A REVIEW OF PHYTOCHEMISTRY AND PHARMACOLOGY OF THE(MYRTACEAE) FAMILY PLANT SPECIES *CALLISTEMON VIMINALIS*

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Abstract

The bottlebrush, typically called to as Callistemon viminalis, is a member of the family Myrtaceae and is well-known for the role it plays in several medicinal practices. An ornamental plant is notable for the many useful properties that it possesses. These properties include those that are antioxidant, moluscicidal, antibacterial, antifungal, allelopathic, anti-platelet aggregation, anti-quorum sensing, anti-infective, and antihelminthic. Additionally, it has been found that an ornamental plant possesses an effective insecticidal activity. This plant contains a wide variety of secondary metabolites, including, but not limited to, triterpenoid, monoterpenes, steroid, steroida l glycoside, phenolic, tetra deca hydro xanthene diones, flavonoids, essential oils, and pyrrole derivatives. It has been hypothesized, on the grounds of the findings of prior investigations, that the principal components of C. viminalis are monoterpenes. These monoterpenes are thought to be primarily responsible for the diverse array of biological activities that C. viminalis exhibits. The purpose of this review is to present information on the cultivation of the substance, as well as its morphology, microscopic studies, physiochemical characteristics, and phytochemical qualities, with the end objective of employing it more widely for the betterment of humans.

Keywords: *Callistemon viminalis,* monoterpenes, phytochemistry, antioxidant, flavonoids.
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INTRODUCTION

Approximately 10 of the approximately 38 species that make up the genus Callistemon are indigenous to the Indian subcontinent. Callistemon viminalis may be found all over the world;however, it is most prevalent in tropical climates, such as those found in South America, Asia, Australia, and Sri Lanka. [1-3]. The weeping bottlebrush, also known as C. viminalis, belongs to the family of plants known as Myrtaceae. C. viminalis has been employed as a curative remedy for a broad variety of conditions for hundreds of years, making it an essential component of traditional medicine. This plant is used to treat a wide variety of medical conditions, including but not limited to stomach problems, skin infections, and respiratory issues [4]. C. viminalis is extremely important to a number of different industries, including

[5] ornamental horticulture, the manufacture of essential oils, forestry, windbreak plantings, and degraded-land rehabilitation. C. viminalis has been proven to be antihelmintic in vitro, which means that it has the potential to kill or slow the growth of parasites such as tapeworms, hookworms, and

earthworms [6]. This is just one of the numerous uses that C. viminalis has. It has been discovered that C. viminalis may successfully control Ephestia kuehniella by having a detrimental effect on the immune cells that are produced by the pathogen [7]. Antibacterial activity has been shown in preparations made from the flowers and leaves of C. viminalis [1, 7]. These preparations were effective against Gram-positive bacteria. C. viminalis has been discovered to be useful in the treatment of haemorrhoids by practitioners of traditional Chinese medicine [8]. In addition to this, it may inhibit the growth of weeds, which makes it a valuable bio-indicator for the management of ecological systems [2]. You may consume the leaves of C. vimi- nalis, and you can also use them as a substitute for tea; in addition, they have a lovely scent and flavour that can revive you [9]. In order to treat gastroenteritis, diarrhoea, and skin diseases, people have traditionally consumed a hot tea produced from C. viminalis. Because of its astringent characteristics, this plant also possesses hemostatic capabilities, which enable it to stop internal bleeding (caused by conditions such as ulcers) by constricting blood vessels[4]. C. viminalis fruits, bark, and leaves have been found to have molluscicide action against Biomphalria alexandrina [10]. Recent research and clinical trials [11, 12] have disproven the efficacy of bottle brush as a molluscicide, bio-repellent for land leeches, insecticidal, and anti- helmintic agent. In addition to its antioxidant and hepatoprotective characteristics [13], it also possesses an anti-thrombin function [14]. In addition to this, it has been demonstrated to fortify the immune system and protect the body from developing chronic diseases that can have an impact on the heart, the brain, and other essential organs [13]. In this review, we have investigated the culture, morphology, microscopic studies, physiochemical, phytochemical, and pharmacological significance of C. viminalis in an effort to come up with a unified strategy for developing viable replacements for a wide range of clinical issues. Specifically, we have been looking at the importance of C. viminalis as it relates to the following: When doing taxonomic study, anatomical traits are taken into consideration [1]. The family Myrtaceae is comprised of over 130 genera and 3000 species of shrubs and trees. Although it is most prevalent in Australia and tropical America, it may also be found in subtropical regions, temperate regions, and tropical regions [4]. Some structural traits, which were very important, are responsible for the separation of these species. These structural characteristics include those found in Callistemon viminalis, Eucalyptus camaldulensis, Myrtus communis L., Psidium guajava L., and Syzygium aromaticum L.

