

Review on Pharmacological Activities of Clerodendrum Paniculatum Linn.

Jiji Mohan M U¹, Mr. Santhan Nehru Narkilli², Dr. Prashobh³, Surabhi G S⁴, Dr. Shruthy B Kurup⁵, Rupitha N S⁶

¹ Assistant professor, Department of Pharmacognosy, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram

² Head, Department of Pharmacognosy, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram

³ Principal, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram

⁴ Assistant professor, Department of Pharmacognosy, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram

⁵ Assistant professor, Department of Pharmacy practice, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram

⁶ Assistant professor, Department of Pharmacology, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram

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ABSTRACT

The plant Clerodendrum paniculatum belonging to the family Verbenaceae is a bushy herb known as Pagoda flower or orange tower flower. It is native to tropical Asia and Papuasias. Ethno - botanically various parts of this plant is used in treatment of various diseases and conditions. Studies indicates that Clerodendrum paniculatum possess various pharmacological activities such as antimicrobial, antioxidant, insecticidal, hypolipidemic, anti-inflammatory, anthelmintic, antimutagenic, cytotoxic and anti-ageing activities. These results are very encouraging and hence this review was intended to study about the plant more extensively to confirm the pharmacological activities and other potential benefits of Clerodendrum paniculatum.

Key words

Clerodendrum paniculatum, pharmacological activities, plant description, ethno - botanical status

I. INTRODUCTION

The plant Clerodendrum paniculatum belongs to the family Verbenaceae (now in Lamiaceae family) is a bushy perennial herb or an erect shrub with cordate-ovate, 3-5 lobed, 4-40 cm long leaves and orange red to scarlet colored, many flowered, axillary and terminal cymes, found in Andaman and Nicobar islands and grown in rocks. The plant is used as an abortifacient by tribals of Andaman and Nicobar islands^[1]. Recent scientific studies proved their biological activity according to their traditional claims and ethno – medical status.



Whole plant of *C. paniculatum*

COMMON NAME AND TAXONOMY ^[2]

PLANT NAME

Clerodendrum paniculatum Linn.

COMMON NAME

Pagoda flower, Orange Tower Flower, Hajar mogra, Arumasachedi

SYNONYMS

Cleianthus coccineus Lour. ex B.A.Gomes
Clerodendrum diversifolium Vahl
Clerodendrum
paniculatum var. *diversifolium* (Vahl) C.B.Clarke
Clerodendrum pyramidale Andrews
Volkameria angulata Lour.
Volkameria diversifolia Vahl

VERNACULAR NAMES

Tamil - Krishna kireedam
Malayalam - Hanuman kireedam, Krishna kireedam
Malay - Pangil pangil
Kannada - Krishna kireeda

TAXONOMICAL STATUS ^[3]

Domain - Eukaryota
Kingdom - Plantae
Phylum - Spermatophyta
Subphylum - Angiospermae
Class - Dicotyledonae
Order - Lamiales
Family - Lamiaceae/ Verbenaceae

Genus - *Clerodendrum*

Species - *paniculatum*

PLANT DESCRIPTION ^[4]

The pagoda flower, so called because of its tall, pyramidal inflorescences, is one of the most spectacular *Clerodendrum* species. The species epithet refers to the large 'paniculate' clusters of flowers (inflorescences), the feature which makes this such a visually-striking plant. The pagoda flower is commonly encountered throughout tropical and subtropical Asia, from Bangladesh to the Moluccas where it is popular as an ornamental and known for its medicinal uses.

PLANT TYPE ^[3]

Perennial shrub
Seed propagated
Vegetatively propagated

DISTRIBUTION

Clerodendrum paniculatum is native to Southern Asia including China, India, Indonesia and Malaysia. It has been introduced into tropical and subtropical regions and often establishes as a garden escapee. It can currently be found naturalized in Central America, Australia, Singapore and on Islands in the Caribbean and Pacific region.

HABITAT

Clerodendrum paniculatum inhabits evergreen jungles, open forests, thickets, open wet areas, railroad embankments, clearings and forest edges. The species is cultivated in garden and yards and can often be found naturalized around settlements and wastelands and along roadside hedgerows

MORPHOLOGY [2]

Height: Shrub, 1-2 m tall

Bark: greyish brown

Stem, Branches and Branchlets: Stem and branches hollow, slightly pubescent, obtusely quadrangular, nodes annulate, slightly hairy. Branchlets 4- angled, subglabrous to pubescent, nodes villous.

Leaves: Leaves opposite, larger at the base gradually becoming smaller towards the apex, ovate-cordate to ovate-suborbicular, palmately lobed, petiole 3-11cm yellow brown pubescent, leaf blade broadly ovate to subrounded, 5-17x 7.5-19 cm, abaxially sparsely pubescent and sandy glandular, adaxially sparsely pubescent to subglabrous, base cordate, margin entire or minutely denticulate, apex acute.

Inflorescence: Terminal panicle, 10-40 cm long, wider in the base, peduncle slightly pubescent, about 1-2 cm long, bracts leaf-like, ovate, apex acute, bractlets linear. Flowers bisexual, numerous, pedicels filiform 5-15 cm long, calyx campanulate, 5 toothed, deeply divided nearly to the base, oblong lanceolate, apex acute, reddish orange, corolla hypocrateriform, 5 lobed, lobes oblong or obovate, apex acute, pubescent outside, reddish orange, about 0.7 cm long, corolla tube slender, curvate, glabrous or very slightly hairy outside about 3 mm long, stamens 4 didynamous, exserted, filaments slender, about 2-3 cm long, reddish, anthers oblong about 2 mm long, ovary bicarpellary, ovoid or globose, 4 lobed, 4 loculed, about 0.2 cm across, style filiform, purple, stigma shortly 2-fid.

Phytochemicals in *C. paniculatum*

Part	Phytochemical
Leaves	Poriferasta-5.22E.25-trien-3β-ol, Rutin and Quercetin, Tannins, phenols, sterols
Root	β-sitosterol; lupeol; oleanolic aldehyde acetate; (22E)-stigmasta-4,22,25-trien-3-one; stigmasta-4,25-dien-3-one; and (3β)- stigmasta-4,22,25-trien-3-ol, Quercetin, Phenolic compounds, flavonoids, saponins, tannins

Fruit and Seed: Drupaceous, globose, about 1 cm in diameter with 4 pyrenes, fleshy, purplish black when ripe, and fruiting calyx persistent.

ETHNOMEDICINAL USES [6]

The plant *C. paniculatum* is reported to have some ethnobotanical uses as ornamental as well as medicinal plant in some parts of the world. The plant is used traditionally in countries such as India, China and Japan for treating rheumatism, ulcer, neuralgia, typhoid, anemia, liver complaints, purification of blood, inflammation, and wounds. It is used as anti-inflammatory and antipyretic drug in traditional Thai medicine. In Lombok, Indonesia, the plant is used to treat sore eyes. *C. paniculatum* is commonly used in hemorrhoids and herbal bath preparation by Yunnanese group in Thailand. The Nicobarese of Nancowry group of Islands in Andaman and Nicobar uses the plant traditionally for treating wounds, jaundice, body ache, snake bite and giddiness. In Southern Nigeria the leaves and roots of *C. paniculatum* is used in treatment of malaria.

PHYTOCHEMICAL CONSTITUENTS [28]

Members of *Clerodendrum* L. are shown to contain myriad of phytochemicals and over 280 phytochemicals have been described from different *Clerodendrum* species. Standard phytochemical tests, chromatographic and spectral methods have been used to identify phytochemicals in *C. paniculatum*. Chemicals viz. (24s) ethylcholesta-5,22,25-triene-3β-ol, β-amyirin and β-sitosterol were obtained from the roots of *C. paniculatum*. 31 Phytoconstituents viz. alkaloids, coumarins, flavonoids, glycosides, phenols, phytosterols, saponins, terpenoids have been detected in the leaves of *C. paniculatum* by standard phytochemical tests. The presence of terpenes, flavonoids, tannins, alkaloids, phenolic acid, sterols, and glycosides in the leaf extract was detected in a study.



Bark of *C. paniculatum*



Stem, Branches and Branchlets of *C. paniculatum*



Leaf of *C. paniculatum*



Inflorescence of *C.paniculatum*

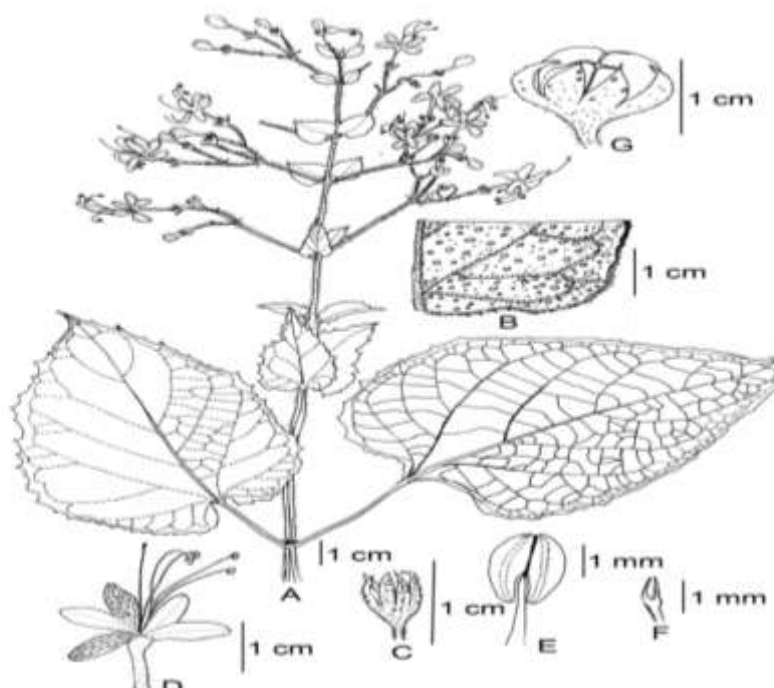


Illustration of *Clerodendrum paniculatum* showing the: (A) flowering branch, (B) abaxial surface of leaves, (C) calyx, (D) flower without calyx, (E) stamen, (F) stigma and (G) fruit with persistent calyx^[5]

PHARMACOLOGICAL ACTIVITIES OF *C. PANICULATUM*

The plant *Clerodendrum paniculatum* has different pharmacological activities that have been confirmed from several studies such as antimicrobial, antioxidant, insecticidal, hypolipidemic, anti-inflammatory, anthelmintic, antimutagenic, cytotoxic and anti-ageing activities. A description on the pharmacological activities of *C. paniculatum* is presented below

In - vitro studies

Antimicrobial activity

The plant *Clerodendrum paniculatum* leaves has been clearly showed strong antibacterial activity against various organisms by using in vitro agar well diffusion method performed by Jeenu Joseph et al^[7] and it shows that the alcohol extract had good antibacterial activity against *Salmonella* Newport and aqueous extract had good activity against *E. coli* when comparing with standard Streptomycin. The petroleum ether, chloroform and ethyl acetate extract showed potential activity against *Vibrio parahaemolyticus*. Also Govindaraju Shruthi et al^[8] studied the inhibitory activity of Methanol extract of *C. paniculatum* against antibiotic resistant strains of *E. coli* and *Klebsiella pneumoniae*. Abdullah et al^[9] studied the antibacterial activity by disc diffusion method on methanol extract of leaves, flowers and stem of *C. paniculatum*. The extracts showed inhibitory activity against *B. subtilis* while no inhibitory activity was observed against *E. coli*. The study by Praveen et al^[10] revealed that the of chloroform and methanol extract of leaves of *C. paniculatum* showed potential inhibition against *Candida albicans*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*. Leena and Aleykutty^[11] revealed the dose dependent antibacterial activity of ethanol extract of *C. paniculatum* root against *B. subtilis*, *E. coli*, *K. pneumoniae* and *S. aureus*

Antioxidant activity

Hafiz et al^[12] investigated the antioxidant activity of ethanolic extract of leaves of *C. paniculatum* and it revealed concentration dependent scavenging of radicals with an IC₅₀ value of 27.73 µg/ml. The study performed by John et al^[13] revealed that ethanol extract of roots of *C. paniculatum* exhibit significant antioxidant activity by DPPH and ABTS radical scavenging assays. Arun et al^[14] revealed the antioxidant potential of methanolic extract of leaf and root of *C. paniculatum* by DPPH radical, hydroxyl radical and superoxide radical scavenging assays and reducing power assay. Krishnan et al^[15] revealed that the

aqueous and methanolic extracts of *C. paniculatum* possess potent antioxidant activity by using reducing power assay. Sincy Varghese et al^[16] studied the antioxidant activity on *C. paniculatum* flower extract by DPPH radical scavenging assay, FRAP assay, Nitric oxide radical scavenging assay, Hydroxyl radical scavenging assay and Hydrogen peroxide radical scavenging assay and revealed that FRAP and reducing power assays exhibit an increased percentage of scavenging with an increase in concentration when compared with standard ascorbic acid.

Antidiabetic Activity

Sincy Varghese et al^[16] studied antidiabetic activity on ethanolic extract of *C. paniculatum* flower by α -amylase inhibition assay and α -glucosidase inhibition assay and revealed that the extract has significant inhibitory action on α -amylase and α -glucosidase and helps to manage the hyperglycemia in Type 2 Diabetes

In-vitro anti-inflammatory activity

Musa et al^[17] studied anti inflammatory activity on different solvent extracts of *C. paniculatum* leaves by human red blood cell membrane stabilization method (HRBC). And the solvent extracts showed potent concentration dependent activity. The study done by Jeenu Joseph et al^[18] showed that the various extracts of *C. paniculatum* leaves possess good HRBC membrane protection activity in human red blood cell membrane stabilization assay. Phuneerub et al^[19] screened anti inflammatory activity on the ethanolic extract of *C. paniculatum* root on the basis of evaluation of nitric oxide, tumor necrosis factor (TNF- α) and prostaglandin E₂ in murine macrophage J774A₁ cells stimulated by lipopolysaccharide and the root extract was shown to significantly inhibit LPS induced nitric oxide, TNF- α and prostaglandin E₂ production in macrophage cells

Mutagenic and antimutagenic activity

Ethanolic extract of *C. paniculatum* root was investigated for mutagenic and antimutagenic activity by Phuneerub et al^[19] by using Ames test on *Salmonella typhimurium* strain TA98 and *S. typhimurium* strain TA100 and revealed that the plant was not mutagenic besides the extract was shown to inhibit mutagenicity of nitrite treated 1-aminopyrene on both strains of *S. typhimurium*

Anti-ageing activity

Krishnan et al^[20] investigated the potential of *C. paniculatum* leaf extract in polyherbal based cream formulations and found out that the plant was least cytotoxic and caused an

increase in the collagen content in human dermal fibroblast indicating skin anti-ageing property. The formulation was also found to upregulate Collagen I gene expression. Krishnan et al ^[15] also revealed anti-ageing activity of methanol and aqueous extract of *C. paniculatum* leaves in human dermal fibroblast

Insecticidal activity

Jadhav et al ^[21] investigated the insecticidal property of ethanolic extracts of *C. paniculatum* leaves against *Spodoptera litura* and *Helicoverpa armigera* by antifeedant assay, growth inhibitory assay and larval mortality assay and the extracts exhibited dose dependent insecticidal activity

Cytotoxic/anticancer activity

The study performed by Phontree et al ^[22] revealed that the compounds viz. Oleanolic aldehyde acetate and (3 β)-stigmasta-4,22,25-trien-3-ol isolated from the dichloromethane extract of root of *C. paniculatum* showed cytotoxic activity against the KB cell line with an IC₅₀ value of 9.58 μ g/ml and 13.14 μ g/ml, respectively. Phontree et al ^[23] also revealed that the compounds such as oleanolic aldehyde acetate and (3 β)-stigmasta-4, 22, 25-trien-3-ol exhibited cytotoxicity against HeLa cells with IC₅₀ values of 31.43 μ g/mL and 28.52 μ g/mL, respectively. The study of Praveen et al ^[10] revealed that various extracts of *C. paniculatum* leaves produces dose dependent cytotoxic effect in terms of mortality of brine shrimp larvae and the petroleum ether extract showed potent activity than methanol extract. The study carried out by John et al ^[13] revealed dose dependent cytotoxicity of various extracts of *C. paniculatum* against different cell lines (HeLa, HepG2, and MCF7) by trypan blue exclusion test, MTT assay and SRB assay

In vivo studies

Anticancer activity

Anticancer activity of ethanolic extract of *C. paniculatum* roots was investigated by John et al ^[13] using tumor model in mice and extract increased the mean survival time and reduced the tumor volume, the anticancer effect observed was not significant when compared to cisplatin. The investigation of Sundaraganapathy and Leena ^[24] showed anticancer activity of ethanolic extract of *C. paniculatum* root and phytosome formulated from root extracts against DLA induced tumor in Swiss albino mice and the administration of root extract and phytosome revealed the anticancer potential by the reduction in tumor volume and

tumor weight and increase in mean survival time and restoration of haematological parameters

Hypolipidemic activity

Selvin et al ^[25] was investigated hypolipidemic activity of *C. paniculatum* leaf extract in male Wistar rats fed with high fat diet. Administration of extract was shown to significantly decrease the level of lipid profile and lipoprotein levels and significant increase in the HDL level and decrease in body weight were also observed in extract treated animals. Sincy Varghese et al ^[26] studied hypolipidemic activity in high fat dieted rats and levels of low density lipoprotein (LDL), high density lipoprotein (HDL), triglycerides and total cholesterol were analyzed in rats after the oral administration of ethanolic extract of *C. paniculatum* flower and it significantly reduced cholesterol values by improving lipid metabolism

Anthelmintic activity

Praveen et al ^[27] evaluated the time taken for paralysis and death of the earthworm *Eudrilus Eugenia* by various solvent extracts of *C. paniculatum* leaves. And the study revealed that the methanol extract has significant activity when compared to aqueous, chloroform and ethyl acetate extracts

Anti-inflammatory activity

Hafiz et al ^[12] studied anti-inflammatory potential of ethanolic extract of *C. paniculatum* leaves in rats by paw edema and granuloma cotton pellet method by using acetosal as a standard and both extracts showed excellent activity at dose 50 mg/kg and 100 mg/kg. The study by Joseph et al ^[18] also revealed anti-inflammatory activity of petroleum ether and chloroform extracts of *C. paniculatum* leaves as evaluated by carrageenan induced paw edema model in male Wistar rats by using indomethacin as a standard and the extracts a showed dose dependant significant reduction in paw edema

Antidiabetic Activity

Sincy Varghese et al ^[26] studied anti diabetic activity of ethanolic extract of *C. paniculatum* flower by Streptozotocin (STZ) induced diabetics in rats by using glibenclamide as a standard. Important carbohydrate metabolizing enzymes like Glucose 6-phosphatase, Fructose 1, 6 diphosphatase and hexokinase were determined in experimental rats. For antihyperglycemic evaluation, glucose, C-peptide, insulin, haemoglobin and glycosylated haemoglobin (HbA1c) levels were analyzed. After the oral

administration of extract, a significant reduction in glucose level is revealed.

II. CONCLUSION

The plant *C. paniculatum* is distributed in many Asian countries. This review conducted in this plant revealed the important medicinal and pharmacological activities. This review also helps in analyzing different medicinal properties such as antimicrobial, antioxidant, insecticidal, hypolipidemic, anti-inflammatory, anthelmintic, antimutagenic, cytotoxic and anti-ageing activities that have been confirmed by both in vitro and in vivo methods. Further detailed study on *C. paniculatum* will facilitate a good platform for new drug discoveries and new formulations

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