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Antibacterial Activities of *Salvia officinalis* and *Opuntia ficus indica* Extracts

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The antibacterial activities of 3 plant extracts of were studied. The dried extracts of *Salvia officinalis* (Lamiaceaea) (leaf) and *Opuntia ficus indica* (Cactaceae) (fruit) were tested in vitro against 3 bacterial species named, *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa* by disk diffusion and micro-dilution. The patterns of inhibition varied with the plant extract and the organism tested. *Staphylococcus aureus* and *Escherichia coli* were the most inhibited microorganisms. *Salvia officinalis* extract was the most active against *Pseudomonas aeruginosa*. Results of this kind herald the interesting promise of designing a potentially active antibacterial agent of plant origin. It can be suggested that ethanol extracts of these plants are a great potential source of antibacterial compounds that could be used in the formulation of new antimicrobial drugs of natural basis.

Key words: Antibacterial, medicinal plants, Opuntia

There are more than 35,000 plants species being used in various human cultures around the world for medicinal purpose. Biologically active compounds present in medicinal plants have always been of great interest to scientist working in this field (Koshy Philip et al, 2011). Natural products perform various functions and many of them have interesting and useful biological activities.

The global emergence of drug resistant bacteria is increasingly limiting the effectiveness of current drugs and significantly causing treatment failure (Hancock, 2005). 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.

The objective of our present work was to investigate the antibacterial potentials of *Salvia officinalis* (Lamiaceaea) (leaf) and *Opuntia ficus indica* (Cactaceae) (fruit) plants against three Gram positive and Gram negative pathogenic bacteria.

MATERIALS AND METHODS

Plant materials and preparation of extracts

The ground dried sample (30 mg) was extracted three times with 1.2 mL MeOH:acetic acid (99:1), sonicated in a water bath at room temperature for 15 min and then centrifuged at 3900 rpm for 15 min (Fish Bioblock Scientific).

The plant materials used in this study consisted of *Salvia officinalis* (leaf) and *Opuntia ficus indica* (Cactaceae) (fruit),which were

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collected from Riyadh markets. *Opuntia* fruits were washed with distilled water, air-dried, and hand-peeled. Both, peel and pulp were freeze-dried and reduced into powders. The leaves of *S. officinalis* were air-dried and grounded into fine powder. The ground dried sample (30 mg) was extracted three times with 1.2 mL 80% ethanol, sonicated in a water bath at room temperature for 15 min and then centrifuged at 3900 rpm for 15 min (Fish Bioblock Scientific). After filtration of total extracts, the ethanol in each filtrate was evaporated completely to dryness under vacuum, and each extract was weighed and subjected to an antibacterial activity test.

Test Microorganisms

Three clinical strains of bacteria used in the study were obtained from the Microbiology Laboratory, Faculty of Medicine, King Khalid University, Riyadh, Kingdom of Saudi Arabia: *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*.

Antibacterial activity

Antibacterial activity was determined by the well diffusion method according to the NCCLS (1993). 100 µl of standardized inoculum of each test bacterium was spread onto sterile Petri plates containing 20 ml of Mueller Hinton agar medium were seeded with a 24 h culture of the bacterial strains. Wells (6 mm diameter) were cut into the agar using a sterile cork-borer, subsequently each well was filled with 100 µl of the ethanol plant extracts and were tested in a concentration of 100 mg/ml. The inoculum size was adjusted so as to deliver a final inoculum of approximately 10^8 colony-forming units (CFU)/ml. Incubation was performed at 37 °C for 24 h. The assessment of antibacterial activity was based on measurement of the diameter of the inhibition zone formed around the well. A standard 30 µg tetracycline disk was used as a positive control.

Minimum inhibitory concentration (MIC) was determined by the micro-dilution method using serially diluted (2-fold) plant extracts according to the NCCLS (2000). A final concentration from 5.20 to 0.642 mg/ml was used for each plant sample. The following ethanol extracts were tested: S. officinalis and *Opuntia ficus indica* were adjusted to contain approximately 10^5 CFU/ml. The test plates were incubated at 37 °C for 18 h.

RESULTS

From the screening of antimicrobial activity of the plant extracts by disc diffusion method, it was observed that both plant extract have antibacterial activities towards *Staphylococcus aureus*, *Pseudomonas*

Table 1. Inhibitory properties (inhibition zone diameter in mm) and minimum inhibition concentration (MIC) of plant extracts on different bacteria

Bacterial Sp.	*Salvia officinalis (Leaves)* MIC		*Opuntia ficus indica (Fruits)* MIC	
	25mg/ml	12.5mg/ml	23 mg/ml	11.5mg/ml
Pseudomonas aeruginosa	18.73(16.22-21.24)	8.04(6.95-9.13)	21.44(19.22-23.65)	13.24(9.35-17.12)
Staphylococcus aureus	10.99(10.14-11.85)	7.74(6.55-8.93)	13.83(9.32-18,33)	13.36(8.10-14.62)
Escherichia coli	9.11(7.11-11.12)	7.48(6.33-8.63)	17.35(13.92-20.15)	14.10(10.11-18.02)

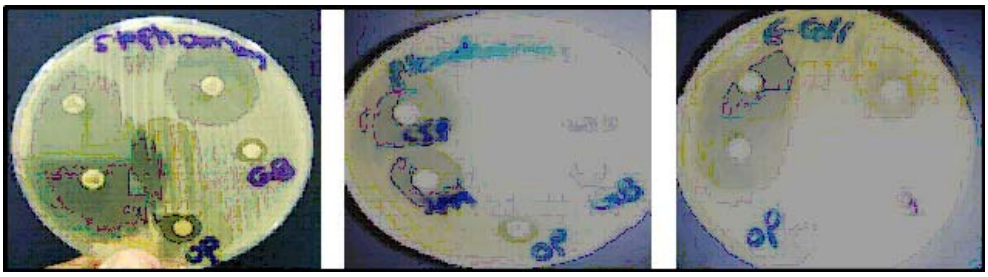

Fig:1 Antimicrobial activities of *ethanolic extract of Salvia officinalis* (leaf) and *Opuntia ficus indica* (Cactaceae) (fruit) on 3 types of pathogenic bacteria.

aeruginosa and *Escherichia coli* bacteria. The zone of inhibitions were observed in both plants and ranged from 8.5 to 12 mm

The results of antibacterial activities of the ethanol plant extracts obtained from the leaves of *Salvia officinalis* and fresh fruits of *O. ficus indica* by agar diffusion method are shown in Table1. The ethanol extracts of the plants screened showed various inhibitory effects (9-15 mm/100 µl inhibition zone) against bacteria (Table 1).

The ethanolic extract of the leaves of *Salvia officinalis* exhibited moderate antibacterial activity with respective means between 10.99 - 25 mm inhibition zone at 12.5 mg/ml concentration and MIC value of 7.74 mg/ml. It showed highest inhibitory activity against *Pseudomonas aeruginosa*, and moderate activity against *Escherichia coli*, and least activity against *Streptococcus pneumoniae* (Table 1). On the other hand, the ethanol extract of the fresh fruits of *O. ficus indica* have a slightly lower antibacterial activity with a zone of inhibition ranging from 13.83 to 18.36 mm at 23 mg/ml concentration and MIC value of 13.36 mg/ml. It was found to be active against *Staphylococcus aureus* and less active against *Pseudomonas aeruginosa*, while it exhibited much less activity against *Escherichia coli*.

DISCUSSION

Medicinal plants play a crucial role in the search for alternative antimicrobial components. According to the World Health Organization, it is estimated that around 80% of the earth's population use some form of herbal medicine in their health care, whereas natural products are a preferable option than synthetic ones (Madhuri and Pandey, 2009). The results obtained in the present study indicate that the ethanol extract of leaves of *Salvia officinalis* and fresh fruits of *O. ficus indica* indicated that the crude extracts of two studied plants showed varied inhibitory activities to the test organisms used, namely *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The results also show that different plants assayed here possess different levels of antimicrobial activities, that ethanol extracts of fresh leaves of *Salvia officinalis* exhibited the highest activity, followed by the fruits of *O. ficus indica*. These results are consistent with previous reports on related plants regarding Gram-positive bacteria (Cowan, 1999). Moreover, the currents results support findings of other researchers who found the presence of antimicrobial activity in *Salvia* and *Opuntia*. In this study, most of the antimicrobial activity in ethanol extracts of investigated plants appears to be explainable by phenolic compounds (Devi et al., 2008). The resistance of Gram-negative bacteria (*P. aeruginosa*) to plant extracts was not unexpected as, in general, this class of bacteria is more resistant than Gram-positive bacteria. Such resistance could be due to the permeability obstacle provided by the cell wall or to the membrane accumulation mechanism (Adwan *et al*., 1998).

CONCLUSION

It can be suggested that ethanol extracts of these plants are a great potential source of antibacterial compounds that could be used in the formulation of new antimicrobial drugs of natural basis.

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