

A REVIEW ON CHEMICAL CONSTITUENTS AND PHARMACOLOGICAL ACTIVITIES OF *CALLISTEMON CITRINUS*: AN ORNAMENTAL PLANT.

Naveen Kumar, Dr. Govind Singh*, Dr. Prabhakar Kumar Verma*

* Department of Pharmaceutical Sciences, M. D. U. Rohtak - 124001, India.

vermapk422@rediffmail.com

Abstract

Nowadays a number of medicinal plants are in use because they produce very less or no side effects and shows therapeutic effect same as that of synthetic drugs. *Callistemon citrinus* is an ornamental plant. *C. citrinus* belongs to myrtaceae family and also known as bottlebrush. The different parts of plant mainly consist of active constituent like 1, 8- cineole, triterpenoids, alpha pinenes, eucalyptol, polyphenols, tannins, alkaloids, flavanoids, saponins, phytosterol etc. *Callistemon citrinus* plant parts are used for the treatment of hypertension, depression, diabetes, MDR TB, inflammation, fungal and bacterial infection. This plant is also used in cough, bronchitis and as insecticides. It also shows activities like antithrombotic, pupicidal, larvicidal, nematocidal, antiphylococcal and antioxidant.

Keywords: Polyphenols, Flavanoids, Saponins .

Introduction

Recently, the demand for the herbal drug for treatment of various diseases is increasing. It has been noticed that not only in India but also globally herbal drugs are being explored more and more. A number of research studies have been undertaken to investigate the potential of herbs in the treatment of diseases [1]. Interestingly it was estimated that more than 25% of the modern medicines have been derived from plants. Indian medicinal plants are possesses pharmacologically potent principles commonly used as home remedies against multiple illnesses [2]. For the last 2500 years, a strong traditional systems of medicine such as Ayurvedic, Chinese and the Unani. Chinese have been practiced in the eastern continent. These traditions are still flourishing and approximately 80% of the people in the developing countries depend on these systems of medicine. Medicinal plants contain therapeutically active substances which act as precursors for the synthesis of new drugs [3]. A number of lead candidates have been isolated from the natural products which may play an important role in future drug development programs [4].

An herb that has shown potential in recent experimental investigation for the management of several human ailments is *Callistemon citrinus* (*C. citrinus*). *C. citrinus* belongs to family myrtaceae and is commonly known as Bottlebrush. The genus of this plant comprises over 30 species and all has great medicinal importance. Morphologically, they were woody trees or shrubs (ca. 0.5 m to 7 m tall) widely distributed in South America, Australia and tropical areas of Asia, but also found all over the world in small numbers. *Callistemon* species have white papery bark and attractive narrow foliage [5]. *C. citrinus* is also named as *Callistemon lanceolatus*. The leaves of this plant are 5–8 mm wide, 3–7 cm long and cultivated mostly as ornamental plant. Pharmacologically, this plant has a potent antifungal, antibacterial, antinociceptive, antioxidant, and anti-inflammatory activities. Moreover, ethanolic extract of *C. lanceolatus* has expressed a potent cardio protective activity with strong elastase inhibition, as well as DPPH radical scavenging activities. It has been found that isolated flavanoids from the aerial parts showed effective against alzheimer's disease [6]. Aerial parts of *C. citrinus* lead to the isolation of two flavones which were characterized as 8-(2-hydroxypropan-2-yl)-5-hydroxy-7-methoxy-6-

methyl-4'-methoxy and 5,7-dihydroxy-6,8-dimethyl-4'-methoxy flavones along with the seven known phytoconstituents. These isolated flavones lowered the blood glucose in streptozotocin induced diabetic rats [7].

Illustration

Height of plant varies from 305 – 457cm with fine appearance.

Leaf Characteristics

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 colour: green

Flower Characteristics

Very showy, red coloured and bottlebrush like shape.

Fruit Characteristics

Fruit shape: round Fruit colour: brown

Fruit length: less than 0.5 inch

Chemical Constituents

This plant contains numerous chemical constituents. Essential oils obtained from the leaves and flowers of this plant were found to be rich in α -terpinene, α - phellandrene, α -terpineol, 1, 8-cineole, α - and β -pinenes, limonene, terpinen-4-ol, linalool, geraniol and *trans*-pinocarveol. Among these, the most widely distributed 1, 8-cineole have a number of medicinal and flavouring properties. The essential oil constituents such as isobutyl isobutyrate, isoamyl acetate, 1,8-Cineole, α -terpinene, *p*-cymene, α -phellandrene contributed greater to the oil obtained from flowers as compared to leaf. Whereas, oil obtained from leaf contains significant amount of β - and α -pinenes, α -terpineol, limonene and other sesquiterpenoids. When essential oils from different parts of this plant were analysed under gas chromatography and gas chromatography-mass spectroscopy, then it showed high content of α -pinenes (32.3%), limonene (13.1%) and α -terpineol (14.6%) in leaf sample, whereas the flower oil was dominated by 1,8-cineole (36.6%) followed by α -pinenes (29.7%). The leaf oils also contained higher amount of monoterpene hydrocarbons (52.1%) and sesquiterpenoids (14%) as compared to flower oil

(44.6% and 1.2%, respectively). Whereas, oils obtained from flower were predominant in oxygenated monoterpenes (43.5%) [8].

Two neolignans, such as callisignan B and A together with pentacyclic triterpenoids esters and known C-methyl- flavanoids, a lignan were also isolated from the leaves of *C. citrinus*. A number of chemical investigations have been done on this plant. Last chemical investigations of plants from this family have showed the presence of various types of secondary metabolites, including triterpenoids, Phloroglucinol Derivatives, and tannins. Eight known triterpenoids i.e. ursolic acid, ursolic acid 3-O-cafeate, alphitolic acid, betulinic acid 3-O-cafeate, morolic acid 3-O-cafeate, lupenol, 3-acetoxy-olean-18-en-28-oic acid, betulinic acid and a new triterpenoid i.e. 30-hydroxyalphitolic acid were isolated from *C. citrinus*. Repeatedly purification and fractionation of the ethyl oxide acetate-soluble extract of the *C. citrinus* aerial parts have showed presence of six flavanoids i.e. syzalterin, 8-demethyleucalyptin, eucalyptin, 4', 5-dihydroxy-6, 8-dimethyl-7-methoxyflavanone, quercetin and sideroxylin. Two new flavonol glycosides i.e. kaempferol 3-O-beta-D-galacturonopyranoside, quercetin 3-O-(2"-Ogalloyl) - beta-D-glucoronopyranoside, and eighteen known polyphenols i.e. phenolic acids, flavanoids and three tannins etc were also isolated from leaves of *C. citrinus* [9].

Pharmacological Activities

Antimicrobial activity: - *C. citrinus* leaves possess a broad spectrum antimicrobial activity against various types of fungi and bacteria. Methanolic extract *C. citrinus* leaves extract inhibited the growth of tested bacteria. Moreover, flower extracts inhibited the growth of 64% of the bacteria tested. It has been found that *C. citrinus* extracts was more active against gram-positive bacteria (100% inhibited) as compared to gram-negative bacteria (27% inhibited by leaf extracts; 55% inhibited by flower extracts) [10]. Alkaloids obtained from *C. citrinus* showed antibacterial activity and also inhibits the transportation of compounds across the cell membrane which are ATP-dependent. It can be concluded that alkaloids are potential antimicrobial constituents of the plant [11].

Cardioprotective effect: - *C. citrinus* extract showed a potent Cardioprotective effect in doxorubicin induced cardiotoxic rats. Doxorubicin showed decrease in the systolic, diastolic, mean

blood pressure and heart rate, where as the *C. citrinus* extract restores the mean blood pressure, diastolic, systolic and heart rate near to normal [12].

Antidepressant effect: - Chloroform fraction of *C. citrinus* showed antidepressant activity, same as that of standard drug, i.e., imipramine (10 mg/kg). As mentioned earlier, *C. citrinus* contains many bioactive compounds and majority of these compounds were terpenoids and flavanoids which are responsible for the antidepressant activity [13].

Antidiabetic effect: - The petroleum ether, chloroform and ethanolic fraction of *C. leaves* showed antidiabetic potential in streptozotocin induced diabetic rats. In *C. treated* diabetic rats improved the lipid peroxidation, antioxidant enzymes and GSH levels despite of any toxic effect [14]. A significant antidiabetic effect was noticed on treating 400 mg/kg of methanolic fruit extract of *C. in* alloxan induced diabetic rats [15]. *C. citrinus* leaves extracts also improved liver profile, body weight, amount of total lipid content and renal profile in alloxan induced diabetic rats [16].

Antitubercular activity: - The *C. citrinus* chloroform extract was not only effective against pan sensitive strains but also on the resistant strains of tuberculosis. This provided rationale for the *C. citrinus* chloroform extracts to be developed into drugs for the treatment of multi drug resistant tuberculosis [17].

Anti-inflammatory activity: - The methanolic leaf extract of *C. citrinus* showed potent anti-inflammatory activity. The anti-inflammatory activity shown by methanolic leaf extract of *C. citrinus* at the dose of 400mg/kg was very much comparable with that of diclofenac sodium i.e. standard drug [18].

Antifungal, Antiaflatoxin and Antioxidant activity: - A number of studies examined that *C. lanceolatus* sweet essential oil possesses antiaflatoxin, antioxidant and antifungal activity. After gas chromatography-mass spectroscopy analysis *C. lanceolatus* essential oils showed the presence of total of 8 compounds, out of which 1, 8-cineole had major contribution.

The antifungal activity of essential oil was due to presence of 1, 8-cineole, which was evaluated by contact assay on Czapek's dox agar The ethanol extracts of *C. citrinus* were found to have DPPH radical scavenging activities and strong elastase inhibition [9].

Calcium channel blocking activity: - The fruit methanolic extracts of *C. citrinus* was found to possess antispasmodic activity on jejunum preparations isolated from rabbit. This extract have showed a relaxing effect on spontaneous contraction of rabbit's jejunum. The fruits of *C. citrinus* showed antispasmodic effect on jejunum of rabbit by blocking their calcium channels [9].

Callistemon citrinus syn. *Callistemon lanceolatus* also showed activities like anti-caries, antioxidant, spasmolytic, hypoglycaemic, hepatoprotective, cytotoxic, anti- *Helicobacter pylori*, and anti-bacterial activity [19].

Discussion

A number of medicinal plants were used in traditional systems. From these medicinal plants a number of active constituents can be withdrawn for the synthesis of new drugs. *Callistemon citrinus* is also the one of important medicinal plant. The leaves of the plant were composed of mainly oxygenated monoterpenes, followed by monoterpene hydrocarbons, sesquiterpene hydrocarbon, and oxygenated sesquiterpene. The dominant constituents in the leaves were eucalyptol, α -pinenes, α -terpineol and pinocarveol. Other notable components found were Pinocarvone, β -pinenes and minor constituents include α -fenchol, terpinen-4-ol, camphene and β -linalool. The flower of plant was found to be rich in sesquiterpene hydrocarbons, followed by oxygenated monoterpenes, oxygenated sesquiterpene and monoterpenes hydrocarbon. The main constituents characterizing the flowers were α -eudesmol, caryophyllene, (-)-bornyl acetate, eucalyptol, bicyclogermacrene, γ -eudesmol and 1R- α -Pinene. Similarly, the stem of plant comprises of oxygenated monoterpenes and monoterpene hydrocarbons. The key components dominating in the stem were eucalyptol, α -pinenes, limonene and α -terpineol. *Callistemon citrinus* possess several pharmacological behaviours like anti-inflammatory activity, antiviral activity, antitussive, bronchodilator, mucolytic and mucociliary effects. It also shows herbicidal activity, antidiabetic calcium channel blocking activity, free radical scavenging activity, antifungal, antithrombin, antibacterial, antioxidant, anticancer and antinociceptive.

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Classification

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Dicotyledons
Subclass	Rosidae
Family	Myrtaceae
Genus	<i>Callistemon</i>
Species	<i>Callistemon citrinus</i> Curtis

Vernacular Names

English	Crimson bottlebrush
Hindi	Cheel Kastula
Punjabi	Palak chachra



Fig – 1 Flower and leaves of *C. citrinus*.



Fig – 2 *C. citrinus* shrub.