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Medicinally important orchids of Northeast India: traditional knowledge and scientific validation

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Northeast India, comprising eight states, harbors a rich gene pool of orchids vital to local culture, economy, and medicine. These plants, with 145 documented species used across the region, are valued for treating diseases like cancer, tumors, nervous disorders, and skin ailments. Key genera include *Acampe*, *Aerides*, *Anoectochilus*, *Bulbophyllum*, *Calanthe*, *Coelogyne*, *Cymbidium*, *Dendrobium*, and *Vanda*, known for their diverse secondary metabolites such as alkaloids, flavonoids, and polyphenols that contribute to their healing properties. However, scientific exploration has been limited, with only 54 species reported to contain active compounds. Future research should focus on identifying new bioactive compounds, validating efficacy through animal and human studies, and exploring traditional knowledge for potential new species, aiming to harness these plants for commercial medicinal applications.

Keywords: Active compounds, Medicinal uses, Northeast India, Orchids

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Northeast (NE) India is the hotspot of biodiversity; situated between 87˚32'E to 97˚52'E latitude and 21˚34'N to 29˚50'N latitude and occupies a total geographical area of 262,251 sq. Km[1]. Comprising of eight states *viz.,* Arunachal Pradesh, Assam, Meghalaya, Manipur, Tripura, Mizoram, Nagaland, and Sikkim; NEaccounts for 7.7% total Indian geographical area yet supports 50% of the flora (ca. 8000 species), where 31.58% (ca. 2526 species) are endemic[2]. This diversity richness is due to peculiar gradient and varied climatic conditions which boasts invaluable genetic resources of large groups of orchids, ferns, oaks (*Quercus* spp.), bamboos, rhododendrons (*Rhododendron* spp.), and magnolias (*Magnolia* spp.), etc.[3] Due to its remarkable flora diversity, the region is known as the 'Cradle of Flowering Plants"[1]. Distinct biogeographic zone of NE is home to about 8,000 species of flowering plants, with a diverse array of orchids playing a key role in the region's and nation's economic growth.

Orchids from the Orchidaceae family, with around 28,000 species in 763 genera, have long been valued for their decorative, ceremonial, and economic importance[4]. Epiphytic orchids like *Laelia autumnalis* in Mexico have been used decoratively since ancient times. Fragrant species such as *Aerides multiflora*, *Cattleya maxima*, and *Rhynchostylis retusa* are popular for outdoor beautification[3]. Research highlights the volatile compounds in Thai orchids, like *Rhynchostylis gigantea* and *Dendrobium parishii*, which include nerol, 2,3-dihydrofarnesol, and 2-pentadecanone[5]. *Vanilla planifolia*, producing the commercial spice vanillin, is primarily supplied by Madagascar, which accounts for 75% of global production, followed by Indonesia, China, Mexico, and Papua New Guinea[3,6]. In Tanzania, Zambia, and Malawi, orchids' tubers are essential for food and income[8]. Various orchid parts, such as leaves, pseudobulbs, and tubers, are edible and medicinal. For instance, *Anoectochilus* leaves are consumed as vegetables, and tubers of *Microtis unifolia* and *Caladenia carnea* are eaten in India. Orchids like *Dendrobium*, *Cymbidium*, and *Phalaenopsis* are widely used in decorations, drying, and weddings[3,6]. Many *Dendrobium* species, along with genera like *Acampe*, *Aerides*, and *Coelogyne*, are used medicinally across Europe, America, Australia, China, and Africa[10-15]. In NE India, orchids are

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integral to traditional medicine, rich in alkaloids, flavonoids, and other phytochemicals[16]. NE India, a significant orchid evolution region, boasts 850 of India's 1,331 orchid species, with 85 species endemic to this area[3,6,17].

Many orchids in NE India are traditionally used as medicine, but their bioactive compounds and pharmacological properties are not well-documented. Additionally, a comprehensive compilation of medicinal orchids from all NE states is lacking. Given the strategic importance of orchids in local folk medicine, this article aims to: I. Document and analyze traditional knowledge and cultural practices related to orchid use across the eight states of NE India. II. Assess the medicinal efficacy of selected orchid species in treating diseases such as cancer, tumors, nervous disorders, and skin problems. III. Systematically identify and characterize the bioactive compounds in these orchids, including alkaloids, flavonoids, sterols, carotenoids, anthocyanins, polyphenols, Bibenzyl derivatives, and phenanthrenes. This work compiles and presents secondary data on widely used orchids and their bioactive compounds for the first time.

The shift from traditional values to phytochemistry

Researchers have recognized the medicinal value of orchids, shifting their focus to phytochemistry and the active metabolites responsible for their effects. This shift involves isolating, identifying, and quantifying bioactive compounds to develop pharmaceuticals and understand plant-derived compounds' mechanisms. Database searches on Web of Science, PubMed, Google Scholar, ResearchGate, ScienceDirect, and Scopus were conducted using relevant keywords. For example, a Scopus search (Fig. 1) yielded 101 published papers, and a word correlation map (Fig. 2) based on co-occurring author keywords illustrates the shift from disease names to the scientific validation of bioactive compounds.

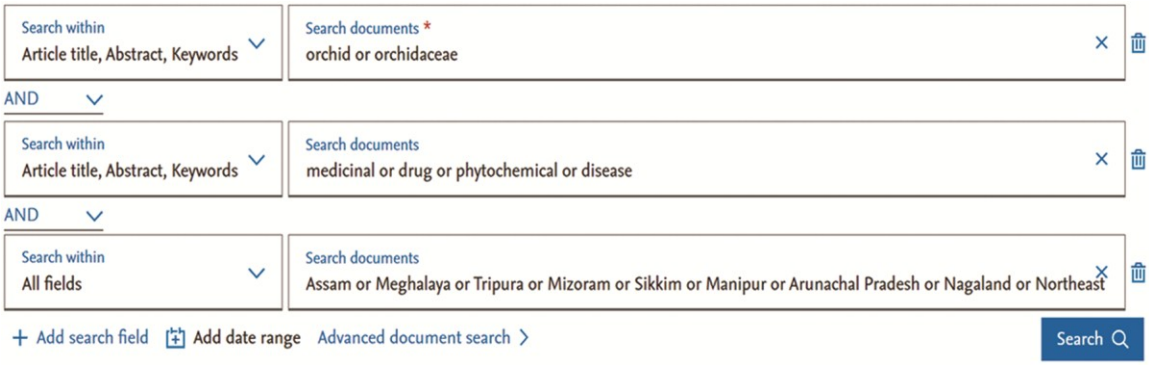

Fig. 1 — Keywords used to search Scopus for published data on medicinal uses of NE Indian orchids

