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Review Article

Therapeutic potentials of *Callistemon lanceolatus* DC

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ABSTRACT

From the ancient times plants are sources of remedies for various disorders. *Callistemon lanceolatus* DC is one of those medicinal plants which is indigenous to Queensland and New South Wales and cultivated throughout Indian in gardens. Different parts of the plant are used by rural people of India. It's claimed traditional uses have been scientifically established. The aqueous or alcoholic extracts of different parts of this plant were found to have various pharmacological activities for example, antifungal, antioxidant, antithrombin, anti-inflammatory, antidiabetic, antimicrobial and herbicidal activities. The present study will give comprehensive information on its pharmacological utility along with the responsible active constituents.

Keywords: *Callistemon lanceolatus*, phytochemicals, therapeutic uses.

INTRODUCTION

Most of the drugs used in primitive medicine were obtained from plants and are the earliest and principal natural source of medicines. There is no doubt that plants are a reservoir of potentially useful chemical compounds which serve as drugs, are provided newer leads and clues for modern design by synthesis (Evans, 2002; Varier, 1995). *Callistemon lanceolatus* DC (*C. lanceolatus*) (Family: Myrtaceae) commonly known as bottle brush, is frequently cultivated throughout India in gardens as ornamental plant. Hummingbirds love the flowers, and the plant is hardier than most Bottlebrushes. Aqueous extracts of the leaves and flowers have antifungal and antibacterial activity. The extract also shows cholinesterase activity. The essential oils from leaves possess antimicrobial, fungitoxic, antinociceptive and anti-inflammatory activities (Kumar et al., 2011). The present study will give comprehensive information on its pharmacological utility along with the responsible active constituents.

Taxonomical Classifiation

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Rosids
Order:	Myrtales
Family:	Myrtaceae
Subfamily:	Myrtoideae
Tribe:	Melaleuceae
Genus:	*Callistemon*

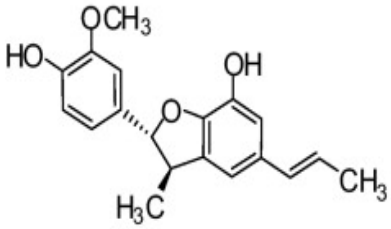
MORPHOLOGY

A handsome shrub or small tree, up to 7.5 m. in height, indigenous to Queensland and New South Wales, frequently cultivated throughout India in gardens. Leaves lanceolate sometimes broadly so, up to 7.5 cm long, with prominent vein, midrib and oil gland; flowers, crimson with dark red anthers, in 10 cm long spikes; capsules depressed-globose. The obvious parts of the flower masses are stamens, with the pollen at the tip of the filament; the petals are inconspicuous (see picture). Flower heads vary in colour with species; most are red, but some are yellow, green, orange or white. Each flower head produces a profusion of triple-celled seed capsules around a stem (see picture) which remain on the plant with the seeds enclosed until stimulated to open when the plant dies or fire causes the release of the seeds. The obvious parts of the flower masses are stamens, with the pollen at the tip of the filament; the petals are inconspicuous (see picture). Flower heads vary in colour with species; most are red, but some are yellow, green, orange or white. Each flower head produces a profusion of triple-celled seed capsules around a stem (see picture) which remain on the plant with the seeds enclosed until stimulated to open when the plant dies or fire causes the release of the seeds (The Wealth of India, 1992).

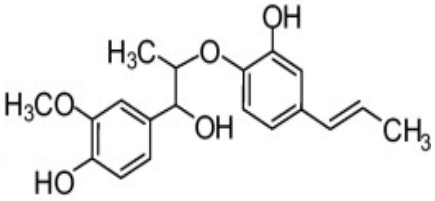
PHYTOCHEMICALS

Preliminary phytochemical screenings were performed for presence of saponins, tannins, carbohydrates, steroids, proteins, amino acids,

phenolic compounds and anthraquinone glycosides (Ali et al., 2011). Two neolignans, named callislignan A and B together with known C-methyl-flavonoids, a lignan and pentacyclic triterpenoid esters were isolated from the leaves of *C. lanceolatus*. Previous chemical investigations of compounds from this family have revealed the presence of various types of secondary metabolites, including triterpenoids (Younes, 1975; Varma and Parthasarathy, 1975), Phloroglucinol Derivatives (Lounasmaa et al., 1977), C-methyl flavonoids (Huq and Misra, 1997) and tannins (Hanaa and Mohamed, 2002).



CallislignanA



CallislignanB

A new triterpenoid, 30-hydroxyalphitolic acid **1**, and eight known triterpenoids, alphitolic acid **2**, lupenol**3**, 3-acetoxy-olean-18-en-28-oic acid **4**, betulinic acid **5**, ursolic acid **6**, betulinic acid 3-*O*-caffeate **7**, morolic acid 3-*O*-caffeate **8**, and ursolic acid 3-*O*-caffeate **9**, were isolated from *C. lanceolatus* (Jeong et al., 2009). Substantial fractionation and purification of the EtOAc-soluble extract of the aerial parts of *C. lanceolatus* afforded six flavonoids, 4',5-dihydroxy-6,8-dimethyl-7-methoxyflavanone (1), eucalyptin (2), 8-demethyleucalyptin (3), sideroxylin (4), syzalterin (5), and quercetin (6) (Park et al., 2010). Two new flavonol glycosides, kaempferol 3-O-beta-D-galacturonopyranoside and quercetin 3-O-(2"-O-galloyl)-beta-D-glucoronopyranoside, were isolated, from leaves of *C. lanceolatus*, as well as eighteen known polyphenols (phenolic acids, flavonoids and three tannins) (Mahmoud et al., 2002) .

TRADITION USES

Callistemon species are used for forestry, essential oil production, farm tree/windbreak plantings, degraded-land reclamation and ornamental horticulture, among other applications (Spencer and Lumley, 1991). In China callistemon species, especially *C. viminalis*, are used in Traditional Chinese Medicine pills for treating hemorrhoids (Ji, 2009). *Callistemon* are also used as weed control (Wheeler, 2005) and as bioindicators for environmental management (Burchett et al., 2002).

THERAPEUTIC USES

Cardioprotective: The ethanol extract of *C. lanceolatus* has shown significant cardioprotection by doxorubicin-induced cardiac toxicity. The elevated ST segment, decreased blood pressure, increased level of serum enzymes and decreased level of tissue antioxidant markers were observed in doxorubicin treatment ($p<0.01$). While 200 mg/kg extract significantly reduced the elevated levels of the serum enzymes and restores the ECG and blood pressure to normal, also significantly increased the tissue antioxidant levels, while decreased the malondialdehyde level ($p<0.01$) when compared with the control. The histopathological study confirmed the cardioprotection. (Firoz et al., 2011).

Antifungal, Antiaflatoxin and Antioxidant activity

The study examined the chemical composition of *C. lanceolatus* (Sm.) Sweet essential oil and its antifungal, antiaflatoxin and antioxidant activity. During standardization of chemical profile, a total of 8 compounds constituting 0.862 mg/mL of oil composition were analyzed by GCeMS analysis where 1,8-cineole was recorded as a major component (0.56 mg/mL). The antifungal activity of EO and 1,8-cineole was evaluated by contact assay on Czapek's dox agar (Shukla et al., 2012). the ethanol extract of *C. lanceolatus* was investigated because it showed strong elastase inhibition and DPPH radical scavenging activities (Kim et al., 2009).

Calcium channel blocking activity

The crude methanolic extract of fruits of *Callistemon citrinus* (C.c) was screened for possible spasmolytic activity on isolated rabbit's jejunum preparations. The extract produced a relaxing effect on spontaneous contraction of rabbit's jejunum. The fruit of *Callistemon citrinus* was found to have spasmolytic effect on rabbit's jejunum through the calcium channel blocking mechanism. (Ali et al., 2011).

Antithrombin activity

Thirty plants collected in central Florida have been extracted. Crude plant extracts have been tested for the antithrombin activity. In the antithrombin bioassay plant extracts which showed an 80% activity or higher were classified as highly active and therefore merit further study relative to drug discovery. The following plants demonstrated activity of 80% or higher: *Ardisia crenata* (80% CH2Cl2 fraction), Tetrapanax papyriferus (83% CH2Cl2 fraction), *Lagerstroemia indica* (85% CH3OH fraction), *C. lanceolatus* (82 % CH3OH fraction), *Antigonon leptopus* (89% CH3OH fraction), *Myrica virginiana* (95% CH3OH fraction), *Myrica cerifera* (81% CH3OH fraction). Chromogenic bioassay result showed antithrombic activity of methanolic extract of *C. lanceolatus* (Chistokhodova et al., 2002).

Antifungal properties

The antifungal activity against *Aspergillus flavus* of the essential oils obtained by hydrodistillation from the leaves of four Myrtaceae from Cameroon (*Callistemon rigidus, Callistemon citrinus, Eucalyptus camaldulensis* and *Eucalyptus saligna*) was established (Dongmo et al., 2010). Leaf essential oils of *Callistemon rigidus* and *Callistemon citrinus* obtained by steam-distillation were assigned for their antifungal activity against *Phaeoramularia angolensis.* The oils of *Callistemon rigidus* and *Callistemon citrinus* were dominated by the presence of 1,8-cineole (79.1% and 73.8% respectively) (Jazet et al., 2009).

Antidiabetic and hypolipidemic activities

C. lanceolatus could be useful in management of type -1 and type-2 diabetes associated with abnormalities in lipid profiles. Ethyl acetate and hexane fractions of dichloromethane extract of *C. lanceolatus*used and diabetes induced by streptozotocin and streptozotocin-nicotinamide (Kumar et al., 2011). Stem bark of *Callistemon rigidus* (Myrtaceae) intensely inhibits α-amylase activity in isolated mouse plasma *in vitro*. Consequently, the active components in this plant were investigated and examined the inhibitory effects of these isolated components on α -amylase in mouse gastrointestinal tract *in vivo* (Kobayashi et al., 2006). *C. lanceolatus* possesses antihyperglycemic property as well improved body weight, liver profile, renal profile and total lipid levels in alloxan-diabetic rats (Kumar et al., 2011).

Anti-inflammatory activity

C. lanceolatus methanolic leaf extracts (200 and 400 mg/kg) significantly inhibited carragennan – induced rat paw oedema formation. The inhibition of oedema by extract was dose dependent. The development of oedema in the paw of the rat after the injection of carrageenan was due to the release of histamine, serotonin, prostaglandin and the like. *C. lanceolatus* methanolic leaf extract showed significant ($P< 0.05$) anti-inflammatory activity at doses of 200 and 400 mg/kg. This significant anti-inflammatory of *C. lanceolatus* methanolic leaf extract at the dose of 400 mg/kg was comparable with diclofenac sodium. The presence of bioactive constituents as indicated above may be responsible for anti-inflammatory activity (Kumar et al., 2011).

Acute toxicity, brine shrimp cytotoxicity and relaxant activity

The screening of fractions of the crude methanol extract of *Callistemon citrinus* Curtis was performed for tracing spasmolytic constituents and for isolation of bioactive compounds. Acute toxicity and brine shrimp cytotoxicity of crude methanol extract were also performed to standardize it. Relaxant constituents were more concentrated in ethylacetate fraction followed by chloroform, n-butanol and aqueous fractions that warrant for its isolation. The crude methanol extract was safe at concentrations 250 mg/ml or below and results of brine shrimp cytotoxicity assay imply that the plant specie may be a source of cytotoxic agents. (Ali et al., 2011).

Antibacterial activity

The antibacterial properties of ethanolic and methanolic extract of *Callistemon citrinus* leaf and *Albizia lebbeck* leaf was studied against different pathogenic bacteria including *Streptococcus pyogenes, Bacillus cereus, Bacillus anthracis, Salmonella typhi, Kelebsiella pneumoniae, Streptococcus epidermidis, Escherichia coli, Pseudomonas aeruginosa* and *Listeria monocytogenes* by disc diffusion method. Their results revealed that the ethanolic and methanolic extract showed good antimicrobial activity against bacteria. It is noteworthy in particular effect against *S. typhi, B. cereus, S. epidermidis, B. anthracis* which is comparable with antibiotics. Good effect of extract of this plant on *P. aeruginosa* that is resistant bacteria is also noticeable. Furthermore, the effect of these extract on gram positive bacteria are more notify than gram negatives. Based on the result of this study it can be said that *Callistemon citrinus* is an effective antimicrobial plant that can be used for folk medicine and will be a good source for finding new antimicrobial agents in order to treat and control infections (Seyydnejad et al., 2010; Seyydnejad et al., 2010).

***C. lanceolatus* protect PC12 cells against Abeta-induced toxicity**

Reducing Abeta-induced neurotoxicity could provide a suitable means of prevention or intervention in the disease course of AD. The neuroprotective effects of isolates from *C. lanceolatus* (Myrtaceae) against Abeta were

evaluated using PC12 cells. Substantial fractionation and purification of the EtOAc-soluble extract of the aerial parts of *C. lanceolatus* afforded six flavonoids, 4',5-dihydroxy-6,8-dimethyl-7-methoxyflavanone (1), eucalyptin (2), 8-demethyleucalyptin (3), sideroxylin (4), syzalterin (5), and quercetin (6). Compounds 1, 5, and 6 were found to protect PC12 cells effectively against Abeta-induced toxicity. In particular, compound 1 showed the most promising neuroprotective effect with an ED (50) value of 6.7 microM in terms of decreasing Abeta-induced apoptotic cell death, and this was accompanied by a decrease in caspase-3 activation and an increase in Bcl-2/Bax ratio. These results suggest that compound 1 could be developed as a candidate anti-AD agent due to its attenuation of Abeta-induced apoptotic cell death (Park et al., 2010).

CONCLUSION

Several flavonoids, triterpenoids, tannins, phenolic compounds have been isolated from its leaves. *C. lanceolatus* shows various types of activities such as free radical scavenging activity, calcium channel blocking activity, antifungal, antibacterial, antidiabetic, antithrombin and herbicidal activity. The broad therapeutic potentials of *C. lanceolatus* may be due to the presence of the investigated active chemical constituents. In future to extend this study, elaborated psychopharmacological studies will be done as the plant contains flavonoids. Furthermore other parts of the plants are to be exploited for further pharmacological investigations along with the establishment of mechanism and chemical constituents responsible for the respective therapeutic potential.

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