CALLISTEMON CITRINUS (BOTTLE BRUSH) AN IMPORTANT MEDICINAL PLANT: A REVIEW OF ITS TRADITIONAL USES, PHYTOCONSTITUENTS AND PHARMACOLOGICAL PROPERTIES

Niranjan Sutar*, Ranju Sutar , Mudit Kumar,
Sir Madanlal Institute of Pharmacy, Alum Pur hauz, Agra road, Etawah -206001,U.P., India.

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ABSTRACT:

Medicinal herbs are moving from fringe to mainstream use with a greater number of people seeking remedies and health approaches free from side effects caused by synthetic chemicals. India officially recognizes over 3000 plants for their medicinal value. It is generally estimated that over 6000 plants in India are in use in traditional, folk and herbal medicine. This article aims to provide a comprehensive review on the phytoconstituents and pharmacological aspects of *C. citrinus*. It is obtained from wet tropics, notably Australia, South America and tropical Asia, but is now spread all over the world. They are woody aromatic trees and The different parts of this herb have been used in common remedies for treatment of diarrhoea, dysentery and rheumatism. It is also used as a water accent, anticough, antibronchtits and insecticide in folk medicine .The innumerable medicinal properties and therapeutic uses of *C. citrinus* as well as its phytochemical investigations prove its importance as a valuable medicinal plant.

KEY WORDS: *Callistemon citrinus*, Bottle brush, Pharmacological activities, Phytoconstituents , Traditional uses.

Corresponding Author: Niranjan Sutar
E mail: niranjansutar77@rediffmail.com
Mobile: +919760085338

INTRODUCTION:

Over the last few years, researchers have aimed at identifying and validating plant-derived substances for the treatment of various diseases. Interestingly it is estimated that more than 25% of the modern medicines are directly or indirectly derived from plants. It is worth mentioning that Indian medicinal plants are considered as a vast source of several pharmacologically principles and compounds that are commonly used as home remedies against multiple ailments [1]. Since early 1990s, the use of forest products for medicine has been emerging as a vital income generating resource for the development of various social groups; hence, there is an increased attention for their long-term sustainability [2]. Indian traditional medicine is based on various systems including Ayurveda, Siddha, Unani and Homoeopathy. The evaluation of these drugs is primarily based on phytochemical, pharmacological and allied approaches including various instrumental techniques such chromatography, microscopy and others. With the emerging worldwide interest in adopting and studying traditional systems and exploiting their potential based on different health care systems, the evaluation of the rich heritage of traditional medicine is essential [3].

C. citrinus (Linn.), which is commonly known as 'Crimson Bottle Brush', is an evergreen tree or shrub, belonging to the family Myrtaceae. It grows upto 6-15 m in height and 1.3-1.5 m in girth with sharp pointed mid-green leaves [4]. The different parts of this herb have been used in common remedies for treatment of diarrhoea, dysentery and rheumatism. It is used as a water accent, anticough, antibronchtits and insecticide in folk medicine [5]. The plant is rich in polyphenols [6].

This evergreen plant's bright red flower spikes. The flowers are followed by small; woody capsules that look like bead bracelets on the bark, and which last for years. *C. citrinus* is an evergreen shrub originating from Australia and known as Crimson bottle-brush, Red bottle-brush or lemon bottle-brush for its original shape and form. Its name Callistemon was given by Robert Brown (21 Dec 1773 – 10 Jun 1858), a Scottish botanist that made important contributions to botany through the use of microscope, and it means beautiful stamens. The Callistemon genus that has among its 140 genera approximately 3800 species many studies have been done on medical properties of different species of C. citrinus: Antibacterial, antifungal and antioxidant activities [7]

CLASSIFICATION:

Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Dicotyledons
Subclass	Rosidae
Family	Myrtaceae
Genus	*Callistemon*
Species	*Callistemon citrinus* Curtis

VERNACULAR NAMES

English	Crimson bottlebrush.
Guajarati	Khakda, Khakra
Hindi	Cheel चील ,Kastula
Manipuri	Barap lei
Kannad	Charoli.
Marathi	Jhankara, Kateri
Tamil	Palasu
Telegu	Seesa Brush
Sanskrit	Naaglingam" or "Shiv-lingi"
Urdu	Sumbul / Simal / Silk cotton *tree*
Punjabi	Palak chachra;
Oriya	Polaso ;
Tamil	Palasu;
Kannada	Muthuga ;

DESCRIPTION

Height: 10 to 15 feet
Texture: fine

Foliage

Leaf arrangement: alternate

Leaf type: simple

Leaf margin: entire

Leaf shape: lanceolate, linear

Leaf venation: pinnate

Leaf type and persistence: evergreen

Leaf blade length: less than 2 inches, 2 to 4 inches

Leaf color: green

Flower

Flower color: red

Flower characteristics: very showy

Fruit

Fruit shape: round

Fruit length: less than .5 inch

Fruit color: brown

Trunk and Branches

Trunk/bark/branches: branches droop; not showy; typically multi-trunked; thorns

Pruning requirement: little required

Fracture: resistant

Cultivation parameters:

Light requirement: full sun

Soil tolerances: clay; sand; loam; acidic; well-drained

Drought tolerance: high

CHEMICAL CONSTITUENTS:

The chemical composition and the antibacterial activity of the essential oils obtained by hydrodistillation from the leaves of *C. citrinus* were analyzed by GC and GC/MS. Twenty-four and twelve components were identified for *C. citrinus*, representing 92.0% and 98.3% of the total oils. The major omponents of *C. citrinus* were 1,8-cineole (61.2% and 83.2%) and alpha-pinene (13.4% and 6.4%),. The in vitro antibacterial activity of the essential oils was studied against 12 bacteria strains using disc diffusion and broth microdilution methods. The oils exhibited strong zone of inhibitions against some bacteria such as S. faecalis (20.3-24.0 mm), both strains of S. aureus (23.0-26.3 mm), B. cereus (17.3-19.0 mm) and S. macrcesens (11.3-23.7 mm) when compared to standard antibiotics gentamycin and tetracycline used as controls. Expect for P. aeruginosa and S. macrcescens, the MIC values of both essential oils ranged from 0.31-2.50 mg/mL.[8]

The compound isolated from different parts of C. citrinus are,

Flowers Flavonoids: pelargonidin-3,5-diglucoside(I), cyanidin-3,5-diglucoside(II) and kaempferol(III); monoterpenoids: β-pinene(IV) and 1,8-cineol; tannins: pyrogallol(V) and catechol(VI); triterpenoids: betulic acid(VII), α-amyrin(VIII) and oleanolic acid(IX) and β-sitosterol(X) [9-12]

Fruits Monoterpenoids: 1,8-cineol and α-terpineol(XI); triterpenoids: α-amyrin(VIII) betulinic acid(VII) and oleanolic acid(IX) and β-sitosterol(X) [9,10]

Leaves Flavonoids: 3'4'7-trihydroxy flavonol(XI), 3'4'7-trihydroxy flavone(XIII), 3'4'7-trihydroxy flavonol- 3-glucoside, 3'4'7-trihydroxy flavone-7-galactoside, 5,7-dihydroxy-3,8,4'-trimethoxy-6-Cmethyl flavone(XIIIII), kaempferol-3-O-β-D-galactopyranoside and quercetin-3-O-(2''- O-galloyl)-β-D-gluconopyranoside; monoterpenoids: 1,8-cineol, α-pinene and limonene: triterpenoids: α-lupenol, 2α-hydroxy uvaol(XIV), 2 α –hydroxy ursolic acid(XV), ursolic acid(XVI), oleanolic acid(IX) and uvaol(XVII) and myrtucommulone and phloroglucinol derivative [12-20]

Seeds Tannins: gallic acid(XVIII) and ellagic acid(XIX)

Stem bark Tannins: 3,3'-di-O-methyl ellagic acid, 3,3',4-tri-O-methyl ellagic acid and ellagic acid(XIX Flavonoids: 5,4'-dihydroxy-6-C-methoxy flavonone, 5,4'-dihydroxy-8-C-methyl-7-methoxy.

FIG-1: CALLISTEMON CITRINUS (L) FRANCO LEAVES

FIG-2: CALLISTEMON CITRINUS (L) FRANCO PLANT

MEDICINAL USES:

Callistemon flowers were used as a food source by Australian Aborigines. The flowers were sucked for their nectar or used to make sweet drinks. *Callistemon* species also had roles as traditional bush medicines for Australian Aborigines, The leaves were used to cure respiratory tract infections. Unfortunately most of our understanding of the antimicrobial potential bacteria and fungi, and to assess the toxicity of the extracts and thus to assess their medicinal potential.

