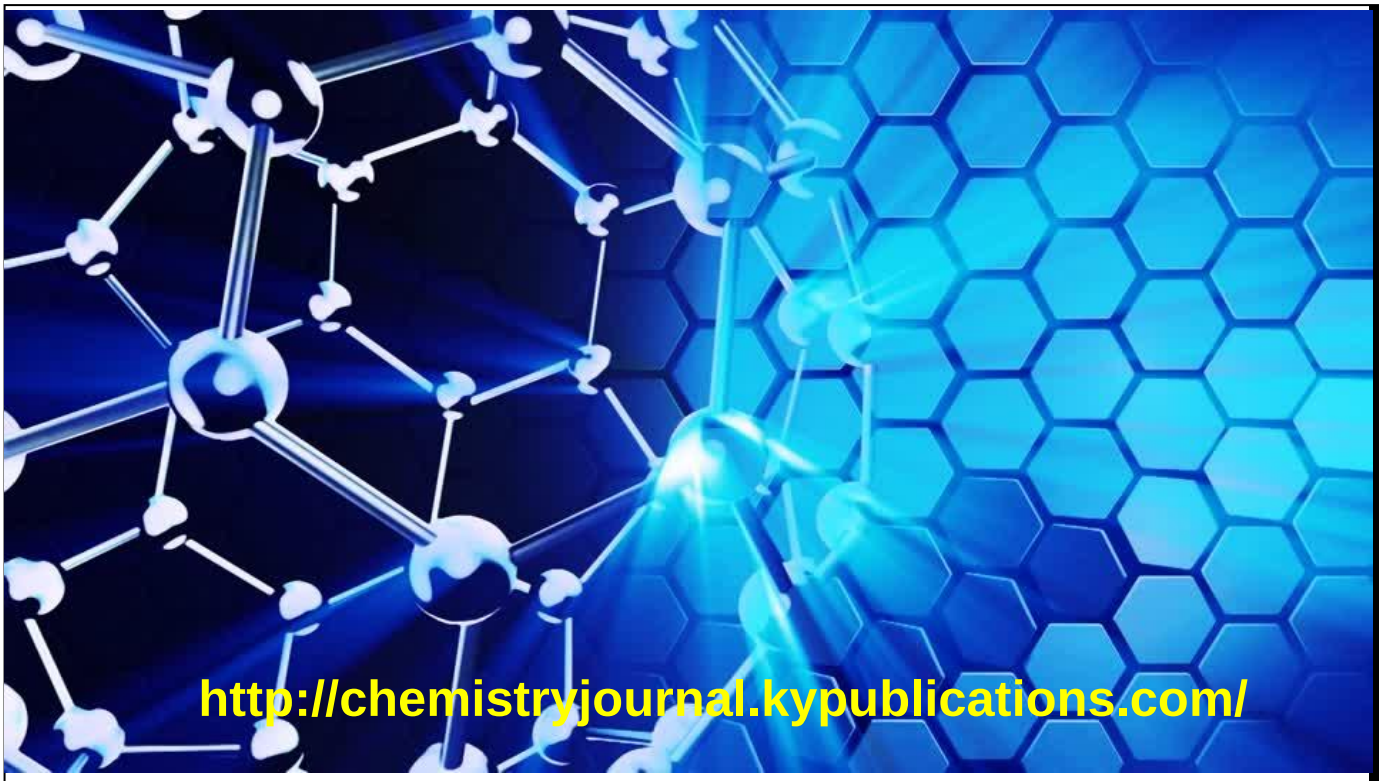

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PHARMACOLOGICAL POTENTIAL AND PHYTOCHEMICAL SCREENING OF AN EPIPHYTIC HERB. *VANDA TESSELLATA* : A REVIEW

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REVIEW ARTICLE

ABSTRACT

Vanda tessellata is an epiphytic and endangered orchid. It is an important medicinal plant in Indian and Chinese folk medicine. Various secondary metabolites are produced by this plant species, many of them are pharmacological interests. Its modern as well as traditional uses make this substance much more valuable. The important pharmacological activities are antibacterial, anti-inflammatory, antioxidant, cytotoxic, analgesic and anticonvulsant activity. This review paper explains the evidence-based information regarding the phytochemistry and also pharmacological activity of this plant.

