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In vitro: Antibacterial activity of *Salsola kali* Linn.

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Abstract

Plant based medicine were commonly used in India and all over world. Medicinal plants produce a variety of compounds of known therapeutic properties. The substances can either inhibit the growth of pathogens or kill them and have least toxicity to host cell are considered for developing new antimicrobial drugs. Plants are known to contain innumerable biologically active compounds, which possess antibacterial properties. Medicinal components from plants play an important role in conventional plant derived medicine. They have been a part of the evolution of human healthcare for thousands of years. Now a day, nearly eighty percent of the global population turns to plant derive medicines as their first line of defense for maintaining health and combating diseases. Antibacterial activity of petroleum ether, ethanol and water extract of different parts of *Salsola kali* Linn. was studied against *E. coli, K. pneumoniae, S. aureus, B. subtilis* and *S. mutans*.

Keywords:- *Antibacterial activity, Medicinal components, Medicinal plant, Salsola kali*

Introduction

The ancient Ayurvedic literature describes *Salsola kali* Linn. ash as "Sarjjikakshara", used for the preparation of a large number of Ayurvedic compounds formulations (Gupta and Nath, 1984), which seems to correct the dysfunctions of liver (Kumar and Upadhyay, 1994). It has the properties of the fire. It is pungent, warm and acrid. It is efficacious in gulma, flatulence of stomach, diseases of belly, bile, worms, asthma, intestinal obstruction, enlargement of spleen and liver. The juice of the plant was said to be rich in soda and it shows excellent diuretic properties (Grieve, 1992). According to Hartwell the plant is used in folk remedies for the cancerous condition. Aerial parts of plant *Salsola kali* contained stigmasterol, campesterol, sitosterol and their glycosides (Prabhat *et al.*, 2005; Prabhat and Navneet, 2007). Medicinal herbs and their extract are widely used in the treatment of liver diseases like hepatitis, chlorosis and loss of appetite (Cupp, 1999). These exert physiological and therapeutic effect (Prabhat *et al.*, 2008). The compounds that are responsible for the medicinal properties of the drug are usually secondary metabolites. Antibacterial activity of petroleum ether, ethanol and water extract of aerial parts, stems, roots and seeds of *Salsola kali* Linn. was studied against *E. coli, K. pneumoniae, S. aureus, B. subtilis* and *S. mutans*.

Materials and Method

The plant material was collected from the Vijay Nager near Ganganager in Rajasthan district. It was identified from Botanical Survey of India, Dehradun (Uttarakhand). The aerial parts, stems, roots and seeds of the plant were collected and dried at room temperature for one week, grounded and kept as dried powdered.

Powdered plant materials were extracted with three different solvents i.e. petroleum ether, ethanol and

water by using soxhlet extractor for 24 hours. The polarity of the solvent would leach out compounds soluble in the particular solvent. The solvent was removed at a low temperature under reduced pressure to yield a thick syrup or semi solid mass. The fractions were further used to test for the antimicrobial activities.

Muller Hinton agar (Himedia No. 173) media was used to test the antimicrobial activity against *Escherichia coli* (MTCC-739), *Klebsiella pneumoniae* (MTCC-109), *Bacillus subtilis* (MTCC-441), *Staphylococcus aureus* (MTCC-96) and *streptococcus mutans* (MTCC-890) by well diffusion method (Ahmad *et al.*, 1998; Ahmad *et al.*, 1999). 8 mm diameter wells were punched in the agar and filled with extracts and respective solvents for negative control and antibiotic (100 mg/ml) was used as positive control. The slants were incubated at 37 ^{0}C for 18-24 hours. The antimicrobial activity was evaluated by measuring the diameter of inhibition zone in mm and their percentage[10].

$$\text{Percentage of Inhibition} = 100 - \frac{T \times 100}{C}$$

Where, C = Growth in standard
T = Growth in test

Results and Discussion

The plant parts showed broad spectrum antibacterial activity (table 1-4) i.e. the petroleum ether, ethanol and water extracts were active against both gram positive and gram negative bacteria. The *Salsola kali* extracts were found to be less effective as compared to ampicillin. Investigation into the folklore antimicrobial activity of *Salsola kali* against *Salmonella paratyphi* and *Serratia marcescens* were conducted[11]. Here we report on the preliminary result from the antibacterial test of twelve crude extracts from plant species. The antibacterial activity of plant parts i.e. aerial parts, roots, stems, seeds and antibiotic ampicillin in all the three solvents against *Escherichia coli, Streptococcus mutans, Staphylococcus aureus, Bacillus subtilis* and *Klebsiella pneumoniae* at concentrations of 100 mg/ml is given in tables 1-4.