Kingdom : Plantae

Sub-kingdom: Tracheobionta

Super division: Spermatophyta
Division : Magnoliophyta

Class : Magnoliopsida
Subclass : Rosidae
Order : Myrtales
Family : Myrtaceae
Genus : Callistemon
Species : Callistemon viminalis

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1. PHYSIOCHEMICAL STUDY

The leaf and stem powder of C. viminalis were analysed not too long ago, and the results were as follows: the ash value was found to be 4.66 in the leaf (% w/w), while the amount of insoluble acid was found to be approximately 2.5 in the leaf (% w/w), and the amount of water-soluble content was found to be 2.45 (% w/w) and 3.6 (% w/w) in the leaf and stem respectively [19]. While for other metrics such as extractive values, water soluble content was assessed to be 11.5 (percent weight) and

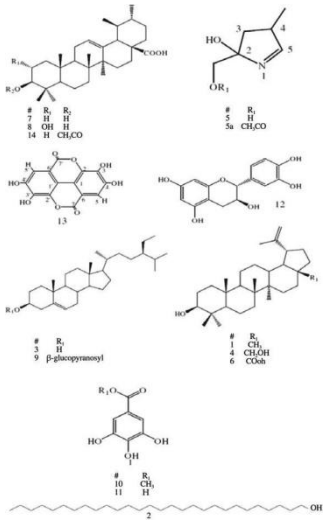
13.4 (percent weight), and alcohol solubility was determined to be 14.4 (percent weight) and 12.5 (percent weight) in the leaf and stem, respectively. The moisture content of the leaf was found to be

percent water by weight, and the moisture content of the stem was found to be 4 percent water by weight [19, 23, 24].

PHYTOCHEMICALS

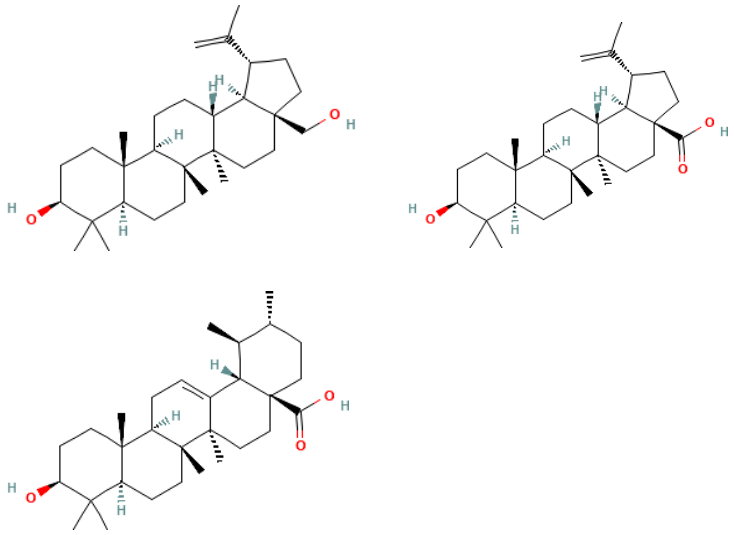
Researchers have determined that C. viminalis has a high concentration of polyphenols, glycosides, flavonoids, alkaloids, saponins, steroids, tannins, and triterpenoids. Figure 1 presents the chemical constituents that were extracted from the various portions of this plant. It was shown that two new epimeric compounds, viminadione A and viminadione B, which are derivatives of tetradecahy- droxanthenediones, exhibit insecticidal action [25]. These compounds are called viminadione A and viminadione B. The antioxidant activity of methyl gallate, gallic acid, catechin, and ellagic acid, which were extracted from the fruits and bark of C. viminalis, was shown to be comparable to that of ascorbic acid [27]. Methyl gallate wasalso found to have anti-inflammatory properties. Compounds such as -Pinene, -Phellandrene, D-Limonene, 1,8-cineole, p-Cymene, -Terpineol, Hexahy- drofarnesyl acetone, and n-Hexadecanoic acid were discovered using GC-MS analysis of the crude hexane extract of C. viminalis leaves, which Callivimi- nones A and B

are two Diels-Alder adducts that were detached or separated from the fruits of C. viminalis. These adducts are composed of polymethylated phloroglucinol and myrcene, and they have an unparalled spiro-[5.5] undecene skeleton. The results of the bioactivity scan showed that compounds 1 and 2 inhibited the generation of NO to an average degree in RAW264.7 macrophages that had been stimulated with lipopolysaccharide. Antibacterial activity of eucalyptol and a-pinene was previously found to be equivalent with chloramphenicol against E. coli and S. aureus by Can-dan, Hwang, Chung, and Matasyoh. [Can-dan, Hwang, Chung, and Matasyoh] According to certain studies, the growth of Bacillus sp., Candida albicans, Escherichia coli, and Staphylococcus aureus can be inhibited by d-limonene. The growth of S. aureus, S. epidermidis, P. aeruginosa, and C. albicans was shown to be inhibited by -phellandrene, according to a number of studies [28-35].

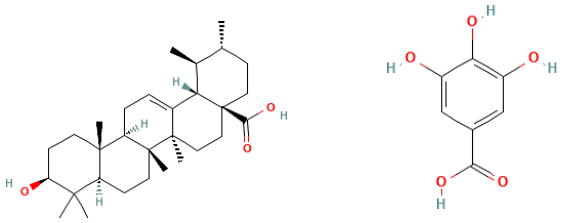


1. Tetra-deca-hydro xanthenedi-ones derivative

2. Tri-terpenoid



2. Phenolic



3. Monoterpenes

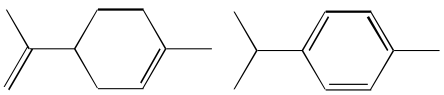
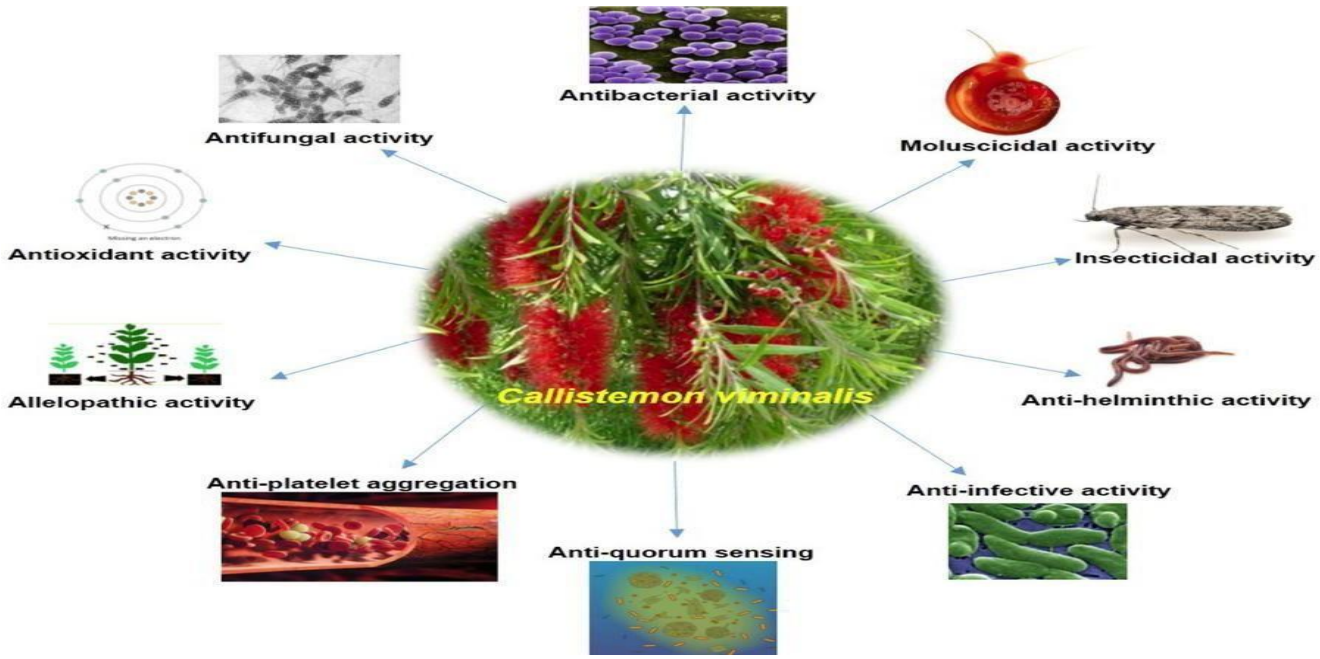


Fig: 1 Some bioactive compounds present in plant parts

PHARMACOLOGY

Anti-fungal activity & Anti-bacterial: Callistemon viminalis essential oil (also known as EOC) contains a high concentration of monoterpenes, which have a wide range of biological effects, including antibacterial, antifungal, insecticidal, and antioxidant effects. Inclusion complexes (ICs) containing cyclodextrins (CDs) are an option that may be utilised to minimise toxicity, improve activity, and decrease the required concentration. As a result, the purpose of this work was to develop an IC (EOC/-CD) and assess its antibacterial, antifungal, and phospholipase activities, in addition to its toxicity. The agar diffusion test was utilised for determining antimicrobial activity, while the disc diffusion test was utilised for determining antifungal activity. The species Lactuca sativa L. was used in experiments to test for toxicity. It was determined if the venom of Bothrops atrox might be used as an inducer for the suppression of phospholipase activity. The minimum inhibitory concentration (MIC) of the infectious agent (IC) was shown to have decreased as a result of antibacterial and antifungal testing. It was most significantly observed for the bacterium Listeria monocytogenes, for which there was a decrease in the MIC from 250 g mL-1 to 62.5 g mL-1 after complexation, and for the fungus Aspergillus flavus, with a decrease in MIC from 125 g mL-1 to 62.5 g mL-1 after complexation. Both of these results were observed after the complexation process. There was no statistically significant difference between the negative control and the positive control in the toxicity tests that were performed using Lactuca sativa as the test subject. These tests demonstrated that complexation led to a reduction in the plant's toxicity. Bothrops atrox venom is responsible for the inhibition of phospholipase activity, and the highest proportion investigated (1:10 m:m) was the one that exerted the greatest amount of inhibition (23%). The tests showed that the complexation of EOC and -CD is a viable option that may be used in a variety of industries, particularly the food sector, to fully realise its application potential. [43,44]

Fig. (2). Pharmacological application of Callistemon *viminalis*



Anti-quorum Sensing

The pathogenicity of many bacterial species is hypothesised to be controlled by a process known as quorum sensing (QS), which is also known as bacterial cell-to-cell communication. Both aqueous and ethanol extracts of C. viminalis leaves have been shown to possess anti-quorum sensing activity [45]. This activity was demonstrated using two biomonitor strains, Chromobacterium violaceum and Agrobacterium tumefaciens, and resulted in the inhibition of the quorum sensing gene.

Anti-platelet Aggregation

Oleanolic Acid (OA), Ursolic Acid (UA), Betulinic Acid (BA), and Maslinic Acid (MA) were isolated from the leaves of C. viminalis and tested in vitro for their anti-platelet aggregation activity on thrombin, Adenosine Diphosphate (ADP), and epinephrine-induced rat platelet aggregation. All four of these acids were found to have anti-platelet aggregati On thrombin-induced platelet aggregation, it was found that the compounds demonstrated the maximum activity by OA (IC50 of 0.84 mg/ml), and that a combination of BA and OA (IC50 of 2.61 mg/ml) was detected. It was established that BA/OA exhibited a considerable platelet aggregation inhibitory effect on epi-nephrine-induced platelet aggregation [46]. The IC50 value for this activity was 2.57 mg/ml.

