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Antimicrobial Potential of Two *Solanum* species used in Folkloric Medicine

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The antimicrobial potential of various fractions of two *Solanum* species were evaluated against five bacteria and four pathogenic fungi, using microbroth dilution assay. These plants are widely used in Ayurveda and traditional system of medicines in India to treat various kinds of microbial infections and other disorders. The extracts of *Solanum xanthocarpum* and *Solanum trilobatum* exhibited antimiciobial activity in a range of 1.12 to 5.0 mg/ml against *Salmonella typhi, Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, Bacillus cereus*. Hexane extracts of *B. lacera* and *Solanum trilobatum*are found to be active against the *Candida albicans*, *Aspergillus fumigatus*, *A. niger* and *A. flavus* in a range of 1.12 to 20.0 mg/ml. The studies were repeated in triplicates at two laboratories to confirm the results.

Key Words: Antifungal, Antimicrobial, Plant extracts, Susceptibility testing.

Nature provides a wide source of medicinal agents for thousands of years since the beginning of man. Herbal remedies are used throughout the world and in past herbs often represented the original sources of most the drugs. Ayurvedic system of medicine is well-accepted medicinal system in India, which uses mainly plant material to treat various kinds of human disorders and also provide promotive and preventive measure. Systematic screening of the plants used in ayurvedic system of medicine to cure various disease conditions may result in the discovery of novel effective anti-microbial therapy[1].

At present time, the number of multi-drug resistant microbial strains and the appearance of strains with reduced susceptibility to antibiotics are continuously increasing[2]. This increase has been attributed to indiscriminate use of broad-spectrum antibiotics, immunosuppressive agent, intravenous catheters, organ transplantation and ongoing epidemics of HIV infection[3,4]. In addition, in developing countries, synthetic drugs are not only expensive and inadequate for the treatment of diseases but are also often with adulterations and side effects. Therefore, there is need to search new infection-fighting strategies to control microbial infections[5,6].

Solanum species are considered to a valuable drug in the Ayurveda . *Solanum xanthocarpum* and *Solanum trilobatum*are reported to have anti-inflammatory, styptic, antipyretic and antimicrobial properties. *Solanum*

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xanthocarpum has profound use in Ayurveda and folklore medicine. It is a commonly growing perennialherbaceous weed with bright green leaves and zig-zag stem, mostly found in the arid region. It is supposed that the plant has solasonine in its different parts, which is responsible for its medicinal value[7-9]. In the present study an attempt was made to screen different extracts prepared from various parts of *S. xanthocarpum* for its antimicrobial action against Gram-positive and Gram-negative bacteria and fungi.

MATERIAL AND METHODS

Plant Material

The roots and leaves of *Solanum lacera, Solanum trilobatum* were collected from the localities of Utter Pradesh and Madhya Pradesh of India. The plant material was dried in shade and used to prepare different extracts.

Preparation of plant extracts

The powdered materials of plants were subjected to Soxhlet extraction successively with n-hexane, chloroform, acetone, methanol and water to obtain respective fractions[9]. Solvents were evaporated under reduced pressure using Rotavapour R-114 (Buchi) and dry fractions were stored at 4 °C till use.

Microorganisms

Clinical isolates of the microorganisms were used along with the standard strains. Quality control strains of *Aspergillus fumigatus* ITCC 4517, *A. flavus* ITCC 5192, *A. niger* ITCC 5405, *Candida albicans* ITCC 4718 obtained from Indian Type Culture Collection, IARI, Delhi. *Salmonella typhi* MTCCB 733, *Escherichia coli* MTCCB 82, *Pseudomonas aeruginosa MTCCB 741, Staphylococcus aureus* MTCCB *737,Bacillus cereus* MTCCB 1272, were included in each test as recommended by the National Committee for Clinical Laboratories Standards (NCCLS), purchased from Institute of Microbial Technology, Chandigarh, India.