Keywords: Epiphytic, Secondary metabolites, Pharmacological activity, Antibacterial activity, Anti-inflammatory activity, Phytochemistry.

INTRODUCTION

Vanda tessellata (Roxb.) Hook. Ex.G. is an endangered and epiphytic orchid. The different parts of this plant has been used as indigenous medicine sources namely *Ayurveda* and local traditional medical practices (Chopra, 1956). Now-a-days drug resistances of pathogenic species are increased. So, plant based antimicrobial agents are used as alternative medicine (Sandrasagaran, 2014).

Description

Vanda tessellata Roxb. is an epiphytic perennial herb. Stems are 30-60cm long, stout and having simple or branching aerial roots. Leaves are 15-20 cm, succulent, long, linear, recurved and complicate. Flowers in 6-10 flowered racemes reaching with the peduncle 15-25 cm long,long-lived flowers occuring in the summer, fall and early winter.Sepals yellow, tessellated along with brown lines and white margins. Petals are shorter than sepals. Lip 16 mm long, bluish with purple dotted. Capsule length 7.5-9 cm narrowly clavate-oblong with acute ribs.

Distribution

This plant is distributed throughout Bangladesh, Indian subcontinent, Srilanka, Myanmar and Indochina. It grows as an epiphytic on Mango, Black berry, and Guava trees.

Synonyms

Epidendrum tesselatum Roxb. 1795; *Vanda roxburghii* R. Br. 1820; *Aerides tessellatum* Wight 1824; *Vanda tesselloides* Rchb. f. 1864 ;*Vanda roxburghii* var. *wrightiana* Rchb.f. 1883;

Taxonomy

Kingdom: Plantae
Class: Monocotyledons
Order: Asparagales
Family: Orchidaceae
Tribe: Vandeae
Genus: *Vanda*
Species: *Vanda tessellata* Roxb.

The aim of this paper is to compile the data regarding the pharmacological potential and phytochemical screening of this plant species which was studied by different scientists and researchers in the world and would help the scientific fraternity to formulate the ways to conserve this valuable endangered medicinal plant species.

ETHNOMEDICINAL USES

The medicinal properties of *V. tessellata* are described in Unani, Ayurveda and traditional Indian medicine (Kirtikar and Basu,1999) . The root of this plant has been used to treat piles, fever, hiccough, dyspepsia, snake bites and bronchitis (Ghani,2003). The root is used in externally for the treatment of rheumatism and allied disorders, and diseases of the nervous system (Uprety *et al.,* 2010) . The leaves are pounded and the paste is applied to the body to alleviate fever; their juice is applied in the ear for the treatment of otitis and also for the treatment of certain inflammatory conditions (Basu *et al.,*1971). Unani practitioners hold it to be laxative and tonic to the liver. It is also used to treat boils on the scalp (Kirtikar and Basu,1999; Ghani,2003). Leaves of *V. tessellata* are macerated with ginger pieces (rhizomes of Zingiber officinale Roscoe) and applied to affected areas and that application for a long time gives satisfactory results in paralysis and is satisfactory for rheumatic pain (Rahmatullah *et al.,*2010; Hasan *et al.,*2012).