Allelopathic Activity

The significant process known as allelopathy is one in which certain biochemical compounds can influence the development of other organisms. The research showed that the essential oils from the flowers of C. viminalis have shown allelopathic activity at intensities that were proportional to different concentrations of the essential oil (0.2 - 5.0 LmL1); the Germination Speed Index (GSI) of lettuce seeds and in the dry mass and length of shoots and roots of lettuce seedlings were entirely inhibited at 5.0 LmL1, as per the observed data [47].

Antioxidant Activity

When compared to gallic acid, which is considered to be a standard chemical, the essential oil of C. viminalis had the greatest level of antioxidant activity (88.601.51%), while gallic acid only shown 80.002.12%. It was shown that an ethyl acetate leaf extract of C. viminalis had an antioxidant activity that was equivalent to that of typical antioxidants such as gallic acid (80.002.12%) [5]. When compared to the standard compounds, such as butylated hydroxy toluene [9], the antioxidant capacity of petroleum extract of C. viminalis leaves exhibited a greater IC50 value than the standard compounds. This value was 56.2 0.54 g/ml. The total extracts, petroleum ether fraction, methylene chloride fraction, and ethyl acetate fraction of the fruits and bark of C viminalis, along with the compounds methyl gallate, gallic acid, catechin, and ellagic acid, showed the highest antioxidant activity, comparable with that of the standard antioxidant, ascorbic acid [27]. The Candida albicans fungus was tested with several extracts of the C. viminalis plant. It has been determined that the minimum inhibitory concentrations (MIC) of C. viminalis in hexane, methanol, and aqueous extracts are 3.2 mg/ml, 1.6 mg/ml, and 3.2 mg/ml, respectively. Antifungal activity was seen in all of the plant extracts; however, the methanol extract had the greatest levels of antifungal activity when compared to the matching aqueous and hexane extracts [49]. When tested against Candida albicans,

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the antifungal activity of crude extracts and essential oil of C. viminalis indicated that the essential oil had a stronger impact than the comparable crude extracts [28]. The essential oil that is extracted from the fresh leaves of the C. viminalis plant was tested against a strain of the Aspergillus niger fungus and was shown to have a reasonable amount of action against A. niger [27].

CONCLUSION

A C. viminalis is an essential medicinal plant with a significant role in traditional medicine has been demonstrated by a number of investigations and tests from the scientific community.Despite the fact that biological and medical uses have been investigated, there are still a great number of pharmacological applications that require investigation. Antioxidant, moluscicidal, antibacterial, antifungal, allelopathic, anti-platelet aggregation, anti-quorum sensing, anti-helminthic, and anti-infective actions on insects are some of the medicinal uses that the plant offers. The majority of the research that were done used plant extracts to describe their findings; nevertheless, the active principle that is involved in these activities still needs to be investigated. Because the value of medicinal plants is based on the active principle that is present in those plants, it is of the utmost importance that the planting material be consistent in terms of both its quality and its quantity. Essential oil, ethyl acetate, chloroform, hexane, methanol, water, and other extracts from various portions of C. viminalis had many bioactive chemical compounds for therapeutic application. These constituents included glycosides, tannins, phenols, flavanoids, alkaloids, saponins, and terpenoids. This study has the potential to be utilised in the future for the purpose of the creation of active chemical components that are found in C. viminalis. According to the World Health Organization (WHO), 80 percent of the world's population, particularly those living in impoverished nations, rely on medications produced from plants for their health care. It has been found that roughly sixty percent of authorised medications for the treatment of acute disorders come from natural sources. The current state of the world is shifting people's perceptions toward the usage of herbal medicines, which have less adverse effects and are thus being included into the research and development of contemporary drugs to treat a variety of acute ailments. According to the findings of our research, C. vimi- nalis, which belongs to the genus Callistimon, has a significant potential to become novel medication sources. Because C. viminalis extracts, essential oil, and constituents possess a wide variety of medicinal activities, it is imperative that additional research be conducted on the drug development potential of these substances.

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