

Therapeutic Potential of *Vanda roxburghii* Roxb.: A Review

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ABSTRACT

Orchids are the largest and the most diverse group among the angiosperms. They are cultivated for beautiful flowers. They exhibit incredible range of diversity in size, shape and color of their flowers. These plants have been well known for their economic importance but less for their medicinal value. Many orchids have been used as drugs in Ayurveda for various ailments. The genus *Vanda* from this family includes a medicinal epiphytic plant *Vanda roxburghii* commonly called as Rasna which is a perennial orchid. The plant has been used traditionally for many ailments. The plant has been subjected to a number of biological activities and has given fruitful results. *Vanda roxburghii* has been found to be useful as aphrodisiac, antibacterial, antifungal, antiulcer, anticonvulsant, antioxidant agent. The plant has also been tested for hepatoprotective, anti-inflammatory, wound healing, antinociceptive, analgesic and antidiabetic activity. The present communication deals with the work done on biological activities of this important medicinal plant.

Keywords: *Vanda*, *Vanda roxburghii*, *Vanda tessellata*, Rasna, Orchidaceae, Epiphyte.

INTRODUCTION

Orchidaceae is the largest family of flowering plants, consisting of 25000-35000 species belonging to 750-800 genera¹. The orchids exhibit greatest diversity in tropical and subtropical regions². Orchid flowers are fascinating and gorgeous and show a wide range of diversity in form, size and color. There is a good increase in world floriculture trade due to the orchid flowers³. The Chinese were the first to write books about orchids. In 1233, Chao Shih-Keng wrote *Chin Chan Lan P'u*, and described 20 species and how to grow them. In 1247, Wang Kuei-hsueh wrote his *Treatise on Chinese orchids*, and described 37 species⁴. Orchids have been used in Chinese traditional medicines since 2800 B.C. Orchids were also used by Indians as for their curative and aphrodisiac activities. In Ayurveda, a number of orchid drugs have been used like *Orchis latifolia*, *Dendrobium alpestre*, *Habenaria acuminata*⁵.

Vanda roxburghii (Synonym- *Vanda tessellata*) Roxb. from family Orchidaceae is a medicinal epiphytic perennial orchid found in the Indian subcontinent⁶. It has leafy stem, which is stout giving rise to many thick fleshy roots. The plant has two types of roots- clinging roots and aerial roots. The clinging roots are small and creep into cracks in the bark of the tree, on which the plant grows. These clinging roots not only fix the epiphyte to its support but also absorb the nutrients that are found within the debris accumulating on the bark. The aerial roots hang in the air and are absorbing in nature. Both kinds of roots are provided with a very delicate fibrous special type of absorptive tissue called the velamen which is dead and perforated⁷. It is cultivated for its handsome flowers. The plant requires plenty of light from November till mid of

February. *Vanda* grows well among foliage plants in warm houses where large aerial roots are freely emitted from the stem sides. The clinging roots are small, white to brown in color and remain attached with the support, whereas aerial roots are long white to brown in color, fragrant having lenticels on outer surface. The leaves are green, succulent and thick with parallel veins⁸.

Indigenous medical systems such as *Ayurveda* and local traditional medical practices have used this plant for treatment of various ailments. Unani practitioners use this plant as a laxative and tonic to the liver. Different parts of this plant are also used in hiccup, piles, and boils on the scalp, secondary syphilis and scorpion-sting⁶.

The plant has been used as alexiteric, antipyretic, sexual stimulant, and also in inflammation, bronchitis, rheumatism, and in nervous disorders⁹. In the ancient Sanskrit literature, the leaves of *Vanda roxburghii* have been prescribed for external application in rheumatism, ear infections, fractures and diseases of nervous system⁵. Paste of leaves is used as application in fevers. It is ingredient of Rasna Panchaka Quatha, an ayurvedic formulation used in the treatment of arthritis and rheumatism. The root is used as antidote against scorpion sting and remedy for bronchitis¹⁰.

