

## Research Article

# Comparative *In vitro* study of antimicrobial activities of flower and whole plant of *Jasminum officinale* against some human pathogenic microbes

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### Abstract

*Jasminum officinale* Linn. (Chameli / Yasmine; Oleaceae), is native to temperate region and cultivated in France, Italy, China, India and Pakistan. Plant is documented to possess beneficial effect in impotence, menstrual disorder, mental depression, analgesic, antispasmodic galactagogue, antiseptic and skin disease etc.. Although, previous studies have documented the antimicrobial study of this plant, while, this work is designated to evaluate and compare the specific antimicrobial activity of different solvent extracts (methanol, DCM) of the flowers and whole plant (leaves, barks and roots), in order to know the best extract and plant part having the beneficial activity against specific microorganisms. *In-vitro*, antimicrobial tests were performed by adopting disc diffusion method against pathogenic bacteria species of both G +ve strains, i.e., *Staphylococcus aureus*, *Bacillus pumilus*, *Streptococcus pneumoniae*, G -ve strains, i.e., *Escherichia coli*, *Citrobacter freundii* and *Klebsiella pneumoniae* and two species of fungi (*Candida albicans*, *Aspergillus niger*), on nutrient agar and sabouraud dextrose agar respectively, to analyze the percentage zone of inhibition at the concentration range of 100 mg/ml of the extract by comparing with various standard antibiotic discs (10 µg/disc). Whole plant extract (methanol) showed significant antimicrobial activity with relative percentage of inhibition of 83.60 (G +ve), 70.25 (G-ve) and 61.15 (fungi) while flowers extract (methanol) showed 64.30, 51.88 and 51.97 relative percentage of inhibition against G +ve, G -ve and fungi respectively. Whereas, DCM extract of flowers and whole plant showed the moderate antimicrobial activity as compared with methanolic extract of flowers and whole plant respectively. Modified agar well diffusion method was adopted to measure the minimum inhibitory concentration. From the present study, it can be inferred that the antimicrobial activity varies from part to part of plant and solvent used, so whole plant extract can be further investigated to discover antibacterial agent for developing new pharmaceuticals to control studied human pathogenic bacteria for the severe illness.

**Keywords:** *Jasminum officinale*, Methanol Extract, Dichloromethane Extract, Antimicrobial Activity, Disc Diffusion Method, Minimum Inhibitory Concentration

### 1. Introduction

In traditional medicinal system, plants and herbs have most widely been used as a source of therapeutic compounds since ancient time. Different Surahs in the Holy Quran such as in Al-Momeenoon, Al-Rehman, Al-Bakra and Al-Inaam narrating the significance of medicinal plants. Islamic medicine begins with Hazrat Adam (A.S.) and was ended at Hazrat Muhammad (SAW) but search on these medicines is still continued throughout the world (Nasr, 1976). Medicinal plant extract are rich source of compounds or secondary metabolite like tannins, terpenoids, alkaloids, flavonoids, etc that exhibits a new potential source of remedy against anti-infectious pathogens and is cheaper than modern drugs infections pathogens, i.e., bacteria, fungi, viruses and nematodes, cause serious infections (Cowan, 1999; Lee et al., 2007) Due to the increase

of resistance to antibiotics, there is a pressing need to develop new and innovative antimicrobial agents. Among the potential sources of new agents, plants have long been investigated. Because, they contain many bioactive compounds that can be of interest in therapeutic. Because of their low toxicity, there is a long tradition of using dietary plants in the treatment of infectious disease in Pakistani folk medicine. Pakistan is amongst the countries, where medicinal plants are being exported in crude form due to non-availability of technological support for value addition of the export herbal products (Malik et al., 2005). The climatic conditions in Pakistan are suitable for the growth of medicinal plants and some local manufacturers are producing herbal medicines on commercial scale for export and the annual turnover of these manufacturers is comparable to any of the multinational companies.