Antibacterial screening

Antibacterial activities of the various extracts of different plants were determined by the micro broth dilution assay as per described by Buwa and Staden (11). The water and ethanol plant extracts were dissolved at 24.0 mg/ml with the extracting solvents. Acetone extracts were also

Table 1. Minimum inhibitory concentration of plant extracts against the microorganisms by micro dilution

Name of the	Minimum Inhibitory Concentration (mg/ml)								
Plant (*B. lacera*)	*E. coli*	*S. typhi*	*P. aeruginosa*	*S. aureus*	*B. cereus*	*A. fumigatus*	*A. flavus*	*A. niger*	*C. albicans*
Water Ext	2.5+0.31	1.06+0.20	2.5+0.31	2.5+0.31	1.12+0.16	1.5+0.33	2.25+0.33	2.25+0.33	1.12+0.16
Methanol Ext	4.0+0.63	2.5+0.31	3.5+0.5	5.0+0.63	4.0+0.63	ND	ND	ND	ND
Acetone Ext	1.75+0.25	2.5+0.31	2.75+0.25	2.5+0.31	1.75+0.25	-	-	-	-
Chloroform Ext	-	-	-	-	-	-	-	-	-
Hexane Ext	-	-	-	-	-	18.0+2.68	20.0 +2.52	-	20.0+2.52
B. eriantha									
Water Ext	2.75+0.25	1.12+0.16	2.5+0.31	2.5+0.31	1.0+0.15	-	-	-	7.0+1.0
Methanol Ext	4.5+0.67	2.5+0.31	5.0+0.63	10.0+1.26	10.0+1.26	-	-	-	-
Acetone Ext	1.25+0.15	5.0+0.63	2.5+0.31		2.5+0.31	2.5+0.31	-	-	-
Chloroform Ext	1.12+0.15	-	-	-	-	-	-	-	-
Hexane Ext	-	-	-	-	-	11.0+2.44	20.0 +2.52	-	11.0+2.44

dissolved in ethanol and rests of the extracts were dissolved in DMSO. Proper controls were kept for each experiment. The bacterial strains used as inocula were grown at 37 °C to get OD 0.6 at 600 nm and used for susceptibility testing. Lowest concentration, which inhibited any visual growth, was considered to be minimum inhibitory concentration (MIC).

Antifungal screening

All the extracts were dissolved in DMSO to achieve a concentration of 24.0 mg/ml. Microbroth dilution assay for *Candida albicans* was performed as described by Espinel- Fromtling *et al.* [12]. *Aspergillus* species cultures were grown on Sabouraud dextrose agar at 37 °C until sporulation occurs, typically 5 days. The spores were harvested in yeast nitrogen broth plus 0.5% glucose (pH 7.0) and the numbers of colony forming units (CFU) per milliliter were determined by plating serial dilutions on Sabouraud dextrose agar plates. For susceptibility tests, serial twofold dilution of extracts were made in yeast nitrogen broth plus 0.5% glucose (pH 7.0) in 100 µl volumes and were inoculated with 100 µl of the spore suspensions having 2 x 10^4 to 2 x 10^5 CFU/ml in yeast nitrogen broth. The cultures were incubated for 48 h at 37 °C. MICs were determined at the lowest concentration that inhibited visible fungal growth.

RESULTS AND DISCUSSION

Results obtained from micro-broth dilution assay are represented in table 1. Water, methanol and acetone extracts of *Solanum xanthocarpum* and *Solanum trilobatum*s showed activity against all the bacterial species used in the present study in a range of 1.12±0.16 to 5.0±0.63 mg/ml. Chloroform and hexane extracts were found to be inactive against all the bacteria used in this study except chloroform extract of *Solanum trilobatum* which showed activity against *E. coli* at a concentration of 1.12±0.15 mg/ml. Water extract of *B. lacera* was found to be active against fungal species used in the study in a range of 1.12±0.16- to 2.25±0.33 mg/ml. Hexane extracts of both species showed activity against fungal species at higher concentrations ranging 11.0±2.44 to 20.0±0.2.52 mg/ml.

Water, methanol and acetone extracts of S. *maxanthocarpum* and *Solanum trilobatum* showed activity against all the bