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Research Article

# Constituents and Antibacterial Activity of Volatile Oil of *Jasminum grandiflorum* (Leaf) from Pakistan

**Sana Siddique[1], Pakeeza[1], Aqsa Aamir[1], Azeem Intisar[1], Ahsan Sharif[1*], Ejaz Ahmed[1], Zeeshan Mutahir[2], Shahbaz Ahmad[3*], Muhammad Ali[3]**

*[1] School of Chemistry, University of the Punjab, Quaid-e Azam Campus, Lahore, Pakistan.*
*[2] School of Biochemistry and Biotechnology, University of the Punjab, Quaid-e Azam Campus, Lahore, Pakistan.*
*[3] Department of Entomology, Faculty of Agricultural Sciences, University of the Punjab, Quaid-e Azam Campus, Lahore, Pakistan.*

## ABSTRACT

In this study, volatile composition and antibacterial activity of leaf of *Jasminum grandiflorum* were reported. The extraction was carried out by microwave that yielded 0.27% of oil. Gas chromatography mass spectrometry analysis led to the identification of 16 constituents where the most dominating compounds were: benzaldehyde (18.33%), caproic acid (5.70%), p-vinylguaiacol (5.58%), p-Ment-8-en-3-one (2.92%), and eugenol (2.59%). The antibacterial potentiality test was performed with the agar well diffusion method that revealed a considerable inhibition at 15.52 mg against *Acinetobacter baumannii* (12 mm), *Escherichia coli* (17 mm) and methicillin-susceptible *Staphylococcous aureus* (24 mm). The antimicrobial potential may be attributed to the occurrence of bioactive components such as benzaldehyde, jasmine, eugenol etc. that have established significance for pharmacological purposes.

**Keywords:** Volatile compounds, antibacterial activity, Jasminum grandiflorum, microwave extraction, GC–MS.

## INTRODUCTION

*Jasminum grandiflorum*, belongs to Oleaceae family of flowering plants consisting of 24 genera and 615 specie (Green, 2004). Popular species of this family are olive, ash and jasmine (Anthony and Margot, 1992). Jasminum is an economically important genus with 200 species innate to temperate and tropical region (Panda, 2005). It is widely cultivated in South Asia, China, Saudi Arabia and Greece. Its species, grandiflorum, is a climbing vine which grows up to 15-25 feet, commonly known as Royal jasmine, Spanish jasmine or Catalan jasmine, velayiti chambeli or Jati (USDA, 2018). Because of its numerous medicinal properties (Rescigno, 2025), it has been subjected to numerous studies revealing its anti-convulsant, antinociceptive (Gupta and Reddy, 2013), anti-inflammatory (El-Sheikh, 2021), anti-acne, anthelmintic (Sandeep et al., 2009), and antiulcer activities (Nilesh et al., 2009).

The utility of plants for phytoremediation of simple and complex health predicaments can be traced back to the origin of mankind and goes back to the earliest of human civilizations where plants were a source of treating intrinsic and extrinsic health problems. The solution for intrinsic disorders is complex and require long-term administration, therefore, immediate solace was observed for extrinsic relief in particular. For instance, plant extracts as antidotes against snake and insect venom reiterated the healing capacity of several plants and highlighted the unexplored potential in the field of pharmacy (Madhuri and Pandey, 2008; Martz, 1992). Antibiotics or isolated bactericidal constituents administered as pharmaceuticals,

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***Correspondence***
*Ahsan Sharif, Shahbaz Ahmad*
*ch.ahsan.chem@pu.edu.pk,*
*shahbaz.ento@pu.edu.pk*

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led to relatively permanent side effects. Another challenge lies in constant evolution of biological organisms that allow bacterial and viral species to develop resistance against inhibitors (Silver and Bostian, 1993).

Plants present several advantages over synthetic alternatives. Firstly, the harmful effects of certain bactericidal constituents are masked by synergistic action of plant extract, just as side effects of Berberine vanished when antibacterial results were compared to those of the extract, but the bactericidal impact remained unchanged (Wang, 2014). Secondly, synthetic allopathic alternatives primarily target and treat a particular health anomaly, whereas, phytotherapy aims at regulating whole biological configuration by servinjg as an astringent, an antidote, an emmenagogue or antiflatulent, simultaneously (Kamboj, 2000). Therefore, a plethora of research is being carried out to produce as many potential herbal medicines as possible.

This study provides essential oil composition of *Jasminum grandiflorum* along with the supporting evidence on its antibacterial potential which reiterate the medicinal utility of the essential oil of this species and its phytochemical profile reveals the components responsible for its higher bioactive potential.

## MATERIALS AND METHODS

### Plant Material and Microwave Extraction

The plant sample was identified as *Jasminum grandiflorum* and voucher specimen number LAH#30119 was obtained from the Department of Botany, University of the Punjab upon submitting plant specimen to its herbarium. Extraction of leaves (70g) was achieved by employing microwave assisted distillation whereby heating the plant material in a domestic and modified oven for 30 minutes at regulated power. Petroleum ether was used as the separating solvent and oil was placed under -10˚C to avoid contamination prior to GCMS analysis. The extract reserved for antibacterial analysis was further concentrated over a hotplate assembly at low temperature and its amount was calculated.

### Gas Chromatography Mass Spectrometry

The Gas Chromatography was carried out by Agilent 5977A GC-MSD system. A non-polar column, DB-5MS (30 m × 0.25 mm × 0.25 µm) was employed. Split mode (split ratio 5:1) was configured for sample injector in a split mode. The flowrate of 1 mL/minute was used for the mobile phase, helium. Injector temperature at sample introduction was 250˚C. Procedure initiating temperature was 50˚C which was raised by 5˚C at every minute till the temperature reached 300˚C where it was held for 1 minute. The mass to charge ratio (m/z) was ranged between 35 and 500. The temperature of detector was set to 240˚C. Ion source temperature was adjusted to 250˚C. The 2011 NIST library served as literary reference for identification of previously known components. A series of alkane standards ($C_7$ - $C_{30}$) was run under same conditions for calculating retention indices.

### Agar Well Diffusion Method

The extract was subjected to antibacterial assay for Gram negative strains of *Escherichia coli*, *Acinetobacter baumannii* and Gram-positive strain of methicillin sensitive *Staphylococcus aureus* labelled as MSSA. These strains were acquired from Jinnah Hospital, Lahore. The growth medium used was Luria-Bertani Agar. The agar medium was allowed to cool as long as it did not agglomerate and was rigorously shaken before pouring to ensure homogeneity. In vicinity of a flame and disinfected environment, 18-20 mL medium was poured into each petri plate. It was allowed to cool and settle as a solid before overnight inversion time. Sterilized agar was plunged out using a Pasteur pipette to obtain wells (5mm). Selected volumes of leaf oil i.e., 10µL, 20µL, 40µL and 80uL with known concentrations were individually added to the respective wells. The drug used as positive control was Doxycycline, having a potency of 25µg. Agar dishes were placed in the incubator at 37˚C for 24 hours. The inhibitory potential was measured in millimeters.

## RESULTS AND DISCUSSION

### Volatile Composition

The obtained essential oil yield was 0.27%. A total of 16 compounds were identified by GCMS analysis where the most dominating compounds were: benzaldehyde (18.33%), caproic acid (5.70%), p-vinylguaiacol (5.58%), p-Ment-8-en-3-one (2.92%), and eugenol (2.59%). The identified oil components are presented in table 1. In the essential oil, numerous bioactive and aroma imparting compounds were identified. The most abundant compound was benzaldehyde which is known to exhibit insecticidal, antimicrobial, and antioxidant activities (Ullah, 2015). One of the particular aroma imparting compound was Jasmone (Scognamiglio, 2021) and it is a bioactive compound (de Moura, 2022). It also acts as insect repellent (Brickett, 2000). Eugenol is an active component of many plants such as cinnamon, Tulsi, *Ocimum sanctum* and clove. It is a well-known medicinal compound because of antiseptic, anti-inflammatory, antioxidant antifungal and analgesic properties and it is used against toothache (Markowitz, 1992). The

presence of leaf aldehyde or hexanal emphasizes bioactive aspect of the extract because it is an antimicrobial agent. (Lanciotti, 2003). Phytol can particularly be signaled out as a constituent that might be responsible for the antibacterial potential revealed in the current study because of the anti-bacterial capacity of this moiety (Saha and Bandyopadhyav, 2020)

