

A REVIEW ON *DENDROPHTHOE FALCATA* (LINN. F.)

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ABSTRACT

Dendrophthoe falcata (Linn.f.) commonly known as 'Vanda' belongs to family Loranthaceae. This is an evergreen parasitic plant grown on different host plant. It is ethnomedicinally used for treating ulcers, asthma, impotence, paralysis, skin diseases and wounds. This plant has religious importance also. It contains many phytoconstituents like quercetin, quercetrin, rutin, gallic acid, beta-amyrin acetate, beta-sitosterol etc. which is responsible for biological activity. Scientific evidence suggest its versatile biological functions such as its potentiality in immunomodulation, wound healing, asthma, hepatoprotective, antioxidant, antidiabetic, contraception. This review study presents a detailed survey of literature on pharmacognosy, phytochemistry, ethnomedicinal uses and pharmacological activities.

Keywords: *Dendrophthoe falcata*, Herbal medicine, pharmacological activity, review.

INTRODUCTION

Medicinal plants are part of human society to combat diseases, from the dawn of civilization¹. Nature has bestowed our country with an enormous number of medicinal plants therefore India has often referred to as the medicinal garden of the world. In the armory of modern medicine, the components of synthetic drugs or the medicinally accepted plants are evaluated for their efficacy against certain diseases thus forming a valuable source of therapeutic agents^{2,3}.

A world health organization survey indicated that about 70 – 80% of the world's population rely on non-conventional medicine, mainly of herbal sources, in their primary healthcare. This is especially the case in developing countries where the cost of consulting a western style doctor and the price of medication are beyond the means of most people^{4,5}.

The important advantages claimed for therapeutic use of medicinal plants in various ailments due to their safety besides being economical, effective and their easy availability^{6,7}.

Dendrophthoe falcata Ettingsh (Family- Loranthaceae) is a large bushy parasitic shrub with grey bark, thick usually opposite leaves, orange-red or scarlet flowers and ovoid – oblong berries⁸. It is also known as *Loranthus falcatus* Linn. f. It is indigenous to India, Srilanka, Thailand, Indo-china, Australia. The numbers of host reported for this parasite is over 3009. About 7 species are found in India. The bark has narcotic properties. It is used in wounds and menstrual troubles and also as a remedy in consumption, asthma and mania. The bark is used as a substitute for betel-nut¹⁰. *Dendrophthoe falcata* is reported to contain biological active substances such as flavonoid, quercetin, kempferol, rutin¹¹, tannins, β -sitosterol, stigmasterol, β -amyrin, oleanolic acid¹².

Vernacular names:¹³

Sanskrit	:	Vanda, Vrikshabhaksha, Vriksharuna
Hindi	:	Banda
Bengali	:	Baramanda
Marathi	:	Vanda
Gujrati	:	Vando
Telgu	:	Badanika, Jiddu
Tamil	:	Plavithil, Pulluri
Malayalam	:	Ithil
Uriya	:	Bridhongo

Scientific Classification:¹³

Domain	:	Eukaryota
Kingdom	:	Plantae
Subkingdom	:	Viridaplantae
Phylum	:	Tracheophyta
Subphyllum	:	Euphyllophytina
Class	:	Magnoliopsida
Subclass	:	Rosidae
Superorder	:	Santalanae
Order	:	Santalales
Family	:	Loranthaceae
Genus	:	<i>Dendrophthoe</i>
Species	:	<i>falcata</i>

Macroscopic Characters

Leaves thick, coriaceous, usually opposite, 7.5 – 18 by 2 – 10 cm, petiolate, exstipulate, decussate, simple, ovate to oblanceolate. A large bushy usually glabrous branch – parasite, bark grey, smooth, small twigs of aerial branches ranging from 2 mm to 2.5 cm in thickness, stem slightly rough to touch, fracture irregular, fractured surface dark brown, no distinct taste or colour^{14,15}. Flowers in short spreading stout axillary unilateral racemes often 2 from an axil, pedicel short, bract 1.6 mm long, broadly ovate, subacute concave, orange red in colour. Calyx 4 mm long, more or less hoary. Corolla 2.5 – 5 cm long, split at the back; tube curved, slightly widened upwards. Berry 8 – 13 mm long, ovoid – oblong, pink, smooth, crowned by a cup-shaped calyx^{14,8}.

Microscopic Characters^{14,15,16}

Transverse section of leaf

Transverse section of the leaf shows a thick cuticle, upper and lower epidermis composed of squish cells with convex periclinal outer walls. The leaf has prominent midrib and even lamina. Midrib is shallowly convex on the adaxial side and broadly semicircular on the abaxial side. It shows prominent cuticle as well as radial wall. Leaf is dorsiventral and embedded in nature. The ground tissue has dilated circular compact parenchyma cell most of them having filled with dense tannin mass. It contains collateral type of vascular bundle.

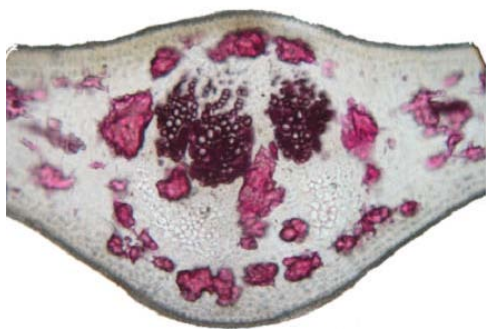


Fig-1 Transverse section of leaf

ep-epidermis, pl-palisade, ph-phloem, sc- stone cells, xy-xylem, ch- chlorenchyma

Transverse section of stem

A transverse section of stem reveals a circular outline with a thick cuticle and epidermis made up of squarish or barrel shaped cells with convex outer periclinal walls and interrupted here and there by lenticular openings. The stem is circular in cross section view. The epidermis consists of single layer of papillate cells with cuticles. The cortex is wide homocellular and parenchymatous. The cells have tannin body. The cortical zone is about 12 layer and 400 μ m wide. The stele consists of wide hollow cylindrical discrete vascular segments which are separated from each other by parenchymatous. These are small clusters of sclerides.

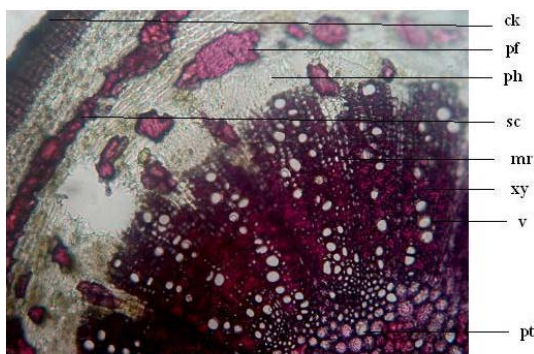


Fig-2 Transverse section of stem

ck- cork, pf-pericyclic fibres, ph-phloem, sc- stone cells, mr- medullary rays, xy-xylem, v- vessels, pt-pith

Phytochemistry

Preliminary phytochemical screening mainly revealed the presence of carbohydrates, alkaloids (leaf), phytosterols, fixed oils and phenolic compounds (Table 1 and 2)^{15, 16}. The alcoholic extract concentrate from the stems was fractionated successively into hexane, chloroform and methanol solubles. The hexane and hexane – benzene (19:1) eluates gave rise to unidentified oils and plant alcohols. With hexane-benzene eluate (3:1) β -amyrin acetate was isolated and identified by hydrolysis (1:1).

An apparently new triterpene, $C_{33}H_{54}O_4$, m.p. 219-220 $^{\circ}C$, $[\alpha]_D + 56^{\circ}$, IR – 1735 cm^{-1} was isolated. Further elution with benzene and benzene-ethylacetate furnished β -sitosterol, stigmasterol and oleanolic acid¹². Different flavonoids were isolated from *Dendrophthoe falcata* Ettingsh growing on different host plants. The reported chemical examination of *D. falcata* growing on *Terminalia tomentosa* has revealed the presence of gallic, ellagic and chebulinic acid and quercetin¹⁷. The bark of *D. falcata* has yielded (+) – catechin

and leucocyanidin¹⁸. Quercetin has also been reported to be the major compound from *D. falcata* growing on *Vitex negundo*¹⁹. Three cardiac glycosides were isolated – strosposide, odoroside F and neritaloside from the leaves of *D. falcata* growing on *Nerium oleander*²⁰. Oleanolic acid, its acetate and methyl ester acetate, β -sitosterol and stigmasterol were obtained from the stems of *D. falcata* growing on *Mangifera indica*¹². Extensive chromatographic screening of extracts of the fruits of the Indian Ayurvedic plant *Dendrophthoe falcata* resulted in the isolation of three new triterpenes, 3β -acetoxy- 1β -(2-hydroxy-2-propoxy)- 11α -hydroxy-olean-12-ene (1), 3β -acetoxy- 11α -ethoxy- 1β -hydroxy-olean-12-ene (2) and 3β -acetoxy- 1β -hydroxy- 11α -methoxy-olean-12-ene (3) along with nine known compounds, 3β -acetoxy- 1β , 11α -dihydroxy-olean-12-ene (4), 3β -acetoxy- 1β , 11α -dihydroxy-urs-12-ene (5), 3β -acetoxy-urs-12-ene-11-one (6), 3β -acetoxy-lup-20(29)-ene (7), 30-nor-lup- 3β -acetoxy-20-one (8), (20S)- 3β -acetoxy-lupan-29-oic acid (9), kaempferol-3-O- α -L-rhamnopyranoside (10), quercetin-3-O- α -L-rhamnopyranoside (11), and gallic acid (12). The structures of these compounds were determined using 1D and 2D NMR and high resolution electrospray mass spectrometry. These compounds were assayed for binding to estrogen receptors- α and β and kaempferol-3-O- α -L-rhamnopyranoside (10) was found to a ligand for both receptors with greater affinity for β . The triterpenes (1-9) are reported for the first time in the genus *Dendrophthoe* and assumes taxonomic significance²¹. α -Glucan phosphorylase of the leaf tissues of *D. falcata* was partially purified and isolated in two forms, A and B by DEAE-cellulose column chromatography. Both the forms utilized soluble starch with equal efficiency, K_m value being 0.12 and 0.25 g/l for A and B respectively. Form A phosphorylase utilized glycogen efficiently, K_m value of 0.42 g/l but glycogen did not serve as primer for the B form. In contrast, the B form alone could utilize achroic dextrin, though with less efficiency than starch. The K_m values for glucose-1-phosphate were 5mM and 1.7 mM for A and B. AMP activated phosphorylase A, at the optimum pH, but not the B form. Among other differences between the two enzyme fractions were stability towards heat, linearity of activity with protein concentration and response to added cations and mercaptoethanol. The two enzymes were sensitive to some phenolics; phloridzin, in particular, was highly inhibitory to fraction B, whereas fraction A was inhibited only slightly. The phenolics in the leaves of *D. falcata* were highly inhibitory to both forms of enzyme²². Hexokinase was partially purified from the leaves of *Dendrophthoe falcata*. The optimum pH for the enzyme was 8.5. The enzyme was sensitive to p-CMB and the inhibition could be reversed by 2-mercaptoethanol. The optimum temperature was 40 $^{\circ}$ and energy of activation 6900 cal/mol. The enzyme had an absolute requirement for a divalent metal ion. Although Mg^{2+} was the preferred metal, it could be partially replaced Mn^{2+} and Ca^{2+} . ATP was the most effective phosphoryl donor. Glucose was the best substrate; the K_m values of 0.14 and 0.26 mM were obtained at saturated and sub-saturated ATP concentration. Phosphorylation coefficients show the following order of reactivity of sugars: glucose > mannose > 2-deoxy D-glucose > fructose > glucosamine > galactose > ribose. The K_m value for ATP was 0.16 mM, which increased to 0.35 mM in the presence of 0.5 mM ADP and 5'-AMP were competitive inhibitors with respect to ATP, and K_i values were 0.4 and 1.2 mM respectively²³.

Pharmacological activities

Hepatoprotective activity

The study revealed that both ethanol and aqueous extracts significantly reduced AST, ALT, alkaline phosphatase, total bilirubin levels and increased the total protein and albumin levels. The liver histology of the ethanolic extract treated group showed microfatty changes with a dense collection of lymphoid cells suggesting evidence of very little necrosis or degeneration. The phenolic compounds and flavonoids in the ethanolic extract of leaves of *Dendrophthoe falcata* are responsible for the hepatoprotective activity²⁴.

Antioxidant, Antihyperlipidemic and Antidiabetic activity

Ethanol extract showed better in-vivo antioxidant activity in both DPPH radical scavenging (IC₅₀=16.78 μ g/ml) and nitric oxide radical scavenging activity (IC₅₀=54.5 μ g/ml) in sodium

nitroprusside/Griss reagent system. The ethanolic extract of aerial parts of *Dendrophthoe falcata* possesses potent antioxidant activity by inhibiting lipid peroxidation, reduced glutathione, superoxide dismutase levels and increased the catalase activity.

Lipid lowering activity of *Dendrophthoe falcata* extract (300 mg/kg/day, p.o) was tested in high fat diet model for 42 days (six weeks). Treatment of *Dendrophthoe falcata* 70% ethanol extract for forty two days along with high fat diet showed significant ($p < 0.01$) reduction in serum total cholesterol (TC), triglyceride high density lipoprotein (HDL) when compared with hyperlipidemic control. The lowered atherogenic index of extract group suggests

antihyperlipidemic and cardioprotective potential. 70% ethanol extract (300 mg/kg/day, p.o) exhibited significant antihyperglycemic activity in alloxan induced diabetic rats with significant improvement in body weight and reduction in blood glucose, serum creatinine and urea level. The methanolic extract of *D. falcata* at 200 mg/kg has also shown significant cytoprotective activity ($p < 0.05$) in alloxan-induced diabetic rats. In addition the extract significantly reduced the elevated level of blood cholesterol ($p < 0.01$) and triglyceride ($p < 0.05$). At the same dose level, the extract significantly improved the alloxan-induced reduction of blood protein level ($p < 0.01$) to normal value^{25, 26, 27}.

Table.1. Preliminary phytochemical screening of leaf powder of *D.falcata*

Test	Petroleum ether	Benzene	Chloroform	Acetone	Ethanol	Water
Alkaloids	-	-	+	-	+	-
Carbohydrates	-	-	-	-	+	+
Phytosterols	+	-	-	+	+	-
Fixed oils and fats	+	+	-	-	-	-
Saponins	-	-	-	-	-	-
Phenolic compounds and tannins	-	-	-	-	+	+
Proteins	-	-	-	-	-	-
Gums and mucilages	-	-	-	-	-	+
Flavonoids	-	-	-	+	+	+

Table 2: Preliminary phytochemical screening of stem powder of *D. falcata*

Test	Petroleum ether	Benzene	Chloroform	Acetone	Ethanol	Water
Alkaloids	-	-	-	-	-	-
Carbohydrates	-	-	-	-	+	+
Phytosterols	+	-	-	-	+	+
Fixed oils and fats	+	-	-	+	+	-
Saponins	-	-	-	-	-	-
Phenolic compounds and tannins	-	-	-	-	+	+
Proteins	-	-	-	-	-	-
Gums and mucilages	-	-	-	-	-	-
Flavonoids	-	-	-	+	+	-

Antinociceptive activity

The present study was undertaken to investigate the antinociceptive activity of ethanolic extract of the barks of *D. falcata* (DFEE) using formalin-induced nociception model, hot plate method (thermal stimulation), acetic acid - induced writhing test, p-benzoquinone induced abdominal constriction test and Haffner's tail clip method in rodents. Pre-treatment with DFEE with a dose of 200 and 400 mg/kg body weight revealed significant ($p < 0.05$) antinociceptive activity against all the tests performed as compared to the control group.^[28]

Contraceptive activity

Adult proven fertile male rats were gavaged methanol extract of *D. falcata* stem at 50, 100 and 200 mg/rat/day for 60 days. The activity was compared with standard drug, i.e. Isonidamide. On day 61 the animals were autopsied and the testes, epididymides, seminal vesicle and ventral prostate were dissected out and weighed sperm motility and density and serum testosterone level were assessed. The sperm motility and density were significantly reduced. The histoarchitecture of testes revealed degenerative changes in the seminiferous tubules, arrest of spermatogenesis at the stage of round spermatid. Serum testosterone levels were decreased significantly in all treatment groups²⁹.

Wound healing and antimicrobial activity

The ethanolic extract of aerial parts of *Dendrophthoe falcata* was investigated for the evaluation of its healing efficiency on excision and incision wound model in rats. The results showed *Dendrophthoe falcata* extract has potent wound healing capacity as evident from the wound contraction and increased tensile strength. Hydroxyproline and hexosamine expressions were also well correlative with the healing pattern observed. Three of the fractions A - C (petroleum ether, chloroform and ethanol respectively) obtained from the

extract exhibited significant antimicrobial activity against the organisms: *Staphylococcus aureus*, *Staphylococcus pyogenes*, *Staphylococcus epidermis*, *Micrococcus luteus*, *Bacillus subtilis*, *Bacillus cereus*, *Klebsiella pneumoniae*, *Enterobacter aerogenes*, *Pseudomonas aeruginosa*, *Serratia marcescens* and five fungi *Candida albicans*, *Candida tropicalis*: dimorphic fungi, *Aspergillus fumigatus*, *Aspergillus niger*: systemic fungi, and some infectious bacteria *Escherichia coli*, and *Salmonella typhi*²⁶.

