



# ETHNOMEDICINAL USES, PHYTOCHEMICAL AND PHARMACOLOGICAL EVALUATION OF *Clerodendrum Paniculatum*: A COMPREHENSIVE REVIEW

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## ABSTRACT

*Clerodendrum paniculatum* L. belongs to Lamiaceae family and have much significance in terms of its medicinal values and pharmacological properties. There are about 500 species or more in their genus. Here we overview the ethnobotanical uses, phytochemical and pharmacological evaluation of *Clerodendrum paniculatum* L. *Clerodendrum paniculatum* is one of the most important species among the genus *Clerodendrum*. They are generally grown for ornamental purposes. The ethnomedicinal importance of plant reported are remedy for ailments and disorders such as wounds, typhoid, snakebite, jaundice, giddiness, malaria, anaemia and haemorrhoids. Phytochemical screening indicated presence of constituents such as alkaloids, coumarins, flavonoids, glycosides, phenols, phytosterols, saponins, terpenoids, rutin, quercetin,  $\beta$ -sitosterol,  $\beta$ -amyrin, lupeol, oleanolic aldehyde acetate, stigmasta-4,25-dien-3-one, and (3 $\beta$ )-stigmasta-4,22,25-trien-3-ol in *Clerodendrum paniculatum*. The plant is shown to exhibit biological activities such as antimicrobial, antioxidant, anthelmintic, anti-inflammatory, antimutagenic, anti-anxiety, hypolipidemic, insecticidal and anti- skin ageing activity, anti-cancer properties.

**Keywords:** *Clerodendrum paniculatum* L., Ethnobotanical, Traditional, Phytochemicals, Biological activities

## 1. INTRODUCTION

Plants are considered as an integral part of daily life. Medicinal plants are known to possess several primary and secondary metabolites. The secondary metabolites in particular are involved in many biological activities. The diverse chemical structures of such secondary metabolites have significant contributions toward new drug development processes. An estimate highlights that around 80% of individuals in developing countries rely on plant-based medicines for their primary healthcare. Since modern medicines indicated various drawbacks in present scenario, plant based medicines are gaining much importance nowadays. Indigenous systems of medicines widely employ plants as a remedy for dreadful ailments.<sup>7-11</sup> The genus *Clerodendrum* L., previously categorised in family Verbenaceae, now belonging to the family Lamiaceae, comprises of more than 500 species. It is a biennial herb that grows up to 1.5 m in height. Several species of the genus are known to have medicinal values and widely used in different parts of the world.<sup>12-16</sup> *Clerodendrum paniculatum* is a shrub and is commonly known as pagoda flower. The species was first described by Swedish botanist Linnaeus. Since the plant have showy orange red to scarlet coloured flowers in terminal panicles they are considered as ornamental plant. They are widely distributed in countries such as India, Sri Lanka, Malaysia, Australia, China, Taiwan, Laos, Cambodia, Vietnam, Indonesia, Bangladesh and many other Asian countries. It is known as Rathapushpa or Ratha hoo in Kannada.<sup>17-19</sup> The pollination process is mainly through butterflies. The plant is reported to have traditional medicinal values and is shown to exhibit a range of biological activities<sup>20-23</sup> In the present review, we present an updated information on the ethnomedicinal uses, pharmacognostic, phytochemistry and biological activities of *C. paniculatum* by an intensive literature survey.

## 2. PLANT DISTRIBUTION

Native to India, Sri Lanka, Malaysia and much of southeastern Asia and are cultivated in various tropical garden worldwide. It is native to tropical Asia and Papuasia (southern China including Taiwan, Indochina, Bangladesh, Sri Lanka, Andaman & Nicobar Islands, Borneo, Sulawesi, Sumatra, Philippines, Bismarck Archipelago).

## 3. COMMON NAMES

Clerodendron, Orange Tower Flower, Pagoda Flower, Krishna kireedam, Hanuman kireedam.

## 4. PLANT PROFILE

Kingdom: Plantae

Class: Dicotyledones

Order: Lamiales

Superorder: Asteranae

Family: Lamiaceae

Domain: Eukaryota

Phylum: Spermatophyta

Subphylum: Angiospermae

Genus: *Clerodendrum*

Species: *Clerodendrum Paniculatum*

## 5. PLANT DESCRIPTION

The plant is erect, semi-woody shrub. The height ranges from 1-2m. Features of leaves include simple, large, opposite, up to 30cm in diameter. Leaves are membranous, cordate-ovate, 3-7 lobed (lobes shallow), margins minutely denticulate, glandular beneath and petiole is up to 30cm long with acuminate apex. Flowers are in large terminal panicles. Calyx is red to orange-red in colour. Corolla are orange-red to scarlet with slender tube which is up to 2cm long and the lobes are approximately 7mm long. Flowering occurs more or less throughout year. Fruit is a drupe, globose, bluish-black in colour and approximately 1cm across.<sup>24,11,5</sup>



Fig 1: Leaf of *Clerodendrum paniculatum*



Fig 2: Flower of *Clerodendrum paniculatum*



Fig 3: Whole plant of *Clerodendrum paniculatum*

## 6. ETHNOMEDICINAL USES OF *Clerodendrum paniculatum*

The plant *Clerodendrum paniculatum* is reported to have some ethnobotanical uses as ornamental as well as medicinal plant worldwide. Used traditionally in countries such as India, China and Japan for treating rheumatism, ulcer, neuralgia, inflammation, and wounds. It is used as anti-inflammatory and antipyretic drug in traditional Thai medicine<sup>25</sup>. In Lombok, Indonesia, the plant is used to treat sore eyes<sup>26</sup>. Commonly used as herbal bath preparation by Yunnanese group in Thailand<sup>27</sup>. 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<sup>13</sup>.

## 7. PHYTOCHEMICAL REVIEW

*C. paniculatum* leaves reported the presence of anthraquinone glycosides, flavonoids, saponins, tannins, proteins, lignin and phenol.<sup>28</sup> The preliminary phytochemical screening were carried out in the petroleum ether, chloroform, ethyl acetate, methanol and distilled water extracts of leaves. The study reveals that carbohydrates, glycosides, tannins and phenolic compounds are present in methanolic and aqueous extract. Sterols are found in all the extracts<sup>29</sup>. Root possess carbohydrates, starch, mucilage, saponins, flavonoids, tannins, phenolic compounds in the ethanolic extract<sup>30</sup>. Constituents like  $\beta$ -sitosterol,  $\gamma$ -sitosterol, octacosnol, clerosterol, bungein A, acetoside, betulinic acid, clerosterol 3-O- $\beta$ -D-glucopyranoside, colebrin A-E, campesterol, 4 $\alpha$ -methyl-sterol, cholesta-5-22-25-trien-3- $\beta$ -ol, 24- $\beta$ -cholesta-5-22-25-triene, cholestanol, 24-methyl-22-dihydrocholestanol, 24- $\beta$ -22-25-bis-dehydrocholesterol, 24- $\alpha$ -methyl-22-dehydro-cholesterol, 24- $\beta$ -methyl-22-dehydrocholesterol, 24-ethyl-22-dehydrocholesterol, 24-ethylcholesterol, 22-dehydro-clerosterol, 24-methylathosterol, 24- $\beta$ -ethyl-25-dehydro-lathosterol, (24S)-ethylcholesta-5-22-25-triene-3 $\beta$ -ol was isolated from various *Clerodendron* species<sup>31</sup>. Roots also showed the presence of Triacontane, clerodin, (24s) ethylcholesta5, 22, 25-triene-38-01,  $\alpha$ -amyrin, j3-sitosterol and clerodolone, (24s) Ethylcholesta-5, 22, 25-triene-3/1-ol,  $\alpha$ -amyrin and 3-sitosterol<sup>32</sup>. Terpenes such as Triactane, clerodin, clerodendrin A, 3  $\beta$ -acetyloleanolicacid, 3  $\beta$ -acetyloleanolic aldehyde, glutinol were found in leaves. Chloroform extract of the root part reported six compounds that are similar to  $\beta$ -sitosterol, lupeol, oleanolic aldehyde acetate, stigmasta-4,25-d en-3-one, (22E)-stigmasta-4,22,25-trien-3-one and (3 $\beta$ )- stigmasta-4,22,25-trien-3-ol<sup>33</sup>.

## 8. PHARMACOLOGICAL ACTIVITY

*Clerodendrum paniculatum* possesses several pharmacological and therapeutical activities such as antimicrobial, antioxidant, anthelmintic, anti-inflammatory, hepatoprotective, anti-lipidemic, anti-viral, anti-diabetic antimutagenic, anti-anxiety, cytotoxic, hypolipidemic, insecticidal and anti- skin ageing activity, anti-cancer, insecticidal, anticonvulsant activities.

- **ANTI-OXIDANT ACTIVITY:**

Ethanollic extract of leaves of *Clerodendrum* was undergone free radical scavenging activity by DPPH, ABTS and O-phenantroline method. The extract revealed activity with an IC50 value of 27.73µg/ml<sup>34</sup>. Ethanol extract of roots of *Clerodendrum paniculatum* exhibited potential antioxidant activity by DPPH and ABTS radical scavenging assays<sup>35</sup>. The antioxidant potential of methanolic extract of leaf and root of *C. paniculatum* was evaluated by DPPH radical, hydroxyl radical and superoxide radical scavenging assays and reducing power assay<sup>36</sup>.

- **ANTI-CANCER ACTIVITY:**

The anti-cancer activity of ethanolic extract of roots of *Clerodendrum paniculatum* was done using liquid tumour model (Solid tumour model). Compared to standard (Cisplatin), the result was not that significant<sup>35</sup>. Dichloromethane root extracts with oleanolic aldehyde acetate and (3β)-stigmasta 4,22,25-trien-3-ol showed cytotoxic activity against the KB cell line with an IC50 value of 9.58µg/mL and 13.14µg/mL. Oleanolic aldehyde acetate and (3β)-stigmasta-4,22,25-trien-3-ol also exhibited cytotoxicity against HeLa cells with IC50 values of 31.43µg/mL and 28.52µg/mL<sup>20</sup>. Methanol extract was found to be less potent compared to petroleum ether extract. Various solvent extract showed dose dependent in vitro cytotoxicity against cell lines HeLa, HepG2, and MCF7 through evaluation by Trypan blue exclusion test, MTT assay and SRB assay<sup>35</sup>. Ethanolic root extract and phytosome formulated from root extracts against DLA induced tumor in Swiss albino mice showed potent anti-cancer activity.

- **ANTI-BACTERIAL AND ANTI-FUNGAL ACTIVITY:**

Anti-bacterial study of petroleum ether, chloroform, ethyl acetate, alcohol and aqueous extracts of leaves of *Clerodendrum paniculatum* were performed. Gram negative bacteria's like *Escherichia coli*, *Salmonella* Newport and *Vibrio parahaemolyticus* were used for conducting evaluation. When compared to standard Streptomycin, Alcoholic extracts had good activity against *E.coli*. *Vibrio parahaemolyticus* growth was better inhibited by petroleum ether, chloroform and ethyl acetate extracts<sup>38</sup>. Successive maceration was conducted with petroleum ether, chloroform, ethyl acetate, methanol and distilled water using leaves. These extracts were tested against *Pseudomonas aeruginosa*, *Streptococcus aureus* and *Candida albicans* at concentrations varies from 100 µg/ml to 2000µg/ml with Amikacin as standard. Chloroform extracts showed greater activity. Chloroform and methanol extracts shows significant activity in anti-fungal test using *Candida albicans* and was compared with clotrimazole that act as standard<sup>29</sup>. A comparative study on ethanolic extracts of *C.paniculatum* and *C. infortunatum* were carried out for anti-bacterial activity against *S.aureus*, *B.subtilis*, *E.coli* and *Klebsiella pneumonia* using ciprofloxacin as standard. *E.coli*, *K. pneumonia*, *S.aureus* at a concentration 100µg/ml showed degree of inhibition as compared to standard. According to evidence collected the plant *Clerodendrum paniculatum* possess a better antibacterial activity with a lesser side effect

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- **ANTI-INFLAMMATORY ACTIVITY:**

Invitro and in-vivo method was performed to study anti-inflammatory activity. Invitro study was carried out by HRBC membrane stabilization method were petroleum ether and chloroform extract showed significant activity in a concentration dependent manner. Petroleum ether at a concentration of 1000µg/ml showed 57.15% protection and chloroform at a concentration of 1000µg/ml showed 48.98% protection of HRBC membrane in hypotonic solution. Indomethacin was used as standard. In vivo anti-inflammatory activity of these chloroform and petroleum ether extracts was analysed by carrageenan induced paw edema method in rats. Inflammatory inhibition was observed at a time interval of 1h,2h,3h,4h. Petroleum ether at a dose of 400 mg/kg showed 69.5% inhibition and was compared with Indomethacin which showed 81.8% inhibition at 10mg/kg. Chloroform extracts showed 49.4% inhibition<sup>39</sup>.

- **ANTHELMINTIC ACTIVITY:**

The standard used for the study was Piperazine. Chloroform, ethyl acetate, methanol, and distilled water extracts of *Clerodendrum paniculatum* leaves were evaluated for anthelmintic activity. Significant activity was shown by methanolic extract. Lesser anthelmintic activity was shown by chloroform and ethyl acetate extracts. No activity was exerted by aqueous extract.

- **HYPOLIPIDAEMIC ACTIVITY:**

Methanolic extract of 200mg/kg/day and 400mg/kg/day were administered by rats. Increased levels of total cholesterol, ester & free cholesterol, phospholipids, triglycerides, low density lipoprotein, and very low-density lipoprotein was seen due to High fat diet (HFD). Administration of 400mg/kg methanolic extract significantly reduced the lipid profile and lipoprotein levels and increased HDL level. Significant reduction of HDL cholesterol level was observed in HFD fed groups. Body weight of HFD fed group was reduced. Significant decrease of plasma free and ester cholesterol, level of lipoprotein, plasma triglycerides level etc was observed. The extract also provide protection against atherosclerosis and decrease the atherogenic index. So, overall as a conclusion it was reported that the methanolic extract of leaves of *Clerodendrum paniculatum* has definite cardio protective effect against hyperlipidemia<sup>41</sup>.

- **INSECTICIDAL ACTIVITY:**

screening for insecticidal activity was performed against *Spodoptera litura* and *Helicoverpa armigera*. The evaluation was carried out in crude ethanolic extracts of leaves of *Clerodendrum paniculatum*. Methods used to perform analysis are antifeedant assay, growth inhibitory assay and larval mortality assay. The extract exhibited a moderate dose dependent insecticidal activity<sup>42</sup>.

- **ANTI-SKIN AGEING ACTIVITY:**

The potential of polyherbal based cream formulations containing *C. paniculatum* leaf extract to reveal skin anti-skin ageing benefits was investigated by Krishnan et al<sup>43</sup>. To a least extent the formulation, which is a cream, was considered cytotoxic and caused an increase in the collagen content in human dermal fibroblast.

The formulation upregulated Collagen I gene expression. It was also observed that the methanol and aqueous extract of *C. paniculatum* leaves showed anti-skin ageing in human dermal fibroblast.

- **MUTAGENIC AND ANTI-MUTAGENIC ACTIVITY:**

Mutagenic and anti-mutagenic activity was analysed in ethanolic extracts of *Clerodendrum paniculatum* root. The method followed was Ames test using *Salmonella typhimurium* strain TA98 and *S. typhimurium* strain TA100. The extract was shown to inhibit mutagenicity of nitrite treated 1-aminopyrene on both strains of *S. typhimurium*. Thus, no mutagenic action was exhibited<sup>25</sup>.

- **ANTI-ANXIETY ACTIVITY:**

In-vivo examination was performed for evaluating anti-anxiety activity in total aerial parts extract of *Clerodendrum paniculatum* linn. Anti-anxiety activity was performed by elevated plus maze and light and dark model. The Ethyl acetate extract showed more significant activity compared to control, petroleum ether and Aqueous extracts. Diazepam is used as standard drug at a dose of 4mg/kg b.w. Flavonoids are considered the most likely ingredient because some flavonoids have anxiolytic properties in mice similar to benzodiazepines and modulate or inhibit GABAA and GABAC receptor currents. GABA is the most potent inhibitory transmitter in the CNS controls the state of neuronal excitability<sup>44</sup>.

## CONCLUSION

*Clerodendrum paniculatum* is a plant which plays a vital role in traditional system of medicines in many countries worldwide. The genus represents herbs, shrubs and small trees and is well-known for its ornamental uses. *Clerodendrum* is a very large and diverse genus with more than 500 species identified and distributed throughout the world. Phytochemical screening indicated presence of constituents such as alkaloids, coumarins, flavonoids, glycosides, phenols, phytosterols, saponins, terpenoids, rutin, quercetin,  $\beta$ -sitosterol,  $\beta$ -amyrin, lupeol, oleanolic aldehyde acetate, stigmasta-4,25-dien-3-one, and (3 $\beta$ )-stigmasta-4,22,25-trien-3-ol anthraquinone glycosides, carbohydrates, flavonoids, saponins, tannins, proteins, lignin and phenol in the leaves. Root of this plant possess the presence of carbohydrates, starch, mucilage, saponins, flavonoids, tannins, phenolic compounds. Some type of terpenes and steroidal compounds are also isolated from various part of this species. The ethnomedicinal importance of plant reported are remedy for ailments and disorders such as wounds, typhoid, snakebite, jaundice, giddiness, malaria, anaemia and haemorrhoids. *Clerodendrum paniculatum* exhibits various pharmacological activities like antioxidant, anti-cancer, anti-microbial, anti-inflammatory, anthelmintic, hypolipidemic, insecticidal, anti-skin ageing, antimutagenic property, anti-anxiety properties.

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