PHARMACOLOGICAL ACTIVITY

Antibacterial activity

Roots of this plant were reported to possess antibacterial and antitubercular properties by Das *et. al.*(1967). Gupta and Katewa (2012) made an attempt to bio-prospect the antimicrobial activity of chloroform, petroleum ether, ethyl acetate, acetone and methanolic leaf extracts of *V. tessellata* against *Staphylococcus aureus ,Escherichia coli Klebsiella pneumoniae, Bacillus subtilis and Proteus mirabilis.* The ethyl acetate extracts of the leaves at 10mg/ml concentration showed significant antibacterial activity against *E. coli, S. aureus and K. pneumonia* with a zone of inhibition of 14.66, 13.66 and 12.00mm and MIC values of 0.78, 0.156 and 1.25 mg/ml respectively. The corresponding MBC values of ethyl acetate extracts against those bacteria fluctuated from 0.625-0.312 mg/ml. The ethyl extracts of *V. tessellata* leaf at 5.0 and 10.0mg/ml concentrations showed antimicrobial activity against *Candida albicans* with 10.0-11.0mm zone of inhibition, respectively.

Behara *et al.*(2013) tested antibacterial activity of *V .tessellata* leaves and root in four different organic solvents such as Methanolic, Butanolic, Chloroform and Di-ethyl ether against 11 human pathogens viz *Bacillus subtilis*, *Escherichia coli* 0157: H7,), Entero-toxicogenic *Escherichia coli (ETEC)*, Entero-pathogenic *Escherichia coli* (EPEC), *Shigella boydii, Shigella sonnei, Shigella dysentriae, , Staphylococcus aureus, Vibrio cholerae* (0139), *Vibrio chlorerae* (Ogawa) and *Vibrio cholerae* (Inaba). The results revealed that all crude extracts showed antibacterial activity in varying degree arresting growth of at least one or more test pathogens. Among the solvents, di-ethyl ether extracts showed significant bactericidal activity against all the pathogens tested followed by butanolic, chloroform and methanolic extracts. The MIC value of different extracts varied between 3.5 to 25 mg/ml.

Chaitanya *et al* (2013) investigated the antimicrobial activity by using polar (Methanol) and non-polar (Chloroform) solvent extracts of *Vanda tessellate* root. The bacterial strains used were *E.coli, Staphylococci, Psuedomonas putida, , Klebsiella pneumonia* and *Bacillus subtilis* and whereas fungal strains used were *Aspergillus niger, Fusarium, Rhizopus, Colletotrichum, and Mucor*. Methanolic root extracts were found to be more active against the tested microorganisms than the non-polar extracts. The analysis revealed highest activity in polar solvent against bacteria in order of the *Klebsiella pneumonia, E.coli, Staphylococcus aureus, Pseudomonas putida, and Bacillus subtilis.* whereas non-polar solvent extracts showed their highest activity against bacteria in order of *Pseudomonas putida, E.coli, Klebsiella pneumonia, Staphylococcus aureus* and *Bacillus subtilis.* The polar and non-polar solvents exhibited broad spectrum inhibition zone against the fungal species *Aspergillus niger, Aspergillus flavus, Fusarium, Colletotrichum, Rhizopus and Mucor*.

Gupta and Katewa (2014a) studied the antibacterial activity of *V. tesselleta* stem of various solvents (petroleum ether, chloroform, ethyl acetate, acetone, methanol and hexane) against bacteria (*Bacillus subtilis, Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Proteus mirabilis)* and fungi (*Candida albicans*, *Aspergillus niger)*. All the extracts found different degree of inhibitory potential against all the microorganisms tested. The antimicrobial activity of the ethyl acetate, chloroform, acetone and hexane stem extract showed dose-dependent activity against all the tested bacteria at different concentrations with the zone of inhibition ranging from 12-22 mm. Among all the studied solvents, only the ethyl acetate extract showed significant antifungal activity at different concentrations against

Candida albicans and *Aspergillus niger* with the zone of inhibition ranging from 12-19 mm. Gupta and Katewa (2014a) found that the MIC values of the different extracts were lower than the MBC values, suggesting that the extract is bacteriostatic at lower concentrations but bactericidal at higher concentration.