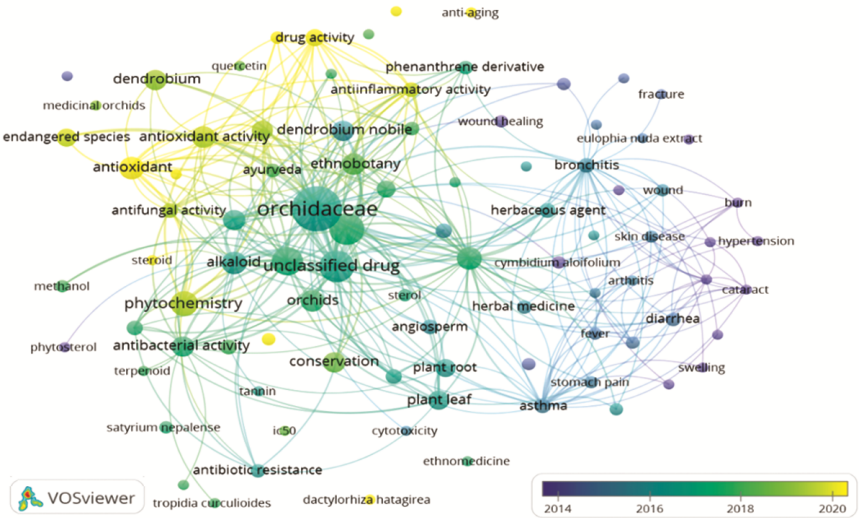

Fig. 2 — Word correlation map based on 101 Scopus publications on medicinal orchids from NE India, generated using VOSviewer version 1.6.19

Recent studies have focused on secondary metabolites and active compounds responsible for disease treatment. Root, leaf, and stem extracts are tested for anti-inflammatory, antioxidant, antifungal, and antibacterial activities, containing phytochemicals like alkaloids, terpenoids, steroids, tannins, sterols, phenols, and quercetin.

Diversity of orchids in Northeast

NE India features diverse ecosystems, including tropical and subtropical forests, high-altitude Himalayan ranges, and unique montane habitats, providing niches and microclimates for various orchid species. The region's climatic conditions range from hot, humid plains to cool, temperate highlands, allowing orchids to thrive across different temperature and humidity levels. High humidity and substantial rainfall in the Northeastern states create ideal conditions for orchids, which often grow as epiphytes on trees or the forest floor. Recognized as a biodiversity hotspot, Northeast India hosts many endemic and rare orchid species, significantly contributing to the region's overall biodiversity.

Table 1 shows the distribution of orchids in the forest cover of NE India. Arunachal Pradesh has the highest number of species, contributing 19% from 130 genera, while Tripura has the lowest at 1% (Fig. 3).

Around 14.29% of the orchid species in NE India are endemic, including about 127 species and 6 varieties from 52 genera[18]. These orchids are widely used by locals for various diseases, and extensive research has been conducted for scientific validation.

Medicinal uses of Orchids in Northeast India

The medicinal potential of NE Indian orchids, especially from genera like *Acampe*, *Bulbophyllum*, and *Dendrobium*, is significant. Despite some exploration, many species remain untapped. Of 145 species, only 54 have documented active compounds, indicating a wealth of undiscovered bioactive molecules. Immediate research is needed to uncover and validate their therapeutic efficacy. These findings have substantial implications for medicine and pharmaceuticals, with orchids' diverse secondary metabolites offering promising reservoirs for new

Table 1 — Distribution of orchids under forest cover from the Northeast India (modified from De and Medhi, 2014)

State	Area	Dense Forest	% Forest Cover	Genera	Species	Reference
	000 Km^2					
Arunachal Pradesh	83,743	54,542	65.13	130	600	[3]
Assam	78,438	15,842	20.19	101	395	[18]
Manipur	22, 327	5,309	23.77	90	389	[19]
Meghalaya	22,429	3,305	14.73	98	352	[3]
Mizoram	21,081	4,279	20.29	86	253	[20]
Nagaland	16,579	3,531	21.29	108	423	[21]
Sikkim	7,096	2,403	38.86	144	561	[20]
Tripura	10,488	1,825	17.4	29	39	[20]

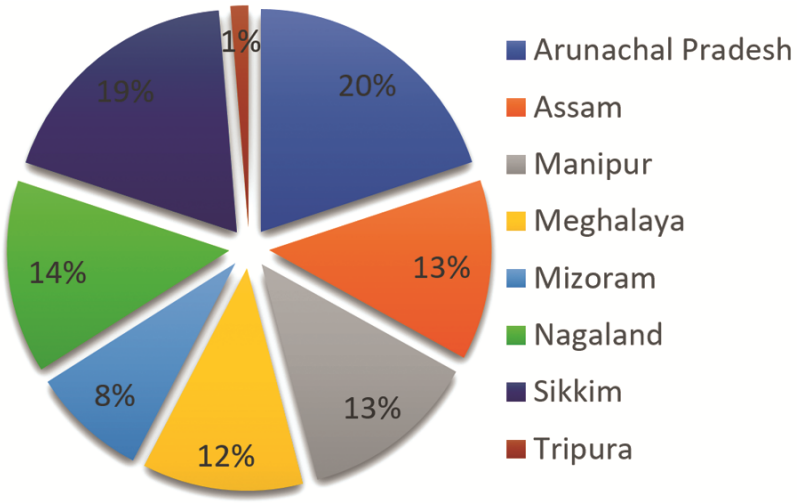

Fig. 3 — Percentage distribution of orchid species from Northeast

drugs. Their efficacy against diseases like cancer highlights their potential in drug development. Orchids with antimicrobial properties could contribute to antifungal and antibacterial drug development. Focused research involving chemical profiling, isolation, and testing could yield new drugs for ailments such as cancer, tumors, and nervous disorders. Table 2 details the medicinal orchid species of the NE and their active compounds, some of which are shown in Figure 4.

