



# REVIEW ON: ANTIMICROBIAL PROPERTIES FROM THE EXTRACTED ESSENTIAL VOLATILE OIL FROM THE LEAVES OF CALLISTRMON VIMINALIS

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## CONTENTS

Chapter no.	Particulars of title	Page no.
1.	Abstract	3
2.	Key words	3
3.	Introduction	4
4.	Aim and objective	6
6.	Material and methods	12
7.	Conclusion	13
8.	Reference	14

## LIST OF TABLES

Table no.	Particulars of titles	Page no.
1.	Chemical constituents of extracts and essential oils from <i>Callistemon viminalis</i>	<b>10</b>

## LIST OF FIGURES

Table no.	Particulars of titles	Page no.
1	Antimicrobial role of <i>Callistemon viminalis</i>	<b>5</b>
2	Shrubs of <i>callistemon viminalis</i>	6
3	Antibacterial activity	7
4	Mechanism of Hemolysis	8

## LIST OF ABBREVIATIONS

Sr no.	Abbreviations	Full form
1.	EO	Essential oil
2.	<i>C.viminalis</i>	<i>Callistemon viminalis</i>

## 1. Abstract :

Callistemon viminalis is commonly known as bottle brush plant belonging to family myrtaceae it has a god great medicinal impoartance is ethnic trialcommunities which are still in practice the present study deals with the pharmacognostic studies including examination of morphological and microscopical characters. The essential volatile oil was extracted by hydrodistillation method from leaves of callistemon viminalis.

The chemical composition of volatile oil was studied by performing its GC study and this project is review on the study of extracted essential volatile oil from leaves of Callistemon viminalis which acts as antibacterial, antifungal, haemolytic, antiviral properties.

## 2. Keywords

*Callistemon viminalis*

Antibacterial activity

Antioxidant activity

Antifungal activity

Essential oils

Biological activities

## 3. Introduction

*Callistemon* plant belongs to family Myrtaceae, consists of 34 species, and is characterized for its cylindrical, brush like flowers resembling traditional bottlebrush. *Callistemon viminalis* (*C. viminalis*) (weeping bottlebrush) is a small tree or shrub native to Australia, and reaching 4 m high in temperate areas where its natural occurs. *Callistemon viminalis* (weeping bottlebrush) is a beautiful evergreen shrub or small tree adorned with pendulous branches clothes with narrow, light green leaves. For the identification of these trees they have attractive narrow foliage and white papery bark. It is drought resistant and uite hardy, although it can be affected by frost in cold climates. The flower-spikes are generally white or greenish but pink, red and mauve forms can be found. The plant is covered with dense spikes, up to 6 in. easily grown in acidic, moist, well-drained soils in full sun to light shade. Generally unfussy when it comes to soil, bottlebrush tolerate poor sandy conditions, but does not thrive in shallow, chalky soils unless plenty of organic matter is dug in. they will tolerate drought as long as it is not too prolonged. Ecologically, *Callistemon* species as a farm tree are planted for forestry plantations or ornamental purposes, and for weed control. It is also used as a water accent, anticough, antibronchitis and insecticide in folk medicine. The numerous medicinal properties and therapeutic uses of *C. viminalis*. Simply put, water bottle brushes are able to reach and clean the crevices of bottles that normal sponges just can't reach. Bottle brush flowers have sweet nectar that can either be consumed by sucking on the flowers or soaking them in water

to make sweet drink. bush food is often closer to home than we realise. Many plants used in landscaping or found commonly in the natural environment are edible or useful in some way. In traditional Chinese medicine pills, *C. viminalis* is used for treating hemorrhoids. Hot drink locally 'tea' in Jamaica from *C. viminalis* has been used for the treatment of gastro-enteritis, diarrhea and skin infections. *C. viminalis*, native to New South Wales, Australia, is an herb that has been used by natives for a long time to treat gastro-enteritis, diarrhea and skin infections.

Many phytochemical researches have been carried out on *C. viminalis* extracts, and showed that the plant is rich in phenolics, triterpenoids, flavonoids, saponins, steroids, alkaloids, tannin, carbohydrates, amino acids and proteins compounds. Bottlebrush trees are not poisonous to humans. In fact, some people occasionally use the leaves to make tea. Blossoms of all bottlebrushes (and Melaleucas) can be used to make sweet tea, or to sweeten other tea.

Perusal of reports related to essential oils (EOs) from leaves included 1,8-cineole (47.9%–82.0%) as the predominant constituent of EO. Sesquiterpene lactones showed good activity against *Saccharomyces cerevisiae*, *Bacillus subtilis* (*B. subtilis*), *Staphylococcus aureus* (*S. aureus*), and *Escherichia coli* (*E. coli*). Terpenoid compounds extracted from *C. viminalis* were characterized by sharp taste, anti-microorganisms, food conserved, analgesic for pain and tonics.

Different solvents extraction as well as EOs from *C. viminalis* grown in different regions around the world, showed a good antibacterial, antifungal and antioxidant activity. For example, *n*-hexane of leaf extracts showed potential activity against skin pathogen *S. aureus*, *Streptococcus pyogenes* and the enteric *Bacillus cereus*, while less activity was found against than intestinal pathogen (*Shigella sonnei*, *Salmonella enteritidis* and *E. coli*). Crude water extract (1 mg/mL) reduced biofilm of *Pseudomonas aeruginosa* (*P. aeruginosa*) formation up to 89%.

Because extracts of *C. viminalis* are rich in polyphenols and flavonoids content, they have advantages for nanoparticle synthesis which showed good eliminating in the process of maintaining cell cultures. The nanoparticles were successfully synthesized using *C. viminalis* leaf extract or flower as reducing agent and stabilizer for nanoparticles. Aqueous (Aq) leaf extract of *C. viminalis* was used to synthesis gold nanotriangles, which was performed in minutes rather than hours, under very mild conditions as well as metal oxide nanoparticles (these metal oxide nanoparticles are chemically stable, have no adverse effect and are used in a variety of different applications such as adsorption, photocatalytic activities, antibacterial and antifungal activities).

Therefore, the present review article summarizes the medicinal and biological values of *C. viminalis* extracts.

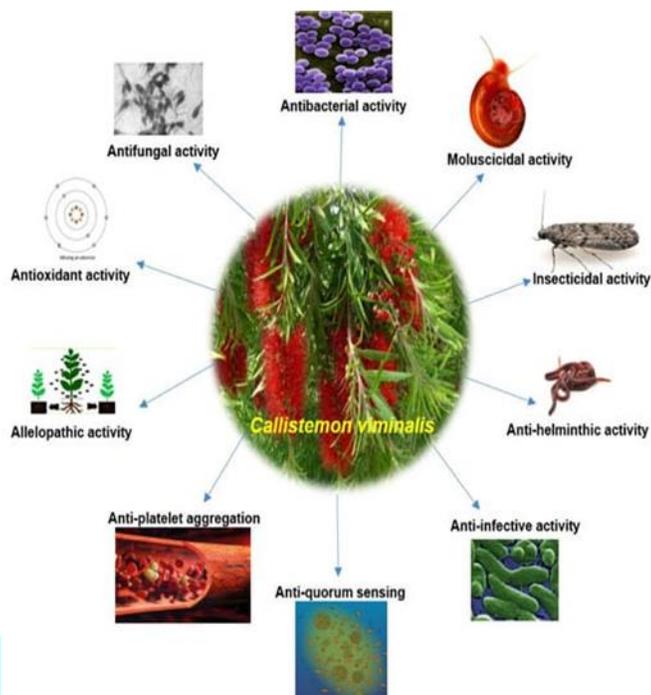


Fig.no 1 Antimicrobial role of *Callistemon viminalis*

**5.Aim and objective :** “ Review on study of the antimicrobial Properties of extracted essential volatile oil from the leaves of *callistemon viminalis*.”