Antibacterial activity of various root extract of *Vanda tessellata* (Roxb.)Hook.ex G.Don such as petroleum ether, chloroform, ethyl acetate, acetone, methanol and hexane against six Gram positive and Gram negative bacteria viz. *Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Proteus mirabilis* and *Bacillus subtilis* and two fungi *Candida albicans* and *Aspergillus niger* by agar-well diffusion method by Gupta and Katewa (2014b). Methanol extract gave maximum percent extractive value followed by petroleum ether, acetone, ethyl acetate and chloroform. Ethyl acetate extract produced definite antibacterial activity against the human pathogenic bacteria such as *Escherichia coli* and *Staphylococcus aureus* with the zone of inhibition was found between 11-16 mm and 11-13 at different concentrations respectively. Among all the solvent extracts only the ethyl acetate extract showed significant antifungal activity against the *Candida albicans* with the zone of inhibition ranging from 11-16 mm at various concentrations. The MIC values of the extract showed lower values than the MBC values, suggesting that the extract showed bacteriostatic at lower concentrations whereas bactericidal at higher concentration.

Bhattacharjee *et al.*(2015) studied *in vitro* antimicrobial activity of using different solvents extracts (chloroform, methanol, ethanol and hexane) from whole plant of *Vanda tessellate* against five clinical pathogenic bacteria *viz. Staphylococcus aureus*, *Bacillus subtilis*, *Vibrio cholerae*, *Escherichia coli, Klebsiella pneumonia* and three fungi *viz. Penicillium* sp. *Rhizopus* sp. *Aspergillus niger* by disc diffusion method. The antibacterial activity against all bacteria with the zone of inhibition was found between 5-15 mm and found that highest inhibition zone (14-15 mm) with the concentration of 10.0 mg/l of chloroform extract. Chloroform extract showed significant antifungal activity against *Penicillium* sp., *Rhizopus* sp. and *Aspergillus niger* with the highest zone (16-17 mm) of inhibition.

Gupta (2016) isolated three unknown compounds named as VT-1 in pure form, VT-2 and VT-3 in semi pure form and showed antimicrobial activity against The pathological strains of test organisms *Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Proteus mirabilis, Bacillus subtilis*, *Candida albicans* and *Aspergillus niger* by agar-well diffusion method. VT-1 showed significant antibacterial activity against *Escherichia coli* (16.66±0.47), *Proteus mirabilis* (15.66±0.47) and *Bacillus subtilis* (14.00±0.00) but less antifungal activity against *Candida albicans* (10.66±0.47) and *Aspergillus niger*(10.66±0.47**)** than VT-2 and VT-3 .Compound VT-2 gives (12.33±0.47) against *Candida albicans* and VT-3(14.33 ±0.47)zone of inhibition against *Aspergillus niger* respectively.

Anti-inflammatory activity

Prasad *et al.* (1968) evaluated that the steroidal fraction of *V. tessellata* possessed significant anti-inflammatory activity against acute inflammation which is induced by carrageenan, serotonin and formaldehyde.

Chawla *et al.* (1992) reported the methanol extract of this plant root showed remarkable anti-inflammatory activity against carrageenan – induced oedema in rodents.

Antioxidant activity

According to Vijaykumar (2013),the petroleum ether extract of leaves of *V. tessellata Roxb* showed significant inhibition of nitric oxide (NO) but not 1, 1-Diphenyl-2- Picrylhydrazil (DPPH). NO inhibition was attained at 200mg/kg. However, at higher concentration the percentage inhibition is reduced due to saturation effect of the extract.