Vanda roxburghii root has been used traditionally in Bangladesh as tonic to brain and in the treatment of nervous system disorders including Alzheimer's disease¹¹. *Vanda* has a long history of use by the native population for its anti-inflammatory activity. Indian *Vanda* has been found to express antiproliferative effects against various types of cancers including choriocarcinoma (cancer of germ cells), lung cancer and stomach cancer¹². Leaf poultice is applied to relieve sprains,

lumbago nad back pain. Juice of leaves and aerial roots mixed with neem oil and garlic is used to treat ear-ache⁹. In the Unani system of medicine, the root is bitter; laxative, tonic to the liver and brain; good for bronchitis, piles, lumbago, toothache, boils on the scalp; lessens inflammations; heals fractures. A paste prepared from aerial roots with tender bud of *Phoenix loureirii* is used for plastering bone fractures. In Chota Nagpur (India), the leaves pounded and made into a paste are applied to the body during fever, and the juice is introduced into the aural opening for inflammation of the middle ear and as a remedy for otitis media. A compound decoction of root is being administrated in a case of hemiplegia as the Indian physicians considered it useful in all nervous diseases, ear infections, bone fractures, fever and rheumatism. The plant is occasionally given as a cure for snake bite¹³.

Chemical constituents

Important constituents of the plant are alkaloids, glycosides, bitter principles, tannins, resin, saponin, sitosterols and coloring matter. A glycoside (melianin) and a complex withanolide have been reported from plant growing in Pakistan¹⁰. The plant root has been found to contain an alkyl perulate and β -sitosterol -D- glucoside. The dried whole herb also contains long chain alkanes and alkanol sitosterol, resin, saponin, tannins, fatty acids, coloring agents¹⁴. Roots also contain tetracosyl ferrulate¹⁵. Qualitative phytochemical screening of various extracts prepared from the plant has revealed the presence of alkaloids, steroids, tannins, glycosides, flavonoids¹⁶. *V. roxburghii* has been reported to contain β -sitosterol, γ -sitosterol, heptacosane, octacosanol, acetyl tetracosylferrulate, 17- β -hydroxy-14,20-epoxy-1-oxo-[22R]-3 β -[O- β -D-glucopyranosyl]-5,24-withadienolide¹⁷ and melianin¹⁸. Ocimene and linalool have been reported in the scent of the plant subjected to GC-MS analysis. Both benzyl acetate and methylbenzoate compounds were identified in the scent of *V. tessellata*. These compounds could have possibly been derived from the benzenoid/phenylpropanoid pathway. Benzaldehyde, benzylalcohol, cinnamyl alcohol, methyl cinnamate, and methyl salicylate are also reported from the plant¹⁹. Column chromatography and preparative thin layer chromatography have led to the isolation of a phenolic component from the chloroform extract of the plant which was named as gigantol. Gigantol is a bibenzyle compound and found to be an important constituent in the orchid plants and has been studied for a number of biological activities¹¹.

Aphrodisiac activity

The indigenous remedies have been used in treatment of sexual dysfunction since the time of Charaka and Sushruta. Plants have been an exemplary source of drugs. Sexual health and function are important determinants of quality of life. To overcome the problem of male sexual erectile dysfunction, various Indian natural aphrodisiac plants were subjected to screening²⁰.

The flower and roots but not the leaves of *V. roxburghii* were found to stimulate the mounting behavior of male mice. The alcoholic extract of the flower (50 or 200 mg/kg) increased mating performance in the mice. The pups

fathered by the extract treated mice were normal with an increasing trend in the male/female ratio of these pups. The extract was not toxic to the animals¹⁴.

Antibacterial activity

Ethyl acetate and methanol extracts of the plant have shown a moderate activity against gram negative and gram positive bacteria. A compound Melianin isolated from the ethyl acetate extract has shown strong antibacterial activity against the tested organisms. It has shown good activity against *Escherichia coli*, *Bacillus subtilis*, *Bacillus cereus* and *Shigella dysenteriae*¹⁸.