**Objectives :**

### 1. Taxonomy of *C. viminalis*

*C. viminalis* belongs to kingdom of Plantae, subkingdom of Tracheobionta, superdivision of Spermatophyta, division of Magnoliophyta, class of Magnoliopsida, order of Myrtales. *C. viminalis* is a genus of *Callistemon* in the family of Myrtaceae. Its species include *Metrosideros viminalis* Sol. ex Gaertn., *C. viminalis* (Sol. ex Gaertn.) G. Don, *Melaleuca viminalis* (Sol. ex Gaertn.) Byrnes.



Fig no 2 Shrubes of Callistemon viminalis

## 2. Pharmacological and biological activities

### 2.1. Antibacterial and antifungal activities

Different extracts of *C. viminalis* including Aq, MeOH and *n*-hexane extracts showed potential activity against some bacterial strains, where the MeOH extract observed good activity against the methicillin-resistant *S. aureus* with inhibition zone value of  $25.61 \pm 2.11$  mm than that the non-methicillin-resistant *S. aureus* (inhibition zone [ $17.41 \pm 1.10$ ] mm). The extracts' potency is attributed to different chemical compositions of *C. viminalis*. Remarkable antimicrobial activity of the EO was found against *S. aureus*, *Enterobacter cloacae*, and *Streptococcus faecalis*, with minimum inhibitory concentrations (MICs) value of 0.08, 0.63, and 0.63 mg/mL, respectively, while the smallest activity was found against *Serratia marcescena* (MIC 5 mg/mL) and *P. aeruginosa* (MIC 5 mg/mL).

Aq extract of *C. viminalis* inhibited nematode death by *P. aeruginosa* strains (PAO1 and PA14) without host toxicity, which suggesting further development as anti-infectives. The extracts dissolved from the inflorescence of *C. viminalis* in water and ethanol extracts have been reported strong antibacterial against *Chromobacterium violaceum* and *Agrobacterium tumefaciens*. Aq extracts of flowers and leaves have been shown an antibacterial activity. Most extracts from the branches did not show measurable activity against the growth of some phytopathogenic potato soft rot bacteria.

Good to moderate antimicrobial activity of methanol leaf extract (MEOHLE) was found. The EO, MeOH extracts, and ethyl acetate fraction extracted from the leaves exhibited high significant activity against *B. subtilis*, *B. cereus*, *Micrococcus luteus*, *Sarcina lutea* and *S. aureus*, *E. coli*, *Serratia marcescens*, *Salmonella typhi*, *Proteus vulgaris* and *P. aeruginosa*.

The Aq and alcoholic extracts from leaves have antibacterial activity against *S. aureus*, *Streptococcus Pneumonia*, *Staphylococcus epidermidis*, *Klebsilla pneumonia*, *Klebsiella oxytaci*, *Proteus vulgaricus*, and *E. coli*, however, the watery extract was more potent than ethanol extract against pathogenic bacteria.

The EO from leaves of *C. viminalis* showed some antifungal activities against *Botrytis cinerea*, *Fusarium oxysporum*, and *Fusarium solani*. The crude extracts of aerial parts (leaves and flowers) of *C. viminalis* had very high activity against *Candida albicans* and *Candida kefyr*, in addition, to their activities against G<sup>+</sup> ve and G<sup>-</sup> ve bacteria. The inhibitory actions of the extracted alkaloids from *C. viminalis* were more effective against *Oscillatoria limnetica*, and *Anabaena cylindrical* increased along with the concentrations revealing a regular pattern. MeOHLE, which confirmed the presence of steroid, terpenoids, flavonoids, tannin and alkaloids was exhibited significant activity against *E. coli*, *S. aureus*, *Aspergillus niger* and *C. albicans*.

The MIC values of *C. viminalis* active extracts against the bacterial strains *Pasturella multocida*, *E. coli*, *B. subtilis*, and *S. aureus* and the fungal strains *Alternaria alternata*, *Ganoderma lucidum*, were ranged from 0.52 to 12.0 mg/mL. Strong antibacterial activity of leaf crude extracts from *C. viminalis* against *B. subtilis* was found (inhibition zone 14.67 mm with MIC 0.312 mg/mL) but not active against the fungi *Aspergillus flavus*, *A. niger*, *Cladosporium oxysporum*, and *Penicillium oxalicum*. The MeOH extract of *C. viminalis* bark showed moderate activity against the incubated wood with the *Trichoderma harzianum*, *Alternaria tenuissima* and *Fusarium culmorum*. Antibacterial activity from leaves, flower, stem with bark MeOH, ethyl acetate, *n*-hexane and distilled water extracts against *B. subtilis* were 13.0 mm, 8.0 mm, 11.0 mm, 0 mm; 15.5 mm, 13.0 mm, 12.5 mm, 13.5 mm; and 8.5 mm, 0 mm, 0 mm, 7 mm, respectively, and all the extracts did not show activity against *E. coli*.

Other antibacterial activity was assayed in the manner of Anti-quorum sensing activity (QS). The Aq and ethanol extracts (inflorescences part) and the Aq extract (leaves) have strong anti-QS activity. The Aq extracts caused a significant inhibition of LasA protease, LasB elastase, pyoverdine production, and biofilm formation and caused the inhibition of QS genes and QS-controlled factors, with marginal effects on *P. aeruginosa* and *Agrobacterium tumefaciens* growth.

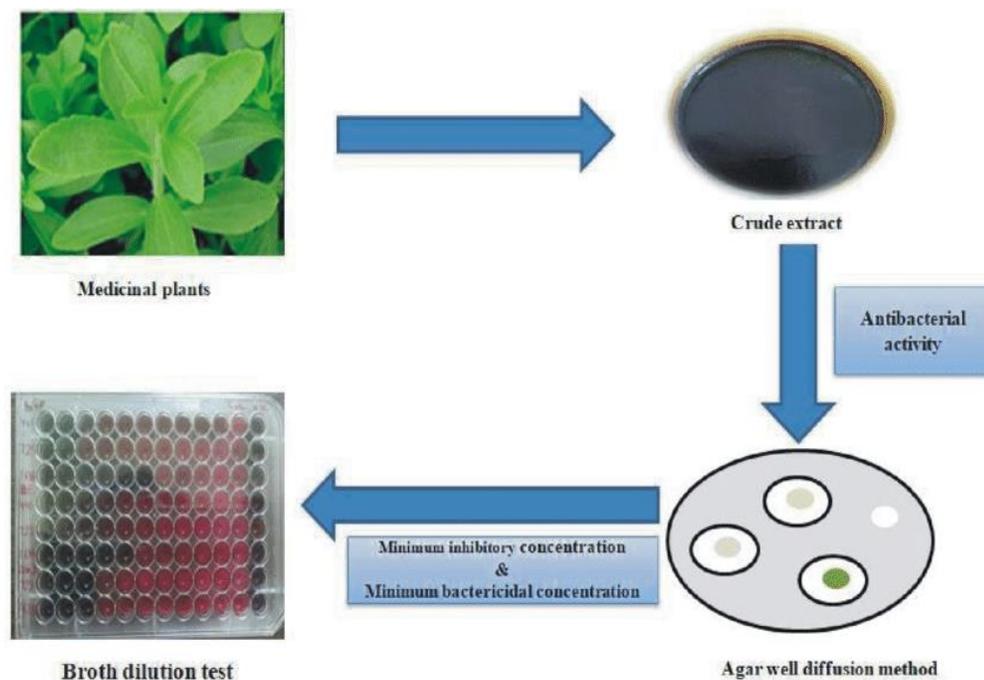


fig no 3 Antibacterial activity

## 2.2. Haemolytic activity

The haemolytic activity of *C. viminalis* extracts against human blood erythrocytes (RBCs) was studied and the lysis percentage of RBCs was found to be in the range of 1.95%–6.33%, which could be a potential source of therapeutic drugs. The haemolytic effect of Leaves' MeOH extract was found in the range of 1.79%–4.95%. The order of % haemolysis of various extracts were chloroform > ethylacetate > 90% MeOH > 95% MeOH > absolute MeOH > petroleum ether > *n*-butanol. The effects of *C. viminalis* leaves alcoholic extract on renal profile test for infected rabbits with *Streptococcus pneumonia* were found to be significant variation in level of blood urea nitrogen, creatinine, creatinine kinase and uric acid.

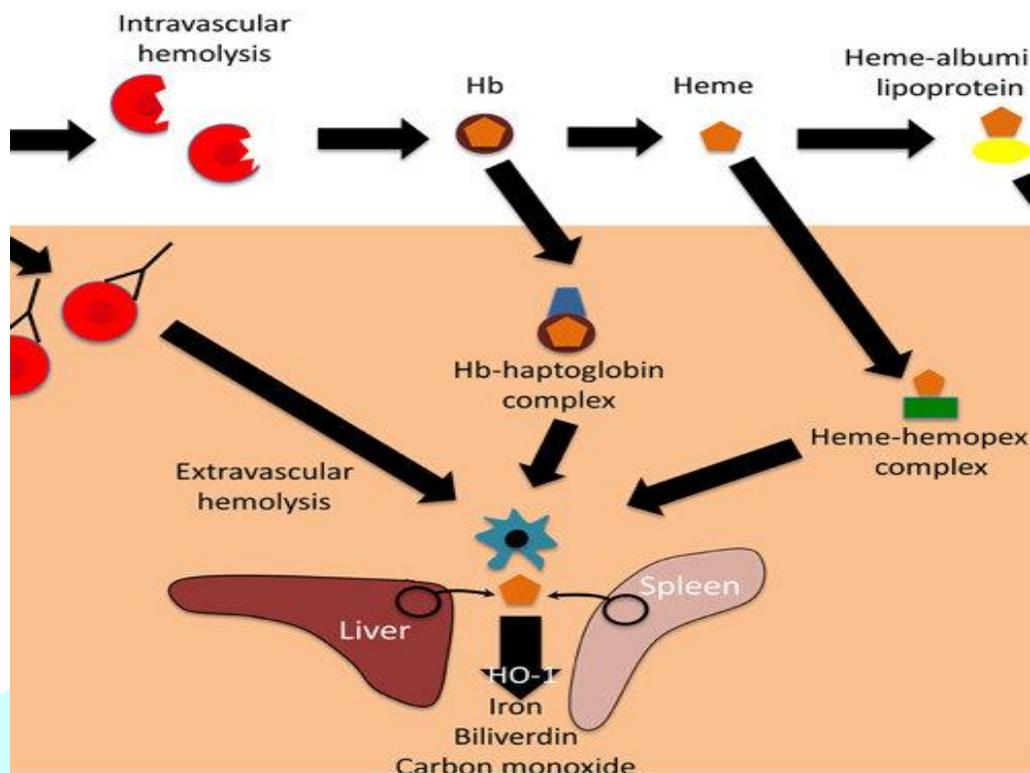


fig no.4 Mechanism of Hemolysis

### 2.3. Anthelmintic activity

*In vitro* the EOs of *C. viminalis* showed good Anthelmintic activity, which produced greater efficacy against earthworms (*Pheretima posthuma*) and tapeworms (*Taenia solium* Linn.) than piperazine phosphate, additionally, the activity against hookworms (*Bunostomum trignocephalum*) was comparable to that of hexylresorcinol.

### 2.4. Insecticidal activity

The EO of *C. viminalis* showed moderate activity in killing of the stored-grain insects namely, *Sitophilus oryzae*, *Tribolium castaneum* and *Rhyzopertha dominica*. The isolated compound viminadione A from the aerial parts exhibited moderate insecticidal activity against *Musca domestica*, *Aphis fabae* and *Thrips tabaci* compared to pyrethrum extract, while viminadione B was less active.

The highest concentrations of EO from dried leaves applied on grains (0.40  $\mu\text{L/g}$ ) and on filter paper discs (0.251  $\mu\text{L/cm}^2$ ) caused 72.6% and 80% mortality rates, respectively, against *Acanthoscelides obtectus*, a major *Phaseolus vulgaris* pest of stored beans in Cameroon, while both powder and acetonc extract showed no activity against the insects at the tested concentration. Furthermore, EO showed activity against adults of *Acanthoscelides obtectus* and *Callosobruchus maculatus*.

*C. viminalis* leaf extracts observed a potential larvicide activity, where the isopropanol extract was highly effective against *Aedes albopictus* larvae with  $\text{LC}_{50}$  value of 71.34 ppm. In addition, slightly attractancy at 50 ppm with almost 2-fold egg lying in treated bowls was found. Fruits, bark and leaf MeOH extracts showed values of  $\text{LC}_{50}$  of 6.2 ppm, 32 ppm and 40 ppm, respectively, against the vector of schistosomiasis, *Biomphalaria alexandrina* snails. The site of action reported from the extracts against insects found by histopathological studies was localized gland. The MeOH extracts showed schistosomicidal activity ( $\text{LC}_{50} \leq 15 \mu\text{g/mL}$ ). Leaf and twigs EO of *C. viminalis* demonstrated strong acaricidal and repellent activities on two-spotted spider mites in both dipping and choice tests with mortality of  $71.2\% \pm 16.3\%$  against *Tetranychus urticae* female adults. The fumigant oil with  $\text{LC}_{10}$ ,  $\text{LC}_{30}$  and  $\text{LC}_{50}$  values were 8.42, 15.86 and 24.60  $\mu\text{L/L}$  air against *Ephesia kuehniella* larvae and the topical LD values were 4.28, 9.64 and 16.91  $\mu\text{g/insect}$ . In addition, the oil caused a drastic reduction in total hemocyte count of treated larvae in a dose-dependent manner at all time intervals.

**3. Table 1. Chemical constituents of extracts and essential oils from *Callistemon viminalis***

source	Main chemical components	Extract type	Activities
Leaves	1,8-Cineole, $\alpha$ -Pinene, $\alpha$ -Terpineol	EO	Antibacterial activity
Leaves	1,8-Cineole, $\alpha$ -Pinene, Terpinen-4-ol	EO	Antibacterial and antifungal activities
Leaves	1,8-Cineole (65.92%), $\alpha$ -Pinene	EO	Antioxidant, antiviral activities
Leaves, flowers	1,8-Cineole, $\alpha$ -Pinene and $\alpha$ -Terpineol	EO	Antitumoral activity
Red flower	Pelargonidin-3,5-diglucoside, Cyanidin-3,5-diglucoside, Kaempferol, $\beta$ -pinene, 1,8-cineol; Pyrogallol; Catechol, Betulinic acid, $\alpha$ -amyrin, Oleanolic acid, $\beta$ -sitosterol	Aqueous extract	Synthesis of nanoparticles
Shade dried leaves	2,5,5,6,8a-Pentamethyl-trans-4a,5,6,7,8,8a-hexahydrogamma-chromene, (10E,12E)-10,12-tetradecadienyl acetate, Z-7-tetradecenal	n-Hexane	Antioxidant activity
Fruits and bark	3,4-Dihydro-2-(hydroxymethyl)-4-methyl-2H-pyrrol-2-ol (5) with the known compounds lupeol (1), octacosanol (2), $\beta$ -sitosterol (3), betulin (4), betulinic acid	Total extracts, petroleum ether (1-4), CH <sub>2</sub> Cl <sub>2</sub> (5-9) and EtOAc (10-13) fractions	Antioxidant activity
Aerial parts	Tetramethylcyclohexenedione, viminadione A and viminadione B		Insecticidal activity

#### 4. Other biological activities:

The EO showed good antiviral activity with TC<sub>50</sub> (50% cytotoxic concentration) value 676.35  $\mu$ g/mL with significant lower toxicities towards the RC-37 cells with C<sub>50</sub> (inhibitory concentration for 50% of plaques) for Herpes simplex virus 1 (HSV-1) (63.73  $\mu$ g/mL) and selectivity index (=TC<sub>50</sub>/IC<sub>50</sub>) was 10.61. With the antitumoral activity, the cytotoxic activity of the EO was observed only in melanoma cultures (HT144), where the cultures treated for 48 h with EO (leaves and flowers) at 200  $\mu$ g/mL reduced the viability by 40% and 25%, respectively. Thus, the antiproliferative activity of the EO (leaves) was more pronounced than the EO (flowers) in cells derived from melanoma.

## 5. Chemical composition of extracts and their biological activities

Literature from different regions around the world showed that the plant has many different chemical compositions in their different parts (leaves, flower, fruits, wood, bark). Some of the isolated compounds from different parts of the plant and obtained from different extracts are presented in .

Most of the studies were focused on the EO composition of *C. viminalis* and it was shown that there were differences in the quantities of the main compound of the oil even in the same country. The leaf EO of *C. viminalis* from Egypt showed the presence of 1,8-cineole (eucalyptol) as the main compound with 47.9% , 64.53%, 71.77% and 65.92% . In the South Africa, it was 83.2% . In addition, linalool, limonene, terpinen-4-ol,  $\alpha$ -terpineol,  $\alpha$ -pinene, and menthyl acetate were also reported.

Furthermore, it was reported that the compounds 1,8-cineole,  $\alpha$ -pinene and  $\alpha$ -terpineol were found in concentrations of 50.4%, 25.8% and 8.7% in leaves EOs and 48.8%, 24.5% and 3.9% in flowers EOs, respectively .

showed some of the isolated compounds as raised in the literature. The isolated phloroglucinols from *C. viminalis*, which have been observed good antibacterial activity against *E. coli* and *B. subtilis* also, have antiviral and antioxidant activities .

## 6. Materials and Methods

### 6.1. EOs extraction

Clevenger-type apparatus, a hydro-distillation method, was used to extract the EOs from the different plant parts for 3 h. The obtained oils were dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>, and stored at 4 °C. GC/MS was used to analyze the chemical compositions of EOs.

### 6.2. Different solvents extraction

Zubair *et al* diagramed simple method for the extraction of the grinded fine powder of leaves using different solvents with different polarities. Salem *et al*. explained the extraction with methanol (MeOH) from leaves and branches and its successive fractionations in different solvents with ethyl acetate, chloroform and then with *n*-butanol saturated with water and the remaining was Aq fraction. Furthermore, fruits and bark were extracted with MeOH and further fractionated by petroleum ether, CH<sub>2</sub>Cl<sub>2</sub> and EtOAc . The plant material could be extracted using hot water, freeze-dried and stored at -20 °C until needed . Other study revealed that the dried ground plant material could be extracted using distilled water in a water bath at 70 °C for 1.5 h to afford the Aq extract.

### 6.3. Extraction with *n*-hexane

Pulverized leaves could be extracted using *n*-hexane in a Soxhlet apparatus.

## 7. Conclusion :

Volatile oil of leaf contain one important componetes 1.8 cineole the future work is to investigate the biological activities of different plant extract and volatile oil of *Callistemon viminalis*. In all parts of plant *callistemon viminalis* there are components which shows antimicrobial activites.

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