Table 2 — Majorly used orchid species of the Northeast India for medicinal practices with their active compounds

Name	Parts used	Used for treatment of	Active compounds	Reference
Acampe carinata (Griff.) Panigrahi	Root leaves decoction	Rheumatism, sciatica, neuralgia, secondary syphilis and uterine diseases, scorpion and snakebites, chest pain, stomach disorders, acidity	NR	[22]
Acampe papillosa (Lindl.) Lindl.	Root pastes and juices	Rheumatism, asthma, eye disease, arthritis, backache, traumatic pain, menstruation pain, neuralgia, snake bite	cis, trans-1,6-Dimethylspiro [4.5] decane, Spiro [3.5] nonan-1-one	[23] [24] [25]
Acampe praemorsa (Roxb.) Blatt. & McCann	Roots, leaf paste	Rheumatism, sciatica, neuralgias, asthma, bronchitis, eye diseases, tonic, curing syphilis and uterine diseases, scorpion, snake bites, hyperacidity, arthritis	Flavidin, Flavidinin	[20] [23] [26] [27]
Acampe rigida (Buch.-Ham. ex Sm.) P.F.Hunt	Root and leaves	Relieves muscle pain, joint pain, promotes blood circulation	NR	[22] [28]
Aerides multiflora Roxb.	Leaf powder/paste, stem, ground fruits, pseudobulb	Tonic, cuts, wounds, earache, antibacterial	Aerimultins A, B, C, dihydrosinapyldihydroferulate, 6-Methoxy coelonin, Gigantol, Imbricatin, Agrostonin, Dihydroconiferyldihydro-p-coumarate, 5-Methoxy-9,10-dihydrophenanthrene-2,3,7-triol.	[20] [22] [29] [30]
Aerides odorata Lour.	Whole plant	Antibacterial, antioxidant, anticancer, treats cuts, wounds, heals boils in ears and noses, tuberculosis, joint pain, swellings	Xanthorrhizol [2-Methyl-5- (1,2,2-Trimethy cyclopentyl)] phenol, s Phenyl (piperidin-3-yl) methanone, (E)-5-Methylundec-4-ene, 2-O-(2-Ethylhexyl)1-O- pentadecyl oxalate, and squalene Ethyl Dglucopyranoside, Methyl (2E)-3-phenyl-2-propeonate 3,7,11-trimethyl1,6,10-dodecatrien-3-ol (2E,6E)-3,7,11-trimethyldodeca-2,6,10-trien-1-ol	[20] [22] [31] [32] [33] [25]
Aerides rosea Lodd. ex Lindl. & Paxton	Leaf	Wounds	NR	[20]
Agrostophyllum callosum (Blume) J.J.Sm.	Powdered tuber	Inflammation, diabetes, wound, skin disorders	Callosuminin, Agrostophyllin, Callosumin	[16] [22]
Anoectochilus roxburghii (Wall.) Lindl.	Whole plant	Fever, lung disease, hypertension, tuberculosis, antioxidant activity	Kaempferol-3-O- -D-[glucopyranoside; Kaempferol-7 - D- [glucopyranoside; Isorhamnetin-3- -D-[rutinoside]; 8-C-phydroxybenzylquercetin; Quercetin-7-O- -D-[6"-O-(transferuloyl)]-glucopyranoside; 5-Hydroxy-3',4',7- trimethoxyflavonol-3- -D-[rutinoside]; Isorhamnetin-3-O -D-[glucopyranoside; Isorhamnetin-7-O- -D-[glucopyranoside]	[16] [20] [22] [25]

(*Contd.*)

Table 2 — Majorly used orchid species of the Northeast India for medicinal practices with their active compounds (*Contd*.)

Name	Parts used	Used for treatment of	Active compounds	Reference
Anoectochilus setaceus Blume	Leaf, stem, pseudobulb	Snakebite, ingredient in certain medicinal oils	NR	[20]
Anthogonium Gracile Wall. ex Lindl.	Tuber paste	Bone fracture, dislocation, boils	NR	[22]
Argostophyllum brevipes King & Pantl.	Powdered tuber	Jaundice	Callosinin, Imbricatin; Flaccidin	[16] [22]
Arundina graminifolia (D.Don) Hochr.	Roots, stem, and pseudobulb	Hepatitis, diabetes, tumor, body ache, foot heels to treat the cracks, hyperliposis, antibacterial activity	DL-Norleucine, N-(2-methoxyethoxycarbonyl)-, pentyl ester, arundinan, brundinaol, arundinoside A-G, arundiquinone & arundigramin racsyringaresinol, astragalin, batatasin III, coelonin, densiflorol B, ephemeranthoquinone, flavanthrin, gramniphenol H, lusian-thridin, orchinol, quercetin	[20] [22] [23] [34] [25]
Brachycorythis obcordata (Lindl. ex Wall.) Summerh.	Tuber and root	Tonic, dysentery, expectorant, astringent	NR	[20] [22]
Bulbophyllum lobbii Lindl.	Leaves	Fever, inflammation, burns	NR	[35]
Bulbophyllum careyanum (Hook.) Spreng.	Leaf powder, pseudobulb	Burns, wounds, fast recovery after childbirth, to cause abortion	NR	[20] [22]
Bulbophyllum leopardinum (Wall.) Lindl. ex Wall.	Juice of leaves and pseudobulb	Burns	2,4-Dimethoxyphenanthrene-3,5-diol	[20] [22] [26] [27]
Bulbophyllum odoratissimum (Sm.) Lindl. ex Wall.	Whole plant decoction, pseudobulb	Tuberculosis, chronic inflammation,fracture, Cytotoxic activity	3,7- Dihydroxy- 2,4,6-trimethoxyphenanthrene, Moscatin, 7-hydroxy-2,3,4-trimethoxy-9,10-dihydrophenanthrene, coelonin, densiflorol B, gigantol, batatasin III, tristin, vanillic acid, syringaldehyde, Bulbophyllanthrone, Bulbophythrin A and bulbophythrin B, 5-(2-Benzo[1,3]dioxole-5-ylethyl)-6-methoxy benzo[1,3]dioxole-4-ol (1) and 5-(2-benzo[1,3]dioxole-5-ylethyl)benzo[1,3]dioxole-4,7-diol	[16] [20] [22] [36]
Bulbophyllum sterile (Lam.) Suresh	Pseudobulb	Rheumatism, swellings	NR	[22]
Bulbophyllum umbellatum Lindl.	Whole plant	To enhance congenity	NR	[20]
Calanthe plantaginea Griff.	Rhizome powder	Tonic, aphrodisiac	NR	[20] [22]
Calanthe puberula Lindl.	Rhizome powder with milk	Tonic	NR	[22]
Calanthe sylvatica (Thouars) Lindl.	Flower juice and leaf	Nose or gum bleedings, cold, cough	(E)-Phenylethanal-oxime, 2-Phenethyl derivative, Isoamyl benzoate, 2-Phenylethanol Benzyl alcohol, (Z)-Phenylethanal-oxime, Isoamyl benzoate, Methyl salicylate	[22] [37]

(*Contd*.)

Table 2 — Majorly used orchid species of the Northeast India for medicinal practices with their active compounds (*Contd*.)

Name	Parts used	Used for treatment of	Active compounds	Reference
Calanthe tricarinata Lindl.	Leaves paste and pseudobulb	Sores, eczema, aphrodisiac	NR	[20] [22]
Calanthe triplicata (Willemet) Ames	Root, flower, and pseudobulb	Diarrhea, gastrointestinal disorders, teeth cavities problems, swollen hands	Glycerin, Phytol acetate, DL-Proline, 5-oxo-, methyl ester, 1, 2, 3-Propanetriol, 1-acetate, D-Alanine, N-propargyloxycarbonyl- dodecyl ester, Triacetin, 6-Octen-1-ol, 3,7-dimethyl-, propanoate, 4H-Pyran-4-one, 2,3-dihydro-3,5 dihydroxy-6- methyl, 2, 4(1H, 3H) – Quinazolinedione,	[20] [22] [24] [37]
Cephalanthera longifolia (L.) Fritsch	Rhizome and root powder	Appetizer, tonic, wound healer, increase vigour, vitality and alleviate impotency, tonic to promote lactation in cattle	NR	[20] [22]
Cleisostoma williamsonii (Rchb.f.) Garay	Leaves and stem	Healing fractured bones,	NR	[1] [22]
Coelogyne flexuosa Rolfe	Paste of pseudobulb	Headache, fever, indigestion	NR	[35]
Coelogyne corymbosa Lindl.	Pseudobulb juice and paste	Wounds, burns as analgesic, headache	Coelogin, coeloginone	[20] [22] [26] [27] [34]
Coelogyne cristata Lindl.	Pseudobulb juice	Aphrodisiac, constipation, wounds, boils, sores, headache, fever, indigestion, cuts	Coeloginanthridin, Coeloginanthrin, Coeloginin, Coelogin, 9,10-Dihydrophenanthrene, 7,8-Dimethoxy-9,10-dihydrophenanthrene-2,4,6-triol	[16] [22] [26] [27]
Coelogyne fimbriata Lindl.	Pseudobulb paste and juice, leaf powder	Headache, fever, indigestion, burnt skin, tonic, aphrodisiac	NR	[20] [22]
Coelogyne flaccida Lindl.	Pseudobulb paste and juice	Headache, fever, indigestion	Callosinin	[16] [20] [22]
Coelogyne fuscescens Lindl.	Pseudobulb paste and juice	Abdominal pain, to heal burns	NR	[22] [26] [27]
Coelogyne nitida (Wall. ex D.Don) Lindl.	Paste and juices of pseudobulbs	Headache, fever, burns, stomach pain	2-Pyrrolidinecarboxylic acid, 1,2-dimethyl-5-oxo-, methyl ester, Quinoline, decahydro-2,5-dipropyl, Cyclohexene, 1,5,5-trimethyl-6-(2-propenylidene), 2(1H)-Naphthalenone, 1-methyl-1-(2-propynyl), Flavidin, 4-Methoxy-9,10-dihydrophenanthrene-2,7-diol, Flaccidin, Imbricatin, Coeloginin, Coelogin, 2,5-Dihydroxy-6,7-dimethoxyphenanthrene-4-carboxylic acid, 9,10-Dihydrophenanthrene	[20] [22] [23] [26] [27]
Coelogyne ovalis Lindl.	Pseudobulb, whole plant	Aphrodisiac, cough, urinary infections, eye disorders	Batatasin III, Flavidin, Imbricatin, Coeloginin, Coelogin, Flavidinin, beta-Sitosterol	[20] [22]
Coelogyne prolifera Lindl.	Pseudobulb paste	Fever, headache, backache, burn, cuts, boil	NR	[20] [22]

(*Contd*.)

Table 2 — Majorly used orchid species of the Northeast India for medicinal practices with their active compounds (*Contd*.)

Name	Parts used	Used for treatment of	Active compounds	Reference
Coelogyne punctulata Lindl.	Powder of dry pseudobulbs	Burn injuries, wound	Coeloginone, coelogin, quabain, batatasin III	[34]
Coelogyne stricta (D.Don) Schltr.	Pseudobulb paste	Headache, fever	Batatasin III, Flavidin, 4-Methoxy-9,10-dihydrophenanthrene-2,7-diol, Oxoflavidin	[20] [24]
Conchidium muscicola (Lindl.) Rauschert	Whole plant	Cardiac, respiratory, nervous disorders	NR	[20] [22]
*Corymborkisveratrifolia (*Reinw.) Blume	Leaf juice	Emetic, constipation, fever in children	NR	[20] [22]
Cremastra appendiculata (D.Don) Makino	Root powder and stem	Snakebite, cytotoxic activity, dental caries, emollient, abscesses, scrofula, freckles	Cirrhopetalanthin; 2,7,2',7',2'-Pentahydroxy-4,4',4",7"-tetramethoxy-1,8,1',1"-triphenanthrene	[16] [20] [22]
Crepidium acuminatum (D.Don) Szlach.	Root powder, stem and pseudobulb	Burns, bronchitis, cold, cough, fever, tuberculosis, weakness, tonic and male aphrodisiac, strength, enhanced sperm formation, against cancers of the liver, breast, cervix etc.	Choline, Stearic acid, Eicosadienoic acid, 1-Hexacosanol, Palmitic acid, trans-2-Icosenoic acid, Arachidic acid, Oleic acid, beta-Sitosterol, Linoleic acid	[20] [22] [26] [27]
Cymbidium aloifolium (L.) Sw.	Seeds, rhizome, Root, Pseudobulb, Leaf, Whole plant	Healing wounds, bone fracture, tonic, rheumatism, nervous disorders, demulcent agent, boils and fever, weakness of eye, burns and sores, tumors, vomiting, diarrhea, vertigo, paralysis, haemostatic	Batatasin III, 4-Methoxy-9,10-dihydrophenanthrene-2,7-diol, Gigantol, 9,10-Dihydrophenanthrene, 4-[2-(3-Hydroxyphenyl) ethyl]-2,6-dimethoxyphenol, Pendulin, 5-Hydroxy-3-methoxyphenanthrene-1,4-dione	[1] [20] [22] [26] [27] [9][38] [25]
Cymbidium devonianum Paxton	Whole plant and root	Cough, cold, Boils	NR	[20] [22]
Cymbidium elegans Lindl.	Fresh juice of whole plant	Enhances coagulating, deep wound, nervous disorders	Cymbinodin	[20] [22] [34]
Cymbidium ensifolium (L.) Sw.	Root and flower decoction	Gonorrhoea, eye sore disorders	NR	[22] [25]
Cymbidium giganteum (L.f.) Sw.	Leaf juice	Clotting of blood in wound	NR	[1]
Cymbidium hookerianum Rchb.f.	Seeds	Cuts and injuries as haemostatic	NR	[20] [22]
Cymbidium iridioides D.Don	Leaf juice, Pseudobulb and root powder	Blood clotting in fresh wounds, tonic, diarrhoea	Gigantol, Taraxerone, Cymbidoside, beta-Sitosterol	[20] [22] [26] [27]
Cymbidium macrorhizon Lindl.	Rhizome decoction	Diaphoretic, boils	NR	[22] [25]
Cypripedium cordigerum D.Don	Whole plant	Tonic	NR	[20]
Cypripedium himalaicum Rolfe	Whole plant	Urine blocks treatment, heart disease, cough, chest problems	NR	[20]
Dendrobium amoenum Wall. ex Lindl.	Pseudobulb paste	Skin burn, cuts, dislocated bones, Antioxidative& antibacterial activity	Isoamoenylin, Leurosine, Flaccidin, Dendrophenol, Amoenin	[16] [20] [22] [26] [27]
Dendrobium chrysanthum Wall. ex Lindl.	Stem and seeds	Tonic, skin disease, enhance immune system, promote the production of body fluid, reduce fever, stomach, haemostatic	Hygrine, Kaempferol	[20] [22] [26] [27] [39] [25]

(*Contd*.)