In another study, the antimicrobial activity of chloroform, petroleum ether, ethyl acetate, acetone and methanolic extracts of *V. tessellata* leaves was carried out against *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Proteus mirabilis* and *Bacillus subtilis*. The ethyl acetate extract of the leaves at 10mg/ml concentration exhibited the most pronounced antibacterial action against *E. coli*, *S. aureus* and *K. pneumoniae*²¹.

A study was carried out to investigate the antibacterial property of various extracts prepared from stems of *V. roxburghii*. Petroleum ether, chloroform, ethyl acetate, acetone, methanol and hexane extracts of *V. roxburghii* were tested against bacteria (*Bacillus subtilis*, *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Proteus mirabilis*). The activity of the crude extracts was determined by the agar-well diffusion method. All the extracts exhibited different degrees of inhibitory potential against all the tested bacteria. The antibacterial activity of the ethyl acetate, chloroform, acetone and hexane stem extract showed concentration-dependent activity. The study indicated the broad spectrum antimicrobial potential of *V. roxburghii* stems²².

Silver nanoparticles were prepared from the leaf extract of *V. roxburghii* and subjected to antibacterial activity. The activity was assayed by using a standard well diffusion method against pathogenic bacteria like *Escherichia coli*, *Salmonella* and *Staphylococcus* species. The nanoparticles were reported to be highly toxic against gram positive as well as gram negative bacteria. The results of the activity were comparable to the standard drug, ampicillin⁶.

A study was undertaken to study the antibacterial effect of various extracts of whole plants of *V. roxburghii*. The results revealed that chloroform extract of *V. roxburghii* showed the highest sensitivity to inhibit the growth of several bacterial species. The inhibitory effect of the extract on the growth of microorganisms could be attributed to the presence of certain phytochemical substances that were found present in the plant extract. The results of the study indicated the broad spectrum antimicrobial potential of *V. tessellata* which make the plant a candidate for bio-prospecting for antibacterial drugs²³.

Antifungal activity

The compound melianin and ethyl acetate as well as methanol extracts of the plant were active against *Aspergillus fumigatus*, *Candida albicans*, *Hensinela californica* and *Rhizopus arijae*¹⁸.

The ethyl extracts of *V. tessellata* leaves at 5.0 and 10.0mg/ml concentrations was also found inhibitory to *Candida albicans*²¹.

Another study was carried out to investigate the antifungal property of various extracts prepared from stems of *V. roxburghii*. The petroleum ether, chloroform, ethyl acetate, acetone, methanol and hexane extracts were tested against the fungi (*Candida albicans*, *Aspergillus niger*). Only the ethyl acetate extract showed significant antifungal activity against the fungi²².

Various solvent extracts such as chloroform, methanol, ethanol and hexane of this orchid *V. roxburghii* were tested for antifungal activity against *Penicillium* species *Rhizopus* species *Aspergillus niger* by disc diffusion method. Chloroform extract showed significant antifungal activity against the tested microorganisms making the plant a good agent for antifungal drugs²³.

Antiulcer activity

An experiment was designed to evaluate the antiulcer activity of petroleum ether extract of *Vanda tessellata* leaves. In acute toxicity testing no mortality was observed in mice even at a dose of 2 g/kg of petroleum ether extract of *Vanda roxburghii*, indicating that the extract is safe.

The results on histopathological investigation on the gastric mucosa of rats revealed that the pretreatment with petroleum ether extract of *Vanda roxburghii* moderately inhibited aspirin induced haemorrhage, edema, dysplastic changes and ulceration. The extract was found to possess antiulcer activity²⁴.