*Jasminum officinale* Linn. (Family; Oleaceae) is known by vernacular name of Spanish Jasmine (English), Jasmine (Hindi), Jaati, Jaatika, Jaatimalli, (Ayurvedic), Jasmine and Yaasmine (Pakistan). *Jasminum officinale* are the important group of flowering shrub (Kiritikar and Basu, 1987). These are widely cultivated in Mediterranean, Caucasus, Northern Persia, Eastern Afghanistan, Hindukush, India, China and Pakistan for their attractive fragrant flowers. These are twining shrubs and sometimes support seeking shrubs. Leaves are 6-10 cm long, opposite, midrib narrowly margined and having 3-7 leaflets. Flowers have white corolla and their flowering time is from May – June. In September – November, flowers are ripped to berry black fruit, full of crimson juice (Khare, 2007)

Whole parts of plant such as stem, barks, leaf and root and flowers are being most widely used traditionally. Flowers of *Jasminum officinale*, are traditionally used as CNS depressant, sedative, mild anesthetic and astringent (Khare, 2007; Duke et al., 2002). Syrup prepared from the flowers, is used for the disorders of the chest, i.e., coughs and hoarseness (Kiritikar and Basu, 1987; Khare, 2007). Whole plant is traditionally used for the chronic ulcer healing, tumor and skin disease (Duke et al., 2002; Khare, 2007). Flower and leaf juices possess the diuretic, anthelmintic and emmenagogue activity. In tradition system, leaves are chewed and used in the treatment of ulceration of the mouth. Leaves contain the resin, salicylic acid, ascorbic acid and alkaloids, used for the treatment of ulcer, fever and skin diseases (Barnes, 2007; Khare, 2007).

The present study was designed to evaluate the antimicrobial activity of the crude extract of whole plant and flowers of *Jasminum officinale*, prepared from dichloromethane (DCM) and methanol solvents, against G +ve strains, i.e., *Staphylococcus aureus*, *Streptococcus pneumoniae* and *Bacillus pumilus*, G -ve strains, i.e., *Escherichia coli*, *Citrobacter freundii* and *Klebsiella pneumoniae* and two species of fungi (*Candida albicans* and *Aspergillus niger*). Aqueous and organic fractions of the methanolic extract of whole plant were also studied.

## 2. Material and Method

### 2.1 Collection of flowers and whole plant

Flowers and whole plants of *Jasminum officinale* were collected from the Botanical Garden of Bahuddin Zakariya University, Multan and were identified by a taxonomist Professor Dr. Altaf Dasti, incharge of herbarium of Institute of Pure and Applied Biology, Bahauddin Zakariya University, Multan (Pakistan). At the time of collection, total weight of fresh flowers and whole plant was almost 400 gm and 1.3 kg respectively. After drying under shade for 25 days, weight of dried flowers and whole plant got reduced to 200 gm and 1.0 kg respectively.

### 2.2 Preparation of DCM and methanolic plant extract

Electrical grinder was used to crush the adulterants free plant material into coarse powder for further procedure. Triple maceration was performed depending upon the polarity of the solvent, for the purpose of extraction of coarse powdered material (Harborne, 1973). Coarse powdered material of flowers (200 gm) and whole plant (1.0 kg), were macerated in measured volume of 80 % aqueous - Dichloromethane (DCM) in two separate air tight amber glass bottles at 25 °C, with occasional shaking thrice a day for three days. After maceration, the soaked coarse powdered material was passed through muslin cloth (double layered), in order to remove vegetative debris and the obtained filtrate was subsequently filtered through a Whatman-1 filter paper. The filtrate was stored in amber glass air-tight container. The previously mentioned extraction procedure was subsequently repeated twice after each day and filtrates of these three macerations

were combined. The extraction of flower and whole plant marc was carried out with 80% aqueous-methanol in separate amber glass bottles by following same procedure.

Rotary evaporator (Rotavapor, BUCHI labortechnik AG, Model 9230, Switzerland) attached with a vacuum pump and a recirculation chiller was used to concentrate the dichloromethane and methanol extract, under reduced pressure at 37 °C. The flower and whole plant extract of dichloromethane and methanol were taken in different amber glass jars and named as JoMf.Cr, JoDf.Cr, JoMw.Cr and JoDw.Cr. All extracts are stored at -4 °C in a refrigerator.