Due to the over exploitation for its volatile oils and secondary metabolites, there is a need to develop alternate strategies for conservation and industrial production of bioactive compounds from this plant [21]. The leaf of the plant is used as a tea substitute and it has a refreshing flavor too. The standardized oil from the leaves of *C. citrinus* has been proved to have anti-nociceptive and anti-inflammatory effects in experimental animals [22]. The oil of *C. citrinus* stimulates the analgesic activity with aspirin and pentazocine. The oil reduces the paw volume in case of paw edema. Many phenolic compounds and cross reactive allergenic components have been identified in this plant[23]**.** The essential oils from *C. citrinus* exhibit higher activity than the synthetic antibiotics like miconazole and clotrimazole [24] **.** The plant has been proved to exhibit anticandidal activity (Dutta et al., 2007). Studies have also proved that the methanol extract of the plant has anti-thrombin activity [25]**.** *C. citrinus* has a phytotoxin (leptospermone) belongs to the family of β- triketones and acts as a natural herbicide (Vogler et al., 1998). This plant is usually propagated through seeds and cuttings; meanwhile, tissue culture technique has also been attempted. The most suitable medium for callus induction of *C. citrinus* is Murashige and Skoog medium (MS), supplemented with 5.0 mg/l of 6- BAP, 4.0 mg/l of Kinetin, 2.0 mg/l of IBA and 30g/l of sucrose[26] **.**

TRADITION USES:

The different parts of this herb have been used in common remedies for treatment of diarrhoea, dysentery and rheumatism. It is used as a water accent, nticough, antibronchtits and insecticide in folk medicine. The plant is rich in polyphenols. *Callistemon* species are used for forestry, essential oil production, farm tree/windbreak plantings, degraded-land reclamation and ornamental horticulture, among other applications [27]. In China callistemon species are used in Traditional Chinese Medicine pills for treating hemorrhoids [28]. *Callistemon* are also used as weed control [29]. and as bioindicators for environmental management [30].

PHARMACOLOGICAL ACTIVITIES

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*, *C. citrinus, Eucalyptus camaldulensis* and *Eucalyptus saligna*) was established (Dongmo et al., 2010). Leaf essential oils of *Callistemon rigidus* and *C. citrinus* obtained by steam-distillation were assigned for their antifungal activity against *Phaeoramularia angolensis*. The oils of *Callistemon rigidus* and *C.citrinus* were dominated by the presence of 1,8-cineole (79.1% and 73.8% respectively) [31] **.**

Acute toxicity, brine shrimp cytotoxicity and relaxant activity

The screening of fractions of the crude methanol extract of *C. 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. [32]**.**

Antibacterial activity

The antibacterial properties of ethanolic and methanolic extract of *C. 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 *C.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 [33] **.**

Calcium channel blocking activity

The crude methanolic extract of fruits of *C.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 *C. citrinus* was found to have spasmolytic effect on rabbit's jejunum through the calcium channel blocking mechanism. [34]

Antimicrobial Activity

Antimicrobial activity against *B. subtilis*, *B. pumilis* and *E. coli* by cup plate agar diffusion method. Streptomycin was used as standard and distilled water was used as negative control. As revealed from Table 3, the chloroform extract exhibited moderate to significant antimicrobial activity against all the tested microbial strains, and it showed significant inhibition on gram (+)ve compared to gram(-)ve. The ethanolic extract exhibited moderate antimicrobial activity. The aqueous extract was devoid of any antimicrobial activity. The chloroform extract showed maximum antimicrobial effect of the three extracts. Antimicrobial activity varied significantly between different extracts of *C. citrinus.* This credit to maximum activity of chloroform extract was supposed to chloroform being an organic solvent and will dissolve organic compounds better, hence liberate component required for antimicrobial activity [35].

CONCLUSION

Before the introduction of modern medicines, disease treatment was entirely managed by herbal remedies. It is estimated that about 80% of the world population residing in the vast rural areas of the developing and under developed countries still rely mainly on medicinal plants. It is quite obvious that the plant is widely used in traditional medicinal system of India and has been reported to possess antifungal, Antimicrobial activity, Calcium channel blocking activity and also used to brine shrimp cytotoxicity and relaxant activity and antibacterial properties. The plant is rich in polyphenols, tannins, flavanoids Monoterpenoids oleanolic acid and glycosides present in *C. citrinus* might be medicinally important and/or nutritionally valuable. The Flowers *Callistemon citrinus* contain Flavonoids: pelargonidin-3,5-diglucoside, cyanidin-3,5-diglucoside and kaempferol Fruits Monoterpenoids: 1,8-cineol and α-terpineol; triterpenoids: α-amyrin, betulinic acid and oleanolic acid and β-sitosterol, Plant Leaves also contain Flavonoids: 3'4'7-trihydroxy flavonol, 3'4'7-trihydroxy flavone, 3'4'7-trihydroxy flavonol- 3-glucoside, 3'4'7-trihydroxy flavone-7-galactoside,In Seeds of the plant gives Tannins: gallic acid and ellagic acid and the Stem bark contain Tannins: 3,3'-di-O-methyl ellagic acid, 3,3',4-tri-O-methyl ellagic acid and ellagic acid Flavonoids: 5,4'-dihydroxy-6-C-methoxy flavonone,

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