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Table 1. Volatile constituents of *J. grandiflorum.*

| Retention Times (min) | Names of compounds | Retention Index in Literature RI $_{(Lit)}$ | Retention Index Calculated RI $_{(Cal)}$ | Relative abundance (%) |
|---|---|---|---|---|
| 3.97 | Leaf aldehyde | 855 | 848 | t |
| 4.00 | 3-Hexenol | 856 | 850 | 1.77 |
| 5.72 | Benzaldehyde | 960 | - | 18.33 |
| 6.33 | Caproic Acid | 987 | 990 | 5.70 |
| 6.54 | (E)-hex-3-enyl acetate | 1001 | 1002 | 1.95 |
| 7.30 | Benzeneacetaldehyde | 1043 | 1043 | 0.75 |
| 8.79 | p-Ethylbenzoic acid | 1363 | 1323 | 0.85 |
| 9.21 | p-Ment-8-en-3-one | 1155 | 1147 | 2.92 |
| 11.54 | p-Ethylguaiacol | 1282 | 1277 | 0.64 |
| 12.12 | p-Vinylguaiacol | 1312 | 1311 | 5.58 |
| 12.86 | Eugenol | 1355 | 1356 | 2.59 |
| 13.53 | Jasmone | 1396 | 1397 | 1.34 |
| 14.85 | Dehydroionone | 1485 | 1480 | 1.75 |
| 19.24 | Octadecane | 1800 | 1789 | t |
| 19.59 | Myristic acid | 1812 | 1815 | t |
| 23.09 | Phytol | 2103 | 2102 | t |