### 2.3 Extract solution preparation

*In vitro*, experiments were performed by dissolving 0.1 gram of the crude extract in 0.1ml (100 µl) of 100% dimethylsulfoxide (DMSO) and volume was made up to 1 ml (1000 µl) with distill water to prepare 0.1 g/ml, w/v stock solution (100 mg/ml), due to its insolubility in distilled water and stored in refrigerator. The dimethylsulfoxide alone did not show any biological activity.

### 2.4 Phytochemical screening

Crude methanolic extract of flower (JoMf.Cr) and whole plant (JoMw.Cr) was subjected to phytochemical screening tests for the detection of alkaloids, tannins, saponins, coumarins, anthraquinones, sterols, flavonoids and terpenes as possible important constituents of the plant, according to standard method (Tona et al., 1998; Evans, 2006). Appearance of yellowish brown coloration on mixing of Dragendorff's reagent with HCl treated aqueous plant extract solution, conform the presence of alkaloids in extract. Formation of froth on vigorous shaking of the aqueous extract solution, conform the presence of saponin. Development of blue green or dark green coloration on mixing of aqueous FeCl<sub>3</sub> with extract solution indicated presence of phenols and tannins. The appearance of pink, violet or red coloration on exposure to NH<sub>4</sub>OH of the mixture of benzene with aqueous solution of plant extract already acidified with 1% HCl was taken as presence of anthraquinones among the plant constituents. The plant material was deemed positive for flavonoids when it gave a yellow color with AlCl<sub>3</sub> reagent.

### 2.5 Standard disc used

Flucloxacillin disc, vancomycin disc, ceftriaxone disc, ciprofloxacin disc, ceftriaxone disc, and levofloxacin disc, were used as standard drugs against *Staphylococcus aureus*, *Bacillus pumilus*, *Streptococcus pneumoniae*, *Citrobacter freundii*, *Escherichia coli* and *Klebsiella pneumoniae* respectively, while against *Candida albicans* and *Aspergillus niger*, amphotericin-B discs were used. All standard discs having drug concentration of 10 µg/disc (Oxoid Ltd. Basingstoke, Hampshire, England) were purchased from G.M, Scientific shop, Multan, Pakistan.

### 2.6 Determination of antimicrobial activity

#### 2.6.1 Culture used

All microorganisms used for the detection of antimicrobial activity of crude extract of *Jasminum officinale*, i.e., *Staphylococcus aureus*, *Bacillus pumilus*, *Streptococcus pneumoniae*, *Citrobacter freundii*, *Escherichia coli*, *Klebsiella pneumoniae*, *Candida albicans* and *Aspergillus niger*, were obtained from the University of Veterinary and Animal Sciences (UVAS), Lahore, Pakistan. All microbes were cultured overnight in a nutrient agar (pH 5) containing agar (1.2%), peptone (0.5%), yeast (0.3%), and NaCl (0.8%) by following the method described by Cruickshank et al., (1975). Microbial colonies were transferred from fresh culture plates to tube containing 10 ml of nutrient broth media, in order to prepare the inoculums. The tubes were shaken occasionally for aeration to promote the microbial growth and were incubated overnight at 37 °C.

#### 2.6.2 Sample, positive and negative control discs

Three types of discs were used, i.e., discs containing plant crude extract were used as sample discs, discs containing standard antibiotics were used as positive control, and discs containing the DMSO were used as negative control. The round discs having the size of 6 mm in diameter were prepared from the whatman-1 filter paper by punch machine.

### 2.6.3 Antibiotic susceptibility testing

Antibacterial activity was assessed by standard disc diffusion method (Taylor et al., 1955; Newall et al., 1996). Nutrient agar media and sabouraud dextrose agar media prepared in distilled water and sterilized in autoclave at 121 °C for 30 minutes. Pour the media into separate petri dishes and allowed to set as a firm gel on cooling. The thickness of gels layer should range between 2-3 mm. The test petri-dishes were incubated overnight at 37 °C and those showing no growth of any kind were selected for further work. The bacteria fungi were transferred from inoculums to petri-dishes by using flame-sterilized forceps, which were subsequently spread by streaking method. The petri-dish with these test discs were then incubated inverted condition for 24 hours at 37 °C. At the end of the incubation period, zone of inhibition (mm) of the each extract were measured in comparison with the positive control (Andrews, 2001; Khyade and Vaikos, 2011). For the conformation of the results, each test was performed in triplicate.

