A REVIEW ON DENDROPHTHOE FALCATA (LINN. F.)

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ABSTRACT

Dendrophthe 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-sitostanol 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: Dendrophthe falcata, Herbal medicine, pharmacological activity, review.

INTRODUCTION

Medicinal plants are part of human society to combat diseases, from the dawn of civilization. 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 armony 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.

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.

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.

Dendrophthe falcata (Family- Loranthaceae) is a large bushy parasitic shrub with grey bark, thick usually opposite leaves, orange-red or scarlet flowers and ovoid – oblong berries. It is also known as Loranthus falcatus Linn. f. It is indigenous to India, Sri Lanka, 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-nut.

Dendrophthe falcata is reported to contain biological active substances such as flavonoid, quercetin, kemperol, rutin, tannins, β-sitosterol, stigmasterol, β-amyrin, oleanolic acid.

Vernacular names:

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<th>Language</th>
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<td>Thril</td>
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<td>Uriya</td>
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Scientific Classification:

- **Domain**: Eukaryota
- **Kingdom**: Plantae
- **Subkingdom**: Viridiplantae
- **Phylum**: Tracheophyta
- **Subphylum**: Euphyllophyta
- **Class**: Magnoliopsida
- **Order**: Santalales
- **Family**: Loranthaceae
- **Genus**: Dendrophthe
- **Species**: falcata

Macroscopic Characters

Leaves thick, coriaceous, usually opposite, 7.5 – 18 by 2 – 10 cm, petiolate, exstipulate, decussate, simple, ovate to oblanceolate. A crown by a cup-shaped calyx. Calyx 4 mm long, slightly spread at the back; tube curved, slightly widened upwards. Berry 8 – 13 mm long, ovoid – oblong, pink, smooth, crowned by a cup-shaped calyx.

Microscopic Characters

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 shallowing 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.
Hexokinase was isolated and identified by hydrolysis (1:1). These are small clusters of sclerenchyma segments which are separated from each other by parenchymatous tissue. The stele consists of wide hollow cylindrical discrete vascular bundles. The cortex is wide homocellular and parenchymatous. The cells have convex outer periclinal walls and interrupted here and there by cuticle and epidermis made up of squarish or barrel shaped cells. The epidermis consists of single layer of papillate cells with cuticles.

The stem is circular in cross sectional view. The cortex consists of single layer of papillate cells with cuticles. The cortex cells have tannin body. The cortical zone is about 12 layer and 400 mm wide. The stele consists of wide hollow cylindrical discrete vascular segments which are separated from each other by parenchymatous tissue. These are small clusters of sclerenchyma.

Fig. 1 Transverse section of leaf

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 sectional 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 mm wide. The stele consists of wide hollow cylindrical discrete vascular segments which are separated from each other by parenchymatous tissue. These are small clusters of sclerenchyma.

Fig. 2 Transverse section of stem

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 benzene – 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, C₃₇H₆₀O₅, m.p. 219-220 °C, [α]D +56, IR – 1735 cm⁻¹ was isolated. Further elution with benzene and benzene-ethylacetate furnished β-sitosterol, stigmasteral and oleanolic acid 17. 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 chebulic acid and quercetin 18. The bark of D. falcata has yielded (+) – catechin and leucocyanidin 19. Quercetin has also been reported to be the major compound from D. falcata growing on Vitex negundo 20. Three cardiac glycosides were isolated – strospeside, odonoside F and neritaloside from the leaves of D. falcata growing on Nerium oleander 21. Oleanolic acid, its acetate and methyl ester acetate, β-sitosterol and stigmasteral were obtained from the stems of D. falcata growing on Mangifera indica 22. 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-[2-hydroxy-11α-methoxy-olean-12-ene (3) along with nine known compounds, 3β-acetoxy-11α-dihydroxy-olean-12-ene (4), 3β-acetoxy-11α-dihydroxy-urs-12-ene (5), 3β-acetoxy-urs-12-ene-11-ene (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-L-rhamnosopyranoside (10), quercetin-3-O-L-rhamnosopyranoside (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-L-rhamnosopyranoside (10) was found to be a ligand for both receptors with greater affinity for β. The triterpenes (1-12) were reported for the first time in the genus Dendrophthoe and assumes taxonomic significance 21. 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, Km value being 0.12 and 0.25 g/l for A and B respectively. Form A phosphorylase utilized glycogen efficiently, Km 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 acrocin dextrin, though with less efficiency than starch. The Km 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 was 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 enzyme 22. 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° and energy of activation 6900 cal/mol. The enzyme had an absolute requirement for a divalent metal ion. Although Mg²⁺ was the preferred metal, it could be partially replaced Mn²⁺ and Ca²⁺. ATP was the most effective phosphoryl donor. Glucose was the best substrate; the Km 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 Km 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 Ki values were 0.4 and 1.2 mM respectively 23.

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 ethanol 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 activity 24.

Antioxidant, Antihyperlipidemic and Antidiabetic activity
Ethanol extract showed better in-vivo antioxidant activity in both DPPH radical scavenging (IC50=16.78 µg/ml) and nitric oxide radical scavenging activity (IC50=54.5 µg/ml) in sodium...
ether, chloroform and ethanol respectively) obtained from the 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 antihyperlipedemic and cardioprotective potential. 70% ethanol extract (300 mg/kg/day, p.o) was 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

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

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### 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. lonidamine. 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 histoarchitcture 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 groups\(^{29}\).

### 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 correlated 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 aeroginosa, 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\(^{30}\).

### Diuretic and Antilithiatic activity

Aqueous and alcoholic extracts of D. falcata were tested for their 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 extract\(^{31}\).

### 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 *Pherotina 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 tuberculosis40. The drug is useful in urinary diseases and calculus as diuretic. It is given in diarrhoea, dysentery, insanity, epilepsy, cardiac troubles, blood diseases, convulsions and nervous complaints34. It is used in menstrual disorder, wounds, ulcer and pulmonary troubles, blood diseases, convulsions and nervine complaints33. It is indigeneous to India, Srilanka, Thialand, Indo- china, Australia. It is a hemi -parasitic plant belonging to the family Loranthaceae. It is also known as Loranthus falcatus Linn. f. It is a species of *Dendrophthoe falcata* from aerial parts of *D. falcata* of *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 pregnancy. Plants grown on host is used for avoiding abortion occurs during 3rd month of pregnancy. Leaf paste is used in skin diseases and also taken for abortion34, 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, Sri Lanka, Thailand, Indochina, Australia. It is a source of mainly therapeutically important chemical constituents as carbohydrates, alkaloids (leaf), phytosterols, fixed oils, phenolic compounds, gallic acid, elagic acid, triterpenes, quercetin, quercetin, rutin, chebulinic acid, β-amyрин acetate, β-sitosterol, stigmasterol etc. Studies have revealed its use in wound healing, ulcer, asthma, paralysis, skin diseases, hepatoprotection, immunomodulation, tumor and acute diarrhoea. The present study includes extraction of leaves using different solvents and evaluation of anthelmintic activities. Dried extracts were tested for anthelmintic activity using *Pherotina 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.

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