Diuretic and Antilithiatic activity

Aqueous and alcoholic extracts of *D. falcata* were tested for their antilithiatic activity and aqueous extract was tested for diuretic activity also. Significant increase in the volume of urine and excretion of Na⁺, K⁺, Cl⁻ was recorded when aqueous extract (4 g/kg p.o.) was administered to rats and compared with frusemide (4 mg/kg) and hydrochlorothiazide (10 mg/kg). Urolithiasis induced by implantation of zinc disc in the urinary bladder of rats developed magnesium ammonium phosphate stones. Ethylene glycol (1%) mixed in drinking water for 4 weeks caused a reduction in stone formation. Significant decrease in the weight of stones was observed after prophylactic or curative treatment in animals which received aqueous or alcoholic extracts of the test drug (4 g/kg, p.o.) in comparison with ethylene glycol or tap water treated control groups. Alcoholic extract was found to be more effective than aqueous extract³⁰.

Neurobehavioral Toxicity

The ethanolic extract of aerial parts of *Dendrophthoe falcata* (L.F.) was administered in three different doses i.e. 250 mg/kg, 475 mg/kg and 950 mg/kg body weight/day for a period of four weeks. At the end of the exposure, behavioural and functional parameters were assessed in a functional observational battery (FOB) and motor

activity was measured in an open field. A decrease in the arousal level was observed in experimental groups. Also, the total number of urine spots increased in a dose dependent manner for extract treated groups. The results suggest that hydroalcoholic extracts from aerial parts of *D. falcata* should be relatively free from any serious neurobehavioral toxicity and safe to use³¹.

Anthelmintic activity

This study was carried out to investigate and proved ethnomedicinal value of the plant. Authenticated plant leaves were taken for the study includes extraction of leaves using different solvents and evaluation of anthelmintic activities. Dried extracts were tested for anthelmintic activity using *Pherotima postuma* as a species of earthworm and compare the paralysis time and death time with standard drug albendazole. Ethylacetate and methanol extracts shows comparable anthelmintic activity with standard drug albendazole. Methanol and ethyl acetate extracts were tested by different chemical tests. It shows presence of tannins, flavonoids, and terpenoids. These phytoconstituents may be responsible for the said activities³².

Traditional and medicinal uses

The entire plant is medicinally important and is used extensively in traditional medicine as an aphrodisiac, astringent, narcotic, diuretic and for the treatment of asthma, wounds, ulcer and pulmonary tuberculosis⁸. The drug is useful in urinary diseases and calculi as diuretic. It is given in diarrhoea, dysentery, insanity, epilepsy, cardiac troubles, blood diseases, convulsions and nerve complaints³³. It is used in menstrual disorder, wounds, in prevention of stone in kidney and bladder, haemorrhage, miscarriage and abortion during pregnancy. Plants grown on *Ficus fistula* host is used for foetus development in Ayurveda. It is used in vatta, kapha and pitta. This plant is used for avoiding abortion occurs during 3rd month of pregnancy³². Leaf paste is used in skin diseases and also taken for abortion^{34,35}.

CONCLUSION

In this review, we have presented information on the pharmacognosy, phytochemistry, ethnomedicinal uses and pharmacological activities. The survey of literature revealed that *Dendrophthoe falcata* is a hemi-parasitic plant belonging to the family Loranthaceae. It is also known as *Loranthus falcatus* Linn. f. It is indigenous to India, Srilanka, Thailand, Indo-china, Australia. It is a source of mainly therapeutically important chemical constituents as carbohydrates, alkaloids (leaf), phytosterols, fixed oils, phenolic compounds, gallic acid, ellagic acid, triterpenes, quercetin, quercetrin, rutin, chebulinic acid, β -amyirin acetate, β -sitosterol, stigmasterol etc. Studies have revealed its use in wound healing, ulcer, asthma, paralysis, skin diseases, hepatoprotection, immunomodulation, tumor and menstrual troubles. Therefore, further studies may be carried out to prove the potential of this plant.

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