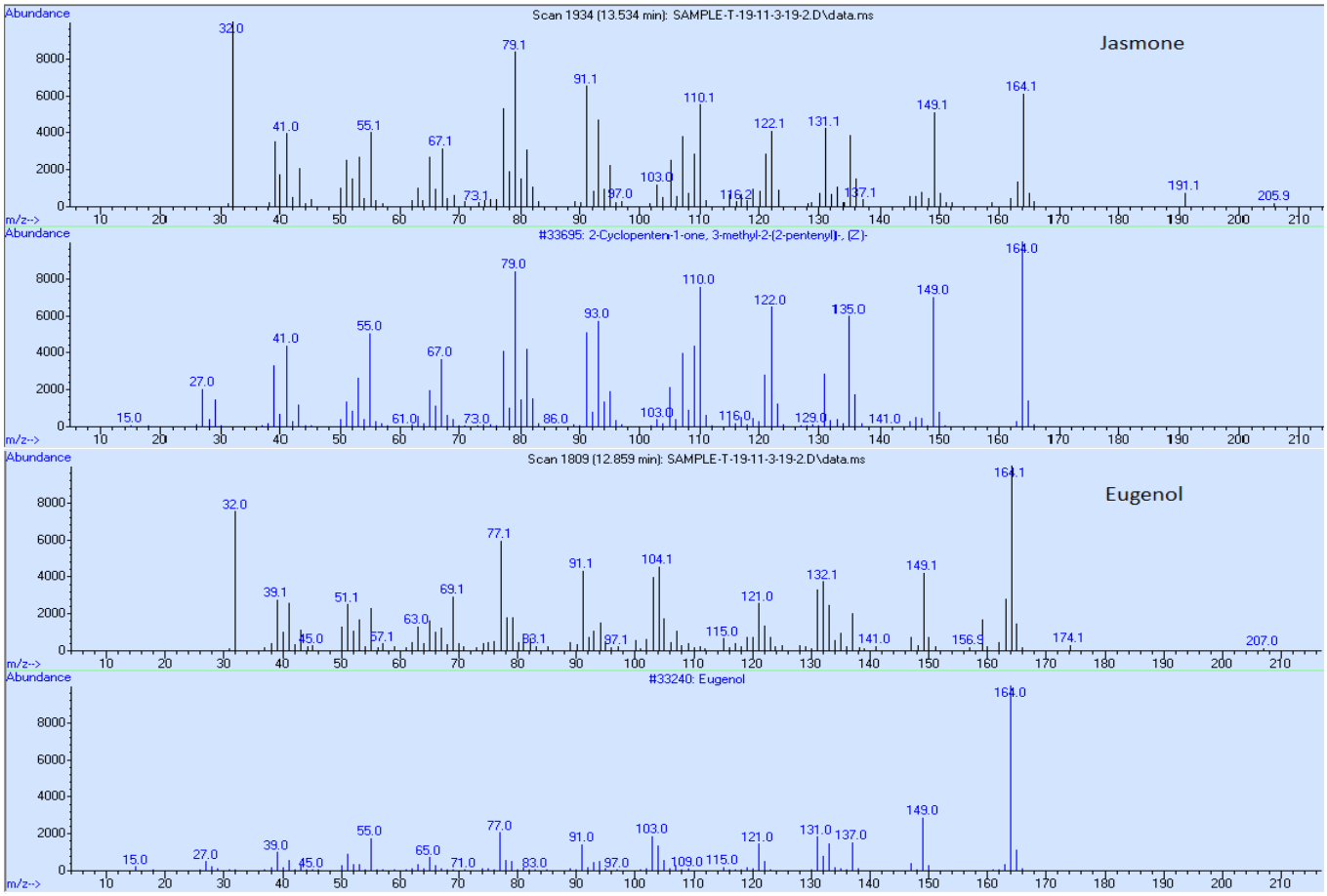


Figure 1. Matching spectra of 2 important compounds: Jasmone and Eugenol.

The results of antibacterial assay are provided in table 2. Inhibition was observed for both gram positive and negative bacteria showing remarkable effectiveness of the leaf extract against *Escherichia coli* in minimum subjected concentration (1.94mg) at a minute volume of 10µL. The bacterial inhibition increases directly with increase in dose for all tested strains. Gram positive strain was also significantly inhibited with a great impact on MSSA. Methicillin susceptible *Staphylococcus aureus* was only second to *E. coli* in being inhibited by the leaf extract at the lowest concentration but it came out to present maximum vulnerability at the highest concentration of 15.5 mg. Least inhibitory potential among tested strains was observed for *Acinetobacter baumannii* which remained unaffected at concentration below 7.76mg of leaf extract, but diminished zones of comparable size were observed at higher concentrations, i.e., at 7.76mg and 15.5mg of leaf extract. All the tested strains can be easily transferred through contaminated water or infested biological fluids. Order of antibacterial activity of *J. grandiflorum* against three strains was: methicillin-Susceptible *Staphylococcus aureus* > *Escherichia coli* > *Acinetobacter baumannii* and it is showing a dose-dependent manner.

Table 2. Antibacterial activity of J. grandiflorum

| **Bacterial strains** | **Concentration of essential oil** | | | | **Positive control** |
|---|---|---|---|---|---|
| | 10µL (1.94 mg) | 20µL (3.88 mg) | 40µL (7.76 mg) | 80µL (15.5mg) | 5µL (25 µg) |
| | Zone of inhibition (mm) | | | | |
| *E. coli* | 10 | 12 | 15 | 17 | 22 |
| *MSSA* | 07 | 08 | 10 | 24 | 29 |
| *A. baumanniii* | 00 | 00 | 11 | 12 | 15 |

## CONCLUSIONS

Essential oil composition and antibacterial activity of *J. grandiflorum* was reported where 16 components were identified that consisted of various aroma imparting and major constituents such as benzaldehyde (18.33%), caproic acid (5.70%), p-vinylguaiacol (5.58%), p-Ment-8-en-3-one (2.92%), and eugenol (2.59%). The antibacterial analysis revealed encouraging figures for bacterial inhibition against various Gram-positive and –negative strains. Hence, this plant is considered as one of the potential candidates for further exploration of its medicinal values.

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## AUTHOR CONTRIBUTIONS

All the authors contributed equally to this research.

## COMPETING OF INTEREST

No conflicts of interest have been disclosed by the authors.

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