Table 2 — Majorly used orchid species of the Northeast India for medicinal practices with their active compounds (*Contd*.)

Name	Parts used	Used for treatment of	Active compounds	Reference
Dendrobium chrysotoxum Lindl.	Extract of stem, flower, leaf and seed	Tonic, haemostatic, antipyretic, Antiangiogenic activity, Anti-inflammatory activity	Erianin, Dendrochrysanene, Diosgenin, beta-Sitosterol-beta-D-glucoside, 7-Hydroxy-2,3,4,8-tetramethoxyphenanthrene, beta-Sitosterol-beta-D-glucoside	[16] [224] [24] [26] [27] [40] [41] [25]
Dendrobium crepidatum Lindl. & Paxton	Pseudobulbs and stem paste	Fractured and dislocated bones, tonic, in arthritis, rheumatism	(+)-Homocrepidine A, (−)-Homocrepidine A, Homocrepidine B, (+)-Dendrocrepidamine A, Dendrocrepidine B, C, D, E, F, Isocrepidamine, Dendrocrepidine A	[20] [22] [40]
Dendrobium densiflorum Lindl.	Fresh root and pseudobulb pastes, Powder seeds	Pimples, plaster in fractured bones, regularize menstrual cycle, Vomiting, quenches thirst, fever of phlegm, boils, other skin eruptions, sprains, inflammations, haemostatic	Scoparone, Allopurinol di-methyl derivative, 4-ethenyl-2,6-dimethoxy, Phenanthrene, 4-methoxy, 3,6-Dimethyl-5-oxo-1,2,3,5-tetrahydroimidazo[1,2-a] pyrimidine, Homoeriodictyol, Ayapin, Scopoletin, 1,4,7-Trihydroxy-5-methoxyfluoren-9-one, Psoralen, 2,5-Dihydroxy-4-methoxy-9H-fluoren-9-one, Asperglaucide, Oleanolic acid, beta-Sitosterol, Kaempferol, Quercetin	[16] [20] [22] [23] [35] [39]
Dendrobium denudans D.Don	Stem	Cough, cold, nasal block, tonsillitis and tonic	NR	[22] [26] [27]
Dendrobium devonianum Paxton	Stem	Immune system enhancer	NR	[22]
Dendrobium eriiflorum Griff.	Pseudobulb paste and powder	Fractured, dislocated bones, tonic	NR	[16] [20] [22]
Dendrobium falconeri Hook.	Stem	Tonic, used in lung cancer	NR	[22]
Dendrobium fimbriatum Hook.	Whole plant	Liver upsets, nervous disability, aphrodisiac, stimulant, demulcents, fever, tonic, fractured bones, cuts, wounds	Diosgenin, Fuscin, Denfigenin, moscatilin, gigantol, defuscin, chrysotoxine, 2,5-phenanthrenediol, 9-10-dihydro-7- methoxy, fimbriadimerbibenzyls, Kaempferol, β-Sitosterol, ayapin, confusarin, crepidatin, physcion, rhein, fimbriatone, scopolin, n-octastylferulate	[1] [20] [22] [26] [27] [34] [39] [42] [43] [38] [25]
Dendrobium fugax Rchb.f.	Whole plant powder	Tonic, general debility stimulant	Salutaridine, thebaine	[22] [34]
Dendrobium heterocarpum Wall. ex Lindl.	Stem/pseudobulb	Canes as paste used to set dislocated bones, anti-inflammatory	3-Hydroxy-4′,5-dimethoxybibenzyl, Gigantol, Dendrocandin I	[20] [40]
Dendrobium jenkinsii Wall. ex Lindl.	Fresh and dried stems	Gastritis, dehydration during fever, thrush, dried eyes like ailments, in preparation of Chinese drug Shih-hu	NR	[20] [22]
Dendrobium longicornu Lindl.	Whole plant juice	Fever, cough	NR	[20] [22]

(*Contd*.)

Table 2 — Majorly used orchid species of the Northeast India for medicinal practices with their active compounds (*Contd*.)