Uddin *et al.*(2015) tested antioxidant activity by a large number assays including ferric reducing antioxidant power, scavenging of 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical and hydroxyl radical, and inhibition of lipid peroxidation assays by using the petroleum ether, chloroform, ethyl acetate and water extracts of *V .tessellata* roots. Their results revealed that chloroform extract showed highest activity with an absorbance of 1.39 at 100 µg/ml concentration, this was near to the activity of the reference standard catechin that gave an absorbance of 1.48 at 100 µg/ml concentration. In DPPH radical scavenging, the IC_{50} of chloroform extract and catechin was found to be 5.76 and 4.55 µg/ml, respectively. Their results also revealed that the chloroform extract showed more efficient activity to scavenge hydroxyl radical with an IC_{50} of 7.96 µg/ml than standard catechin whose IC_{50} was found to be 9.45 µg/ml under the same condition. In case of the inhibition of brain lipid peroxidation they showed that the chloroform extract had the maximum activity among the extracts tested in with an IC_{50} value of 27.52 µg/ml.

The methanolic root extract of *V .tessellata* exhibited antioxidant activity in DPPH radical scavenging activity, nitric oxide scavenging power assay tested by Islam *et al* (2016). In DPPH and NO scavenging assay the extract shown

adequate antioxidant activity with the IC_{50} values in DPPH radical scavenging and NO scavenging assays were found to be 113.35±1.27 and 127.31±0.26 µg/mL while the IC_{50} values of ascorbic acid were 12.30±0.11 and 18.64±0.22 µg/mL. Reducing power activity of the extract was found to increase in a dose dependent fashion.

Cytotoxic activity

Chowdhury *et al* (2014) showed cytotoxic activity of methanol and aqueous leaves extract of *V. tessellata* by the brine shrimp lethality assay. The LC_{50} for methanol and aqueous extract of *V. tessellata* leaf were found that 574.32 and 430.41 µg/mL respectively and standard was used vincristine sulphate with 0.74 µg/ml.

The cytotoxic potentiality of all the root extracts (methanol root extracted fractionated petroleum ether -VRP, chloroform -VRC, ethyl acetate-VRE, and residual aqueous fraction -VRA) of *V.tessellata* were performed on brine shrimp nauplii using Mayer's method by Uddin *et al* (2015). Among the fractions, VRC exhibited the lowest LC_{50} value (75.79 µg/ml) while VRA provided the highest LC_{50} value (502.42 µg/ml). The calculated LC_{50} value was 153.72, 223.01, and 343.64 µg/ml for VRM, VRP and VRE respectively. The results reveal that LC_{50} value of all test samples, compared with standard vincristine sulfate (LC_{50} = 0.89 µg/ml) was lower than the cutoff value for cytotoxity.

The methanolic root extract of the *V.tessellata* was investigated for cytotoxic activity using Brine Shrimp lethality bioassay by Islam *et al* (2016). In this the extract showed significant toxicity of Brine Shrimp nauplii with the LC_{50} value of 25.19+-0.98 µg/mL.

Analgesic activity

Analgesic activity of methanol and aqueous extracts of *V.tessellata* leaves was determined by Chowdhury *et al* (2014). The results exhibited a significant (p < aqq 0.05 - < 0.01) dose-dependent antinociceptive activity in hot plate and tail immersion test. The reaction time onward to 90 min the at 200 and 400 mg/kg doses. In acetic acid-induced writhing test, compared with control and oral administration of aqueous and methanol leaves extracts (200 and 400 mg/kg) reduced the writhing significantly. At the concentration 400 mg/kg showed maximum percentage of pain inhibition 42.37% and 45.08% for aqueous and methanol leaves extracts respectively. Diclofenac sodium (10 mg/kg) and nalbuphine (10 mg/kg) were used as reference antinociceptive drugs.