### 2.6.4 Determination of relative percentage inhibition

The relative percentage inhibition of the crude extract with respect to positive control was calculated by using the following formula (Ajay et al., 2002).

$$\text{Relative percentage inhibition of crude extract} = 100 \times (a-b) / (c - b)$$

Where,

a: total area of inhibition of the test extract

b: total area of inhibition of the solvent

c: total area of inhibition of the standard drug

The total area of the inhibition was calculated by using

$$\text{Area of inhibitory zone} = \pi r^2$$

Where r is radius of zone of inhibition

### 2.6.5 Determination of minimum inhibitory concentration (MIC)

MIC of the crude extract was determined by using modified agar well diffusion method (Tagg et al, 1976; Saratha et al., 2010). The crude extract was dissolved in DMSO to obtain a concentration range of 25, 50, 100, 150, 300, 600, 1200, 1500, 2000, and 5000 µg/ml. In each of these plates four wells were cut out using a cork borer. Using a micropipette, 100 µl of each dilution was added in to wells and plates were incubated at 37°C for 24 hours. The minimum concentration of each extract showing a clear zone of inhibition was considered to be MIC.

### 2.7 Statistical analysis

The results of the antimicrobial activity of crude extract are expressed as mean ± standard deviation of the response of 3 replicates determinations per sample. Statistically significant differences between groups were measured using one-way analysis of variance (ANOVA) followed by two sample t-test of all groups versus their respective control group and \*p < 0.05 was considered statistically significant, p > 0.05 was considered as non-significant and \*\*p < 0.01 was considered highly significant. Results were analyzed statically by using “Graph Pad Prism” version 6, (Graph Pad Software, San Diego, CA, USA).

## 3. Results

### 3.1 Phytochemical screening

Freshly prepared metahhnolic extracts of whole plant and flowers of *Jasminum officinale*, were subjected to a preliminary phytochemical screening for various constituents and the results revealed the presence of alkaloids, saponins, tannins, resin, flavonoids and terpenoids.

Table 1: phytochemical constituents of methanolic crude extract.

Plant name	Alkaloids	Saponins	Tannins	Resin	Flavonoids	Terpenoids	Sterol
JoMf.Cr	+++	+++	++	++	+++	+ (minor)	-
JoMw.Cr	+++	+++	+++	+++	+++	+++	-

Where, (+++ = present; - = absent)

JoMf.Cr = Methanolic crude extract of flowers of *Jasminum officinale*.

JoMw.Cr = Methanolic crude extract of whole plant of *Jasminum officinale*.

### 3.2 In Vitro antimicrobial activity of the plant extract

Diameter of the zone of inhibition, relative percentage of inhibition and minimum inhibitory concentration (MIC) of the DCM, and methanolic extract of flowers and whole plant of the *Jasminum officinale*, against different pathogenic bacteria and fungi, are shown in table 2, 3 and 4. Crude methanolic extract of whole plant of *Jasminum officinale*, showed stronger antibacterial activity against studied G +ve bacterial strains as compared to G -ve strains and fungal species, in comparison with crude methanolic extract of flowers and DCM extract of flowers and whole plant.

The crude methanolic extract of whole plant (JoMw.Cr) showed the zone of inhibition (mm<sup>2</sup>) of 324.95 ± 1.71 against *Bacillus pumilus*, 225.40 ± 0.31 against *Staphylococcus aureus*, 270.00 ± 0.84 against *Streptococcus pneumoniae*, 222.75 ± 1.71 against *Escherichia coli*, 165.05 ± 0.51 mm<sup>2</sup> against *Citrobacter freundii* and 226.85 ± 0.51 against *Klebsiella pneumoniae* as compared with standard drug vancomycin (388.75 ± 0.76), flucloxacillin (268.66 ± 1.71), ceftriaxone (333.15 ± 0.54), ceftriaxone (326.65 ± 0.54), ciprofloxacin (234.95 ± 2.11) and levofloxacin (333.15 ± 0.54) with relative percentages of inhibition 83.60, 83.90, 81.09, 68.20, 70.5 and 61.10 respectively. Similarly, the crude DCM extract of whole plant (JoDw.Cr) showed the zone of inhibition (mm<sup>2</sup>) of 314.00 ± 1.71 against *Bacillus pumilus*, 218.90 ± 0.31 against *Staphylococcus aureus*, 254.35 ± 0.84 against *Streptococcus pneumoniae*, 199.58 ± 1.71 against *Escherichia coli*, 156.00 ± 0.51 against *Citrobacter freundii* and 221.55 ± 0.51 against *Klebsiella pneumoniae* as compared with standard drug vancomycin (388.75 ± 0.76), flucloxacillin (268.66 ± 1.71), ceftriaxone (333.15 ± 0.54), ceftriaxone (326.65 ± 0.54), ciprofloxacin (234.95 ± 2.11) and levofloxacin (333.15 ± 0.54) with relative percentages of inhibition 80.77, 81.47, 76.35, 61.10, 66.39 and 66.10 respectively. Antibacterial activity of the aqueous and organic fraction of the crude methanolic extract of whole plant was also studied, which showed that organic fraction had more potent antibacterial activity as compared to aqueous fraction.

The crude methanolic extract of flowers (JoMf.Cr) showed the zone of inhibition (mm<sup>2</sup>) of 209.85 ± 1.71 against *Bacillus pumilus*, 139.35 ± 0.31 against *Staphylococcus aureus*, 170.00 ± 0.84 against *Streptococcus pneumoniae*, 102.95 ± 1.71 against *Escherichia coli*, 85.64 ± 0.51 against *Citrobacter freundii* and 122.65 ± 0.51 against *Klebsiella pneumoniae* as compared with standard drug vancomycin (388.75 ± 0.76), flucloxacillin (268.66 ± 1.71), ceftriaxone (333.15 ± 0.54), ceftriaxone (326.65 ± 0.54), ciprofloxacin (234.95 ± 2.11) and levofloxacin (333.15 ± 0.54) with relative percentages of inhibition 64.30, 61.86, 62.95, 45.80, 51.88 and 54.10 respectively. Similarly, the crude DCM extract of flowers (JoDf.Cr) showed the zone of inhibition (mm<sup>2</sup>) of 180.10 ± 1.71 against *Bacillus pumilus*, 116.85 ± 0.31 against *Staphylococcus aureus*, 152.65 ± 0.84 against *Streptococcus pneumoniae*, 95.00 ± 1.71 against *Escherichia coli*, 77.00 ± 0.51 against *Citrobacter freundii* and 96.75 ± 0.51 against *Klebsiella pneumoniae* as compared with standard drug vancomycin (388.75 ± 0.76), flucloxacillin (268.66 ± 1.71), ceftriaxone (333.15 ± 0.54), ceftriaxone (326.65 ± 0.54), ciprofloxacin (234.95 ± 2.11) and levofloxacin (333.15 ± 0.54) with relative percentages of inhibition 55.45, 51.83, 56.55, 42.65, 46.70, and 42.65 respectively.

Whereas, methanolic and DCM extract of whole plant and flowers of *Jasminum officinale* showed antifungal response against *Candida albicans* and *Aspergillus niger*, in comparison with the amphotericin-B.

After statistical analysis, P value was determined which was found to be significant for methanolic and DCM extract of whole plant, against G +ve, i.e., less than 0.05 (P < 0.05), as compare with the methanolic

and DCM extract of the flowers of the *Jasminum officinale*. It shows that methanolic extract of whole plant (JoMw.Cr) has strong antibacterial activity against Gram +ve strains as compared to Gram -ve strain of bacteria.

Table 2: Antibacterial activity of the methanolic and DCM extract of the flowers and whole plant of

S.No.	Bacterial Strains	Gram Strain (+/-)	Zone Of Inhibition (mm/sensitive strain)						
			<i>Jasminum officinale</i> (Sample)				+ve control		-ve control
			Flowers		Whole plant		Standard discs <sup>a</sup> (10 µg/disc)		DMSO
			DCM <sup>a</sup>	M <sup>a</sup>	DCM <sup>a</sup>	M <sup>a</sup>			
1	<i>Bacillus pumilus</i>	+	15.15±0.85	16.35±0.70	20.00±0.75	20.35±0.55	Vancomycin	22.25±0.87	NR
2	<i>Staphylococcus aureus</i>	+	12.20±0.67	13.35±0.35	16.70±0.67	16.95±0.83	Flucloxacillin	18.50±1.71	NR
3	<i>Streptococcus pneumoniae</i>	+	13.95±0.55	14.72±0.67	18.00±0.71	18.55±1.05	Ceftriaxone	20.60±0.71	NR
4	<i>Escherichia coli</i>	-	11.00±0.70	11.45±0.55	15.95±0.85	16.85±0.85	Ceftriaxone	20.40±0.87	NR
5	<i>Citrobacter freundii</i>	-	9.90±0.67	10.45±0.85	14.10±0.55	14.50±0.35	Ciprofloxacin	17.30±0.63	NR
6	<i>Klebsiella pneumoniae</i>	-	11.10±0.35	12.50±1.09	16.80±.71	17.00±0.75	Levofloxacin	20.60±0.75	NR
7	<i>Candida albicans</i>	fungus	11.95±0.70	12.25±0.67	16.60±0.71	17.00±1.09	Amphotericin -B	21.75±0.55	NR
8	<i>Aspergillus niger</i>	fungus	10.95±0.67	11.45±0.35	15.45±0.65	16.15±0.70	Amphotericin -B	20.80±0.75	NR

*Jasminum officinale* against different strains of bacteria and fungi.

Values are presented as mean ± S.E of triplicate experiments,

<sup>a</sup> Diameter of the zone of inhibition including diameter of disc 6mm.

NR = No response, DMSO = Dimethylsulfoxide

Table 3. Relative percentage inhibition against different strains of bacteria and fungi (values are expressed as mean  $\pm$  SEM., n = 3)

S.No	Bacterial strains	Gram Strain (+/-)	Relative percentage inhibition (%)			
			Flowers		Whole plant	
			DCM	M	DCM	M
1	<i>Bacillus pumilus</i>	+	55.45	64.30	80.77	83.60
2	<i>Staphylococcus aureus</i>	+	51.83	61.85	81.47	83.90
3	<i>Streptococcus pneumoniae</i>	+	56.55	62.95	76.35	81.05
4	<i>Escherichia coli</i>	-	42.65	45.80	61.10	68.20
5	<i>Citrobacter freundii</i>	-	46.70	51.88	66.39	70.25
6	<i>Klebsiella pneumoniae</i>	-	42.65	54.10	66.50	68.10
7	<i>Candida albicans</i>	fungus	49.40	51.97	58.28	61.15
8	<i>Aspergillus niger</i>	fungus	46.15	50.15	55.20	60.30

Where; M = Methanolic extract,  
 DCM= Dicholoromethane extract

### 3.3 Minimum inhibitory concentration

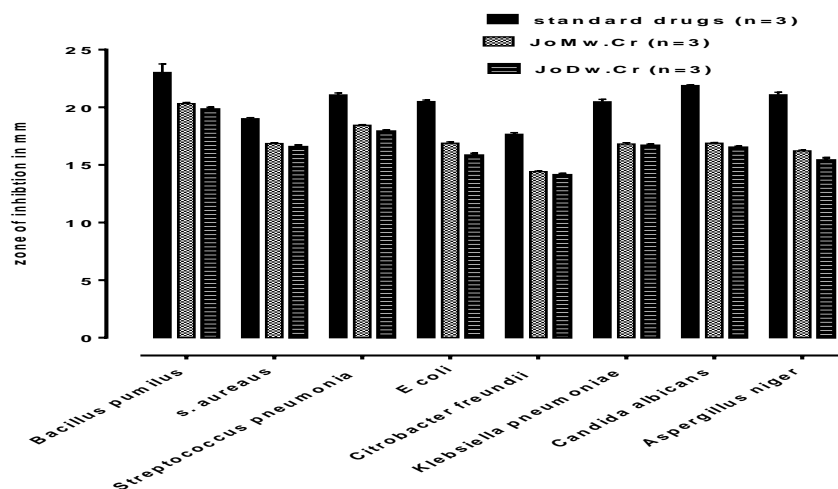
As shown in Table 4, methanolic crude extract of whole plant (JoMw.Cr) of *Jasminum officinale* showed strong inhibition against tested G +ve bacteria, i.e., 100  $\mu$ g/ml as compared to tested G -ve bacteria, i.e., 150  $\mu$ g/ml, whereas, MIC values of DCM extract of whole plant, were ranged from 150-300  $\mu$ g/ml. For the methanolic and DCM extract of the flowers of *Jasminum officinale*, MIC values were ranged from 300-600 and 600-1200  $\mu$ g/ml respectively. MIC values for the fungal species were ranged from 600-2000  $\mu$ g/ml.

In this study, methanolic crude extract of whole plant showed the highest antibacterial activity against the bacteria tested with lowest MIC values of 100  $\mu$ g/ml.

Table 4. Minimum inhibition concentration (MIC) against different strains of bacteria and fungi

S.No	Bacterial strains	Gram Strain (+/-)	Minimum inhibitory concentration( µg/ml)			
			Flowers		Whole plant	
			DCM	M	DCM	M
1	<i>Bacillus pumilus</i>	+	600	300	150	100
2	<i>Staphylococcus aureus</i>	+	600	300	150	100
3	<i>Streptococcus pneumoniae</i>	+	600	300	150	100
4	<i>Escherichia coli</i>	-	1200	600	300	150
5	<i>Citrobacter freundii</i>	-	1200	600	300	150
6	<i>Klebsiella pneumoniae</i>	-	1200	600	300	150
7	<i>Candida albicans</i>	fungus	2000	1500	1200	600
8	<i>Aspergillus niger</i>	fungus	2000	1500	1200	600

Where; M = methanolic extract,  
 DCM= Dichloromethane extract

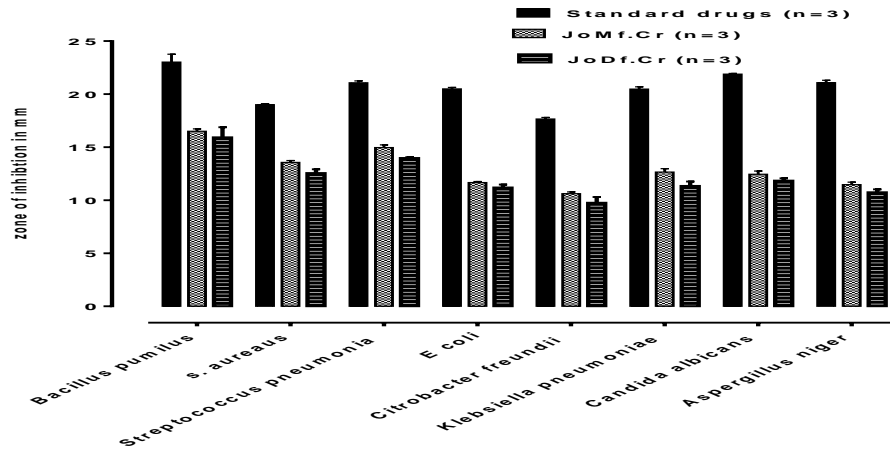


(A)

JoMw.Cr = Methanolic crude extract of whole plant of *Jasminum officinale*.

JoDw.Cr = DCM crude extract of whole plant of *Jasminum officinale*.





(B)

JoMf.Cr = Methanolic crude extract of flowers of *Jasminum officinale*.

JoDf.Cr = DCM extract of flowers of *Jasminum officinale*.

Figure 1: Zone of inhibition of the methanolic and DCM extract of (A) whole plant (B) flowers of *Jasminum officinale* in diameter (mm) against different strains of bacteria and fungi (values are expressed as mean  $\pm$  SEM., n = 3).

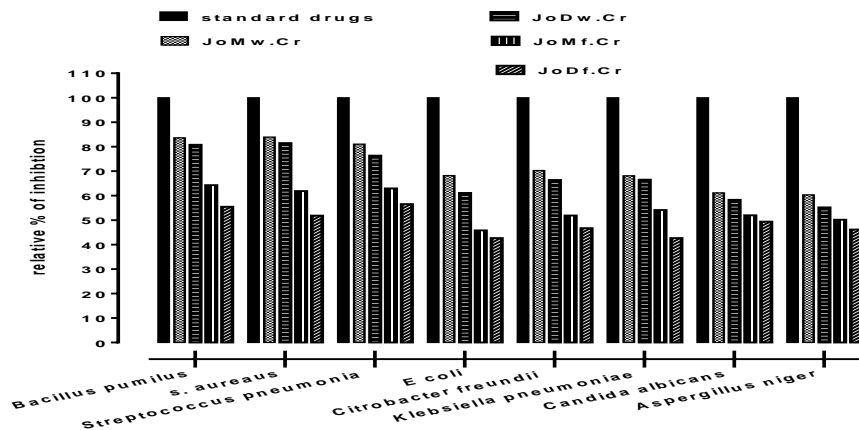


Figure 2: Relative percentage inhibition of the methanolic and DCM extract of whole plant and flowers of *Jasminum officinale* against different strains of bacteria and fungi.

#### 4. Discussion

Ethnobotanicals are practiced in almost all culture of the world, to treat the healing and microbial diseases (Khan et al greater potential of the whole plant extract (methanolic and DCM) against pathogenic bacteria and fungal species as compared to the flower extract (methanolic and DCM) and support the view, that medicinal plants might be useful in the development of novel antimicrobial agents (Heinrich, 2001). Extensive antibiotic use, in the management of infectious disease cause bacterial resistance especially against *S.aureus* (Timothy and Whitman, 2008). Methanolic extract (organic fraction) of whole plant showed significant antibacterial activity against different pathogenic species of G +ve bacteria, i.e., *Bacillus*

*pumilus*, *Staphylococcus aureus*, and *Streptococcus pneumoniae*, with relative percentage of inhibition of 83.60 %, 83.90 %, and 81.05% respectively, as compared with standard vancomycin, flucloxacillin and ceftriaxone (10 µg/disc) respectively, and their MIC range from 100–150 µg/ml. Multidrug resistant bacteria have limited the efficacy of antibiotics against infections caused by the G –ve bacteria (Abbanat et al., 2008). G -ve bacteria have also been found to be less susceptible to plant extracts in earlier studies done by other researchers (Kuhnt et al., 1994; Afolayan and Meyer, 1995) but in our study, we observed that whole plant extract (methanolic) was active against different pathogenic species of G –ve bacteria, i.e., *Escherichia coli*, *Citrobacter freundii*, and *Klebsiella pneumoniae*, with relative percentage of inhibition of 68.20 %, 70.25 %, and 68.10 % respectively, as compared with standard, i.e., ceftriaxone, ciprofloxacin and levofloxacin (10 µg/disc) respectively, and their MIC value range from 150 –300 µg/ml. Similarly, crude extract show the somewhat activity against tested fungus, i.e., *Candida albicans* and *Aspergillus niger*. Antimicrobial activity of the plant against G +ve and G-ve bacteria and fungi, may be indicative of the presence of the broad spectrum antibiotic compounds in plant (Siddhuraju and Becker, 2003; Vaghasiya and Chanda, 2007).

The crude methanolic extract of flowers and whole plant indicate the accumulation of alkaloids, saponins, tannins, resin, flavonoids and terpenoids. Thus our results in this study can be attributed to the presence of these chemical constituents. Further purification and study of the active principle (s) from the plant will provide better understanding of these activities.

This study revealed the presence of outstanding antimicrobial activity against pathogenic microbes, may be used to control the infectious diseases. Multidrug resistant pathogens are responsible for the dramatic increase in the mortality and morbidity of the infectious diseases. Safe and effective therapies are required to overcome the issue of decreased antibiotic efficacy altered by the resistance. As the crude extract of *Jasminum officinale* show the significant antimicrobial activity, it can be considered for low risk of resistance development. Moreover, this study can be used as a tool for the isolation of pure antimicrobial from the plant.

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