Anticonvulsant activity

The ethanolic extract of the roots of the plant has been subjected to anticonvulsant activity on maximal electroshock induced seizures, pentylenetetrazole and picrotoxin induced seizures in mice. The parameters used for observation were latency of tonic convulsions and the number of animals protected from tonic convulsions. The extract at a dose of (100 mg/kg) was shown to have significant ($P < 0.05$) increase in latency to clonic convulsions²⁵.

Hepatoprotective activity

The petroleum ether extract of leaves of *V. roxburghii* Roxb has shown significant hepatoprotective activity in albino rats with CCl₄ liver injury. The extract was given orally at doses of 100, 200 and 400 mg/kg. The activity was found to be dose dependent. The probable mechanism is that it maintains structural integrity of hepatocyte cell membrane and may be due to the ability to suppress the oxidative degradation of DNA. The results were comparable to a well known hepatoprotective drug, Silymarin²⁶.

Antinociceptive activity

The aqueous and methanolic leaf extracts of *V. roxburghii* were screened for antinociceptive activity in acetic acid-induced writhing test, hot plate test, and tail immersion test in mice. The extracts at doses of 200 and 400 mg/kg exhibited a significant dose-dependent antinociceptive activity in hot plate and tail immersion test. From the acute oral toxicity test, the plant was found to have low toxicity profile²⁷.

Antioxidant activity

The petroleum ether extract of *V. roxburghii* Roxb showed optimum percentage of inhibition of nitric oxide (NO) but not, 1-Diphenyl - 2 - Picrylhydrazil (DPPH). NO inhibition is attained at 200mg/kg. At higher concentration the percentage inhibition was reduced due to saturation effect of the extract. It has not exhibited any appreciable DPPH radical scavenging activity²⁸.

Silver nanoparticles prepared from the leaf extract of *V. roxburghii* were subjected to antioxidant activity using DPPH scavenging method. The activity was higher than the plant extract alone and was comparable to the standard antioxidant (Butylated hydroxytoluene)⁶.

Chloroform extract was shown to demonstrate strong ferric-reducing antioxidant power and scavenging activity against DPPH and hydroxyl free radicals when compared with the other extracts and the reference standard catechin¹¹.

Anti-inflammatory activity

Two compounds from *Vanda roxburghii*, heptacosane and octacosanol have shown marked anti-inflammatory activity in carrageenan induced oedema in rats and mice²⁹.

A polyherbal formulation OST-6 is used in the management of osteoporosis in postmenopausal women. This formulation contains *Vanda roxburghii* as one of its ingredients. The plant possesses anti-inflammatory properties and relieves joint pains in osteoporosis³⁰.

Wound healing activity

The plant was subjected to wound healing testing. Local administration of the crude extract to rats for wound healing revealed 60% reduction in wound diameter compared to the control. It significantly increased the dry granulation tissue weights, hydroxyproline, hexosamine and protein content in the test group. The pro-healing action of this extract may be attributed either to increased collagen deposition or to better alignment and maturation or both. The results suggested that the extract of *Vanda roxburghii* administered topically has wound healing potential in rats¹³.

Antidiabetic activity

A study was performed to evaluate the effects of the leaf extract of *Vanda roxburghii* (Roxb.) in the management of diabetes. The plant did not show any direct effect in reducing postprandial hyperglycaemia in normoglycaemic rats³¹.

Analgesic activity

The oral administration of both doses (200 and 400 mg/kg) of *Vanda roxburghii* methanolic extract significantly inhibited writhing response induced by acetic acid in a dose dependent manner. Acetic acid-induced writhing model represents pain sensation by triggering localized inflammatory response. Such pain stimulus leads to the release of free arachidonic acid from tissue phospholipid. The extract was found to exhibit the analgesic property³².

Conservation of orchids in India

Orchids have enjoyed a special place in the life and culture of ancient Indians. These plants have been conserved directly or indirectly in the sanctuaries created by the kings. The endemic and rare orchids having

ethnomedicinal properties need attention for scientific research for use as human welfare¹².

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