Uddin *et al.*(2015) tested antinociceptive effect in mice using acetic acid-induced writhing, formalin injection, and hot plate tests of *V.tessellata* methanol root extracted fractionated petroleum ether (VRP), chloroform (VRC), ethyl acetate (VRE), and residual aqueous fraction (VRA). In the acetic acid-induced writhing test, mice disposed with various concentrations (12.5, 25, and 50 mg/kg) exhibited reduced number of writhing. Amongst, ethyl acetate fractions (VRE) of this plant root exhibited the maximum activity at various concentrations (12.5, 25, and 50 mg/kg) i.e. 43.65, 71.34, and 80.23 %, respectively in a dose-dependent fashion. Otherhand, chloroform root fraction denoted as VRC at three different concentration (12.5, 25, and 50 mg/kg) showed the maximum reduction of paw licking time in mice during the 1^{st} phase of the formalin test i.e. 15.00, 37.05, and 56.44 %, respectively and during the 2^{nd} phase of the same test resulted 20.55, 49.08, and 59.81 %, respectively. In hot plate test, VRE treatment at doses of 25 and 50 mg/kg both increased the maximum latency time after 30 min.

Islam *et al* (2016) showed analgesic activity of the methanolic root extract of *V.tessellata* using acetic acid induced writhing model of pain in mice. The crude extract at 200 and 400 m /kg b.wt. doses displayed significant ($p<0.001$) reducing in acetic acid induced writhing in mice with a maximum effect of 75.89% reduction at 400 mg/kg b.wt. Which is comparable to the standard diclofenac sodium (86.52%).

Anticonvulsant activity

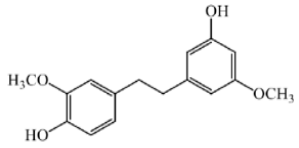
The ethanolic extract of the roots of *Vanda roxburghii* was studied for its anticonvulsant effect on maximal electroshock-induced seizures pentylenetetrazole, picrotoxin induced seizures in mice by Pathan and Ambavade (2014). The latency of tonic convulsions and the number of animals protected from tonic convulsions were observed. It has been found in clonic convulsions of their work that the ethanolic root extract of this plant (100 mg/kg) showed significant ($P<0.05$) increase in latency. *Vanda roxburghii* showed anticonvulsant activity against Pentylenetetrazole, Maximal electroshock and Picrotoxin induced convulsions in mice.

PHYTOCHEMICAL ANALYSIS

Accroding Ghani *et al* (1994) the plant has an alkaloid, flavonoids glycoside, tannins, β-sitosterol, γ-sitosterol and a long chain aliphatic compound, fatty oils, resins and different colouring matters. Roots of *V.tessellata* contain β-sitosterol-D-glucoside and tetracosylferrulate.

The phytochemical tests was carried by Sirisha *et al* (2013) indicate the presence of phytoconstituents like the flavonoids, tannins, saponins, terpenoids, steroids and alkaloids in the petroleum-ether extract.

Uddin *et al* (2015) was isolated active compounds from the chloroform separation using column chromatography and preparative thin layer chromatography . The component was identified as gigantol by comparing its ^{13}C NMR and ^{1}H NMR spectra. Gigantol 1-(3'-hydroxy-5'-methoxyfenyl-2-(4"-hydroxy-5"-methoxyfenyl)ethan, a bibenzyle compound has been found to be an important constituent in the orchid plants



Gupta (2016) had been isolated and identified three unknown compounds VT-1 in pure, VT-2 and VT-3 in semi pure form out of new 17-ketosteroid from *Vanda tessellate.* The structure of compound 1 was elucidated on the basis of FT-IR,^{1}H and ^{13}C NMR spectroscopy and found it to be a ketonic compound named as 3-ethoxy-10,17dimethyltetradecahydro-1*H*cyclopenta[a]phenanthren -17(2*H*)-one. Its molecular formula is $C_{21}H_{34}O_2$ and mass weight is 318.494 g .

CONCLUSION

From this review work of the existing study concluded that *V.tesselata* has been used in the treatment of many diseases and also any other microbial infection. Various bioactive compounds isolated from different parts from this plant parts. This plant can be a good source to herbal drug industry. The plant contained various the phytochemicals that can be utilised for the development of phyto-therapeutics. There is very much important to conserve this plant by tissue culture, *ex situ* or *in situ* conservation for its potential in the field of medicinal as well as pharmaceutical sciences for novel application.

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