Table-1:The percentage of inhibition of stems extract and antibiotics (Ampicillin) against pathogens

Pathogens	Zone of inhibition (in mm) (extract 100 mg/ml)			Zone of inhibition (in mm) (antibiotic 100mg/ml)			Percentage of inhibition		
	Petroleum ether	Ethanol	Water	Petroleum ether	Ethanol	Water	Petroleum ether	Ethanol	water
E. coli	NI***	12	10	14	18	20	0.00	33.33	50.00
K.pneumoniae	10	20	20	22	27	30	54.54	25.92	33.33
S. aureus	20	25	20	25	29	30	20.00	13.79	33.33
B. subtilis	20	24	26	26	28	30	23.07	14.28	13.33
S. mutans	10	20	20	18	26	30	44.44	23.07	33.33

*** Represents no inhibition

Table-2: The percentage of inhibition of roots extract and antibiotics (ampicillin) against pathogens

Pathogens	Zone of inhibition (in mm) (extract 100 mg/ml)			Zone of inhibition (in mm) (antibiotic 100mg/ml)			Percentage of inhibition		
	Petroleum ether	Ethanol	Water	Petroleum ether	Ethanol	Water	Petroleum ether	Ethanol	water
E. coli	NI***	14	10	14	18	20	0.00	22.22	50.00
K.pneumoniae	10	19	20	22	27	30	54.54	29.62	33.33
S. aureus	18	20	18	25	29	30	28.00	31.03	40.00
B. subtilis	20	18	20	26	28	30	23.07	35.71	33.33
S. mutans	12	20	20	18	26	30	33.33	23.07	33.33

*** Represents no inhibition

Table-3: The percentage of inhibition of seeds extract and antibiotics (ampicillin) against pathogens

Pathogens	Zone of inhibition (in mm) (extract 100 mg/ml)			Zone of inhibition (in mm) (antibiotic 100mg/ml)			Percentage of inhibition		
	Petroleum ether	Ethanol	Water	Petroleum ether	Ethanol	Water	Petroleum ether	Ethanol	water
E. coli	NI***	15	10	14	18	20	0.00	16.16	50.00
K.pneumoniae	10	20	19	22	27	30	54.54	25.92	36.66
S. aureus	12	22	18	25	29	30	52.00	24.13	40.00
B. subtilis	10	25	20	26	28	30	61.53	10.71	33.33
S. mutans	NI***	20	21	18	26	30	0.00	23.07	30.00

*** Represents no inhibition

Table-4: The percentage of inhibition of aerial parts extract and antibiotics (ampicillin) against pathogens

Pathogens	Zone of inhibition (in mm) (extract 100 mg/ml)			Zone of inhibition (in mm) (antibiotic 100mg/ml)			Percentage of inhibition		
	Petroleum ether	Ethanol	Water	Petroleum ether	Ethanol	Water	Petroleum ether	Ethanol	water
E. coli	NI***	12	10	14	18	20	0.00	33.33	50.00
K.pneumoniae	10	20	18	22	27	30	54.54	25.92	40.00
S. aureus	10	15	16	25	29	30	60.00	48.27	46.66
B. subtilis	12	14	15	26	28	30	53.84	50.00	50.00
S. mutans	10	18	18	18	26	30	44.44	30.76	40.00

*** Represents no inhibition

The zone of inhibitions obtained in crude extracts of different parts of plants varied against pathogens while it was same in case of ampicillin. The results revealed that antibiotic is more effective as compared to crude extracts. The ethanolic extracts of seeds showed the highest activity against *Bacillus subtilis* followed by *Staphylococcus aureus, Klebsiella pneumoniae, Streptococcus mutans* and *Escherichia coli* as compared to other extracts.

The extracts of stems showed maximum activity followed by seeds, roots and aerial parts. The antibacterial therapy is going through crises due the rapidly increasing development of resistance to existing agents. Antibiotic resistance has increased substantially in the recent years and is posing an increasing therapeutic problem. The use of plants as primary health remedies is quite common due to their pharmacological properties. The plant produced a variety of phytoconstituents that have antibacterial

activity. These compounds include stigmasterol, campesterol, b- sitosterol and their glycosides etc. The natural antimicrobial compounds in plants can inhibit the growth of bacteria by means of unknown mechanisms other than that of known antibiotics and for this reason the search for new antibiotics must continue. The present study has shown that the plant and its parts are potentially a rich source of antibacterial agents. The plant extracts inhibited the growth of tested pathogens. The crude extracts (100mg/ml) of each part was used for determination of their potency against pathogens and compared with antibiotic (100mg/ml). The extent of antimicrobial activity of the extracts based on inhibition zone diameter has been described as low (10-14), moderate (15-20) and strong (21-26) by Ahmad *et al*. (1999). In our study, seeds and stems extracts showed strong activity against all pathogens and followed by roots and aerial part. The ethanolic and water extracts of each part is highly effective against all pathogens because more phytoconstituents were leached in these solvents. Our findings have validated the use of this medicinal plant for the treatment of microbial infections such as diarrhoea and fever. It seems important to recommend that further studies using isolated constituents instead of whole extracts must be done in this field. Health foundations have to increase their funding of these studies and research to help saving the lives of many peoples. This will also offer a great help in facing the emergence and spread of antimicrobial resistance.

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