ex situ* in orchidaria are always vulnerable to genetic loss because to inadequate local adaptation, pests and diseases, and poor management practices. It is necessary to methodically recreate the collections using a variety of conservation techniques [4]. For the safe, long-term, and sustainable conservation of orchid genetic resources, the centre intends to employ further

conservation approaches throughout the 12th Five Year Plan, such as seed, *in vitro* conservation, and cryopreservation. NRCO may also actively participate in identifying orchid-rich environments, investigating the reasons behind orchid biodiversity loss, and recommending relevant actions in collaboration with the Ministry of Environment and Forest and the National Biodiversity Authority of India. Even though NRCO has been approved by the National Active Germplasm System (NAGS) as an Active Germplasm Site for Orchids, maintaining orchid germplasm at one or two sites seems to be a challenging undertaking. As a result, in order to conserve and use orchid germplasm sustainably, NRCO intends to collaborate with local orchidaria. Initiatives must be taken to identify farmers and communities involved in conserving orchid biodiversity, to learn about Indigenous Technological Knowledge (ITK) regarding medicinal use of orchids and their scientific applications, and to secure the sharing of benefits with local people as conservers of biological resources and holders of knowledge and information relating to the use of biological resources. These actions are necessary to respect and protect the knowledge of local communities related to biodiversity. Validation for the goal of obtaining a fair share of the advantages resulting from the utilisation of orchid resources and related information about orchid use. Following the establishment of a local (panchayat) Biodiversity Management Committee, these organisations could take part in the benefit-sharing scheme.

Future Directions

Through good scientific innovation a novel new drug can be designed for the therapeutic uses for instance in place of the chemotherapy that will be having painful side effects on patients, hormonal replacement therapy and pain killers that will be having harmful effects on the endocrine system and the detoxification system (Liver and kidneys) the development of the extract from orchids in its purified form and in its active form will be able to have the potential effects to be able to cure the medical issue without any side effects. We can use the latest technology and its filtration process to use the orchids extract as a novel drug to cure any illness. A lot of awareness has to be made on the conservation strategies of orchids. Since orchids are been exploited for their use as ornamental plants and for their aesthetic value, and a lot of their habitat are getting destructed due to anthropogenic activities, We need to have effective measures in conserving them in their natural habitats. Ecologists, Environmental activists and conservation environmentalists must take an active part in conserving orchids in sustainable ways for future generations.

Conclusion

Orchids are not only valued for their beauty and their aesthetic values as ornamental plants, but are also values as potential medicinal plants for Ayurveda and Chinese medicine as well. They are used to cure various ailments such as targeting the central nervous system, reproductive system, lymphatic system, endocrine system, excretory system, skin, immune system, gastro intestinal system, respiratory system, emotional well-being, good for hair and nails as well. Their importance in the medicinal market is slowly coming up with a lot of potential scientists investigating their bio medicinal uses as well. They values as a potential medicine should also be researched further in place of allopathy and homeopathy as a good source of medicinal values. They are slowly getting extinct and it takes a lot for their protection as well according

to CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) and listed under the IUCN Red list of the conservation of endangered species. A lot of conservational strategies are kept in place to preserve orchids for the fore coming generations as well. Together the need to conserve orchids is a must and the need to deliver the a novel drug from suitable bioactive constituent from orchid flower through innovation is required for mass production to potentially cure the above listed diseases and disorders.

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