Name	Parts used	Used for treatment of	Active compounds	Reference
Dendrobium macraei Lindl.	Whole plant paste	Snake bite, general stimulant, asthma, bronchitis, throat trouble, fever, as an aphrodiasic	Desmosterol, Stearic acid	[20]
Dendrobium moniliforme (L.) Sw.	Pseudobulb	Anti-inflammatory, Antipyretic	Dendrobine, Dendromoniliside A; Dendromoniliside B & Dendromoniliside C, Alkyl ferulates, Moniliformin; 2,6-Dimethoxy-1,4,5,8-Phenanthradiquinone; 7-Hydroxy-5,6-dimethoxy-1,4-phenanthrenequinone, *n*-Tetracosyl *trans*-ferulate, *n*-Pentacosyl *trans*-ferulate	[10] [22] [40]
Dendrobium monticola P.F.Hunt & Summerh.	Whole plant, pseudobulb	Boils, pimples, other skin eruptions	NR	[20] [22]
Dendrobium moschatum (Banks) Sw.	Leaf juice, seed powder, pseudobulb	Earache, haemostatic, weakness, fractured, dislocated bones	Dendrobine, Benzofuran, Dodecane, 2,4,6-trimethyl, Quinolinedione, 3-benzoyl-3-(phenylmethyl), Tetracosamethyl-cyclododecasiloxane, Cycloheptasiloxane, tetradecamethyl, 1,6-Dimethyl-5-oxo-1,2,3,5 tetrahydroimidazo[1,2-a] pyrimidine, Cyclohexasiloxane, dodecamethyl, Dendrophenol, Moscatin, Coumarin, Tricosane, 7-Pentacosene	[1] [16] [20] [23] [24] [26] [27] [39]
Dendrobium nobile Lindl.	powdery seeds, root, Stem, pseudobulb, whole plant	Wounds, longevity and aphrodisiac, stomachic, pectoral, antiphlogistic, expectorant, analgesic, antipyretic, antiepileptic, to increase appetite, rheumatism, excessive perspiration, impotence, entropion, leucorrhea, Anti-tumor, nervous system related disorders, tonic, vigour, anti-ageing, reduce salivation, thirst, tongue dryness, night sweating, menstrual pain, nightfall, dyspepsia, fever, anorexia, pulmonary tuberculosis, lumbago.	Dendrobine, Dendroside A; Dendroside D; Dendroside E; Dendroside F; Dendroside G & Dendronobiloside A, 4,7-Dihydroxy-2-methoxy-9,10-dihydrophenanthrene; Denbinobin, Dendroban-12-one, Ethylamine, 2-((p-bromo-a-methyl-a-phenylbenzyl) oxy)-N,N-dimethyl-, 1,6-Methanonaphthalen -5(1H)-one, octahydro-2,4a,8a-trimethyl-, (1S,2S,4aR,6R,8aS), Cycloheptasiloxane, tetradecamethyl, Photocitral A, Octatriene, 1,3-trans-5-trans (fucoserratenemonoterpenoid), 4(1H)-Pyrimidinone, 6-methyl-2-propyl	[1] [16] [20] [22] [23] [26] [27] [39] [44] [45] [25]
Dendrobium transparens Wall. ex Lindl.	Pseudobulb and stem paste	Fractured, dislocated bones	NR	[20] [22]
Dienia cylindrostachya Lindl.	Pseudobulb, stem	Tonic, strengthen kidneys	NR	[20] [22]
Echioglossum williamsonii (Rchb.f.) Szlach.	Leaf juice	Swellings of hands, legs and for bone fractures	NR	[20]
Epipactis helleborine (L.) Crantz	Tuber and whole plant	Treat insanity, gouts, headache, stomachache, nervous disorders	NR	[22]

(*Contd*.)

Table 2 — Majorly used orchid species of the Northeast India for medicinal practices with their active compounds (*Contd*.)

Name	Parts used	Used for treatment of	Active compounds	Reference
Eria bamboosifolia Lindl.	Whole plant	Stomach disorder in combination with *Aegle mermaelo,* hyper-acidity	NR	[20] [25]
Eria muscicola (Lindl.) Lindl.	Whole plant	For disorders of chest, lungs, eyes, ears, nervous system	NR	[1]
Eria pannea Lindl.	Root	Bone ache, fracture, skin inflammation, bodyache	NR	[20] [38] [25]
Eria spicata (D.Don) Hand.-Mazz.	Stem/pseudobulb	Head ache, stomach ailments	NR	[20] [25]
Eulophia campestris Wall. ex Lindl.	Rhizome	As tonic, effective in curing stomach ailments	NR	[1]
Eulophia dabia (D.Don) Hochr.	Rhizome	Appetizer, tonic, aphrodisiac, purulent cough, heart trouble, to reduce cough, cold, as blood purifier	NR	[22]
Eulophia nuda Lindl.	Root	Bronchitis, tumour,blood related diseases, boils, and abscesses	Nudol, Eulophiol, 9,10-dihydro-2,5-dimethoxyphenanthrene-1,7-diol, 2,3,4,7-tetramethoxyphenanthrene, 9,10-dihydro-4-methoxyphenanthrene-2,7-diol, l,5-dimethoxyphenanthrene-2,7-diol, 1,5,7-trimethoxyphenanthrene-2,6-diol, 5,7-dimethoxyphenanthrene-2,6-diol, 4,4,8,8-tetramethoxy-[1,1-biphenanthrene]-2,2,7,7-tetraol, 2,2,4,4,7,7,8,8-octamethoxy-1,1-biphenanthrene, 9,10-dihydro-1-(4-hydroxybenzyl)-4,7-dimethoxyphenanthre ne-2,8-diol, 1-(4-hydroxybenzyl)-4,8-dimethoxyphenanthrene-2,7-diol, 3,4-dihydroxy-3,5,5-trimethoxybibenzyl, Bis(4-hydroxybenzyl) ether, Lupeol	[20] [46] [47] [25]
Eulophia spectabilis Suresh	Tuber and leaf	Appetizer, aphrodisiac, tonic, blood-purifier, tuberculosis glands on neck, tumors and bronchitis, pinworm, roundworm infections, skin diseases	2,7-Phenanthrenediol, 3,4-dimethoxy-, 1-Hexacosanol, 4-Hydroxybenzaldehyde, 4-Hydroxybenzyl alcohol, 9,10-Dihydrophenanthrene, 1,5-Dimethoxyphenanthrene-2,7-diol, Lupeol, 2,6-Phenanthrenediol, 1,5,7-trimethoxy-, 2,5-Dimethoxy-9,10-dihydrophenanthrene-1,7-diol, 2,7-Phenanthrenediol, 3,4-dimethoxy-	[22]
Flickingeria fugax (Rchb.f.) Seidenf.	Whole plant	Tonic, general stimulant	NR	[22] [26] [27]
Galeola falconeri Hook.f.	Tuber paste	STDs like syphilis	NR	[20]
Geodorum densiflorum (Lam.) Schltr.	Tuber and root	Wounds, skin diseases, carbuncles, insect bites, dysentery, diabetes, improving fertility in men, to regularize menstrual cycle in women	NR	[20] [22] [48] [25]
Goodyera repens (L.) R.Br.	Tuber and leaf	Syphilis, blood purifier, female disorders, stomach disorder, bladder diseases, reptile bite	NR	[20] [22]

(*Contd.)*

Table 2 — Majorly used orchid species of the Northeast India for medicinal practices with their active compounds (*Contd*.)

Name	Parts used	Used for treatment of	Active compounds	Reference
Goodyera schlechtendaliana Rchb.f.	Leaf, stem and whole plant	Internal injuries and to improve circulation, blood purifier, acne, pruritus, psoriasis, fungal infections on skin, tonic	NR	[20] [22] [25]
Gymnadenia orchidis Lindl.	Tuber powder and root	Cuts, wounds, gastritis, diarrhea, liver and urinary disorders, aphrodisiac and tonic, rejuvenates bodily strength, increases sperm count, restores diminished kidney heat	NR	[20] [22]
Habenaria commelinifolia (Roxb.) Wall. ex Lindl.	Whole plant	As Salep in combination with other orchids	NR	[20]
Habenaria dentata (Sw.) Schltr.	Whole plant	Analgesic, aphrodisiac, disinfectant, anti-rheumatic,urinary and orthopedic problems	Habenariol, gastrodigenin	[22] [34]
Habenaria furcifera Lindl.	Tuber paste	Cuts, wounds, insect bites, tonic to improve body fluid	NR	[22] [25]
Habenaria pantlingiana Kraenzl.	Tuber paste	Snake bites	NR	[22]
Habenaria pectinata D.Don	Tuber and leaf	Arthritis, snakebite	NR	[22] [25]
Herminium lanceum (Thunb. ex Sw.) Vuijk	Whole plant	Extract of plant given in suppressed urination	NR	[22] [34]
Herminium monorchis (L.) R.Br.	Root	Tonic	NR	[20]
Liparis nervosa (Thunb.) Lindl.	Tuber	Stomachache, burns, malignant ulcers	Linoleic acid, phydroxybenzaldehyde, swertisin, 6,8-di-C-αL-arabinopyranosyl genkwanin, apigenin	[22] [34]
Liparis odorata (Willd.) Lindl.	leaf juice, stem, pseudobulb	Burns, cancerous ulcers, gangrene, lever, dropsy	NR	[1] [20] [22] [31] [25]
Luisia trichorhiza (Hook.) Blume	Leaf, paste of whole plants	Muscular pain, Jaundice, antibacterial	NR	[20] [22] [25]
Luisia tristis (G.Forst.) Hook.f.	Leaf juice	Chronic wounds, boils and burns	NR	[22]
Luisia zeylanica Lindl.	Leaf	Chronic wounds, boils and burns	NR	[20]
Malaxis acuminata D.Don	Decoction of pseudobulb	To control bleeding diathesis, burning sensation in stomach, fever, arthritis, blood vomiting, tonic, tuberculosis	NR	[20][26] [25]
Malaxis muscifera (Lindl.) Kuntze	Pseudobulb	Useful in sterility, seminal weakness, dysentery, fever, general debility as a tonic, male infertility, fever and burning limbs	NR	[22]
Monomeria barbata Lindl.	Pseudobulb	Coughs, pulmonary tuberculosis, trauma	NR	[22]
Mycaranthes pannea (Lindl.) S.C.Chen & J.J.Wood	Decoction of root and leaf	Chicken pox, malaria, fractured bones, muscle swellings, used in bathing in cases of ague	NR	[20] [22]
Nervilia aragoana Gaudich.	Leaf decoction, whole plant	Protective medicine after childbirth, uropathy, haemoptysis cough asthma, vomiting, diarrhoea& mental instability	NR	[20] [25]
Nervilia macroglossa (Hook.f.) Schltr.	Tuber	Increase male impotency	NR	[22]

(*Contd*.)

Table 2 — Majorly used orchid species of the Northeast India for medicinal practices with their active compounds (*Contd*.)

Name	Parts used	Used for treatment of	Active compounds	Reference
Oberonia caulescens Lindl.	Tuber	Liver ailments	NR	[22]
Oberonia falconeri Hook.f.	Whole plant	Bone fractures	NR	[22]
Orchis latifolia L.	tubers and roots	Nerve tonic, aphrodisiac	NR	[1]
Otochilus albus Lindl.	Whole plant	For improving general strength as tonic	NR	[20] [22]
Otochilus porrectus Lindl.	Whole plant	Tonic, sinusitis, rheumatism	Flavidin, Cyclootochilone	[20] [22] [26] [27]
Papilionanthe teres (Roxb.) Schltr.	Leaf, stem and whole plant	Fevers, dislocated bones, burning sensation, cough, cold, pus formation in ear, nose bleeding	Butanenediol, vandateroside I, II, III	[1] [26][27] [34]
Peristylus constrictus (Lindl.) Lindl.	Root extract	Boils	NR	[22]
Phaius tankervilleae (Banks) Blume	Pseudobulbs, Tuber, leaf, flower	Dysentery, tonic, swelling of gout, to reduce pain of fractured bones, redness and swelling, wounds, boils, swellings, pain of abscess	NR	[1] [20] [22] [34]
Pholidota articulata Lindl.	Root powder, pseudobulb, fruit, Whole plant	Tonic, cancer, skin ulcers, skin eruptions, dislocated bones	Flavidin	[20] [22] [26][49]
Pholidota chinensis Lindl.	Pseudobulb extract	Toothache, stomachache and inflammation, internal bleeding, asthama, tuberculosis, rheumatism, dysentery	Pholidotol A, Pholidotol B	[20] [22] [46]
Pholidota imbricata Hook.	Pseudobulb	Pain of nasal, abdominal and rheumatic, fever, pain, swelling during arthritis, tonic, body pain, skin rash	Imbricatin, phoimbrtol A, loddigesiinol B, shanciol B, quercetin, luteolin, platycaryanin D	[20] [22] [24] [26][27] [34]
Pholidota pallida Lindl.	Root and pseudobulb	Nasal, abdominal, rheumatic pains, fever, insomnia, intestinal worm	Loddigesiinol B, luteolin, phenanthrene, phoimbrtol A, platycaryanin D, shanciol B	[20] [22] [34] [50]
Pinalia spicata (D.Don) S.C.Chen & J.J.Wood	Stem paste	Stomachache, headache	NR	[22]
Platanthera edgeworthii (Hook.f. ex Collett)	Root and leaf	Blood purifier	NR	[20]
Platanthera latilabris Lindl.	Pseudobulb	Blood purifier	NR	[22]
Platanthera sikkimensis (Hook.f.) Kraenzl.	stem/pseudobulb	Naval abdominal, rheumatic pain	NR	[20]
Pleione humilis (Sm.) D.Don	Pseudobulb powder and paste	Tonic, cut, wounds	NR	[22]
Pleione maculata (Lindl.) Lindl. & Paxton	Rhizome	Liver complaints, stomach ailments, antibacterial, anti-biofilm action	phenol 4-(ethoxymethyl), 8-oxatetracyclo{5.2.1.1(2,6). 1(4,10)}dodecane, 7-tertbutyl-1,9,9-trimeth, , docosane, 2,4-dimethyl, kryptogenin 2,4-dinitrophenyl hydrazine, N-decyl-alpha,D-2-deoxyglycoside, 1-methylsulfanyl9,10-dioxo-9,10-dihydro-anthracene2-carboxylic acid, Arabidol	[20] [22] [51] [52]
Pleione praecox (Sm.) D.Don	Pseudobulb powder and paste	Tonic, cut, wounds	NR	[20] [22]

(Contd.)

Table 2 — Majorly used orchid species of the Northeast India for medicinal practices with their active compounds (*Contd*.)

Name	Parts used	Used for treatment of	Active compounds	Reference
Polystachya concreta (Jacq.) Garay & H.R. Sweet	Pseudobulb	Arthritis	NR	[22]
Ponerorchis chusua (D.Don) Soó	Tuber	Diarrhea, dysentery, chronic fever	NR	[20] [22]
Renanthera imschootiana Rolfe	Leaf paste	Skin diseases	NR	[20] [22] [25]
Rhynchostylis retusa (L.) Blume	Leaf, root, flower, whole plant	Rheumatism, constipation, gastritis, acidity, as emollient, cuts, wounds, menstrual pain, arthritis, emetic, asthma, tuberculosis, nervous twitching, kidney stone, insect repellent, to induce vomiting, blood dysentry	Gigantol, flavidin	[20] [22] [34] [53] [25]
Satyrium nepalense D.Don	Pseudobulb	Tonic, dysentery, diarrhea, malaria, aphrodisiac, growth supplement of children, cut, wounds, cold, cough, fever	Gallic acid, p-hydroxybenzoic acid, syringic acid, caffeic acid	[1] [20] [22] [54] [55] [53]
Smitinandia micrantha (Lindl.) Holttum	Root and stem	Tonic, antibacterial	NR	[20] [22]
Spathoglottis plicata Blume	Leaf decoction	Rheumatism, used in hot as a foment	NR	[20]
Spiranthes sinensis (Pers.) Ames	Root, stem and tuber	Intermittent fever, fatigue, hemoptysis, kidney diseases, tonic, sores	Spiranthesol, Spiranthoquinone, Spiranthol C, Spirasineol B, Sinensol A, Sinensol B, Sinensol C, Sinensol D, Sinensol E, Sinensol F	[20] [22]
Thunia alba (Lindl.) Rchb.f.	Stem and whole plant paste	Dislocated bones	NR	[10] [20] [22] [26]
Tropidia curculigoides Lindl.	Tuber and stem decoction	Diarrhoea, malaria, antimycobacterial, leishmanicidal activity	4-hydroxybenzaldehyde , 4,4'-dihydroxydiphenylmethane , 3,5-dihydroxy-4-methoxybenzoic acid, 3-cyano-3-methyl-4-oxo-pentanoic acid amide, Phenol, 4-(methoxymethyl), Pentadecanoic acid, Hexadecanoic acid, Heptadecanoic acid, Phenol, 4,4'-methylene-bis, Methyl stearate, Stigmasterol, Z-verongulasterol, 24-norursa-3,12-diene	[20] [22] [56] [53]
Trudelia cristata (Wall. ex Lindl.) Senghas ex Roeth	Root	Wounds, cuts, dislocation of bones	NR	[20]
Vanda coerulea Griff. ex Lindl.	Leaf and flower juice	Expectorant, eye diseases, diarrhoea, loose motion, dysentery, external skin diseases, eye drops for controlling glaucoma, cataract, blindness, as appetizer, tonic	Imbricatin, methoxycoelonin, gigantol, flavidin, coelonin, stilbenoids	[1] [22] [34] [57] [25]
Vanda cristata Wall. ex Lindl.	Leaf and root	Tonic, expectorant, tonsillitis, bronchitis, dry cough, cuts, wounds, boils, dislocated bones	Gigantol, flavidin, coelonin, Glycerin, 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-, 2-Methoxy-4-vinylphenol, 2(4H)-Benzofuranone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-, 1-Eicosanol, Phytol, Stigmast-4-en-3-one	[1] [22] [49] [34]

(*Contd*.)

Table 2 — Majorly used orchid species of the Northeast India for medicinal practices with their active compounds (*Contd*.)

Name	Parts used	Used for treatment of	Active compounds	Reference
Vanda roxburghii R.Br.	Root, leaf, stem and flower	Rheumatism, nervous problems, bronchitis, fever, inflammatory conditions, antidote, otitis, rheumatic, similar kind of pain, syphilis	NR	[1] [20] [25]
Vanda spathulata (L.) Spreng.	Leaves, stem and flower	Skin diseases, diarrhoea, asthma, tuberculosis and madness	NR	[1]
*Vanda tessellata (*Roxb.) Hook. ex G.Don	Leaf, root, plant ash	Rheumatism, allied disorders, sprains, rheumatism, antidote for spider, snake bite, antibacterial, cholera, high fever, bone fracture	Tetracosylferulate, beta-Sitosterol, Daucosterol, beta-Sitosterol-d-glucoside, Heptacosane, Tetracosylferulate, 1-Octacosanol, Tannic acid, beta-Sitosterol, Tessalatin, Oxo-tessallatin, 2,5-Dimethoxy−6,8-dihydroxy isoflavone, Gallic acid, 2.7.7-Trimethyl bicycle [2–2–1] heptanes	[20] [26] [27] [57]
Vanda testacea (Lindl.) Rchb.f.	Leaf and flower	Antiviral, anticancer, earache, rheumatism	NR	[20] [24]
Zeuxine longilabris (Lindl.) Trimen	Whole plant	Whooping cough	NR	[22]
Zeuxine strateumatica (L.) Schltr.	Root and tuber	Tonic	NR	[20] [22]

NR: Not Reported

Fig. 4 — Some medicinally important orchids: a. *Vanda coerulea* Griff. ex Lindl. b. *Thunia alba* (Lindl.) Rchb. f. c. *Rhynchostylis retusa* (L.) Blume d. *Calanthe puberula* Lindl. e. *Renanthera imschootiana* Rolfe

Conclusion

In conclusion, orchid species in NE India, with 145 recognized medicinal applications across eight states, are valuable both regionally and globally for pharmaceutical research. The link between these orchids and indigenous cultures underscores the interconnectedness of biodiversity, cultural practices, and potential medical benefits. Their diverse secondary metabolites, including alkaloids, flavonoids, and sterols, offer promising avenues for addressing prevalent health issues. Demonstrated efficacy against diseases like cancer, tumors, mental disorders, and skin problems highlights their potential as sources of innovative therapeutic agents. Future research should prioritize isolating and identifying new bioactive chemicals from these orchids, followed by rigorous preclinical and clinical studies. This scientific validation enhances our understanding and positions these orchids as candidates for mainstream pharmacology. Preserving indigenous knowledge and cultural traditions related to orchids is crucial, necessitating collaboration among scientists, ethnobotanists, and local communities for conservation and sustainable utilization. Integrating orchids into commercial pharmaceutical applications not only benefits the local economy but also advances global healthcare solutions. Ultimately, NE India's orchids represent more than botanical interest; they offer significant potential as sources of potent medicines. Leveraging their medicinal properties through interdisciplinary research and sustainable practices promises substantial benefits for humanity worldwide.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Author Contributions

AG- Conceptualization, Software, Validation, Investigation, Writing, Visualization, Review & Editing; AN- Conceptualization, Validation, Investigation, Resources, Review & Editing; JSK- Conceptualization, Validation, Review & Editing, Visualization, Project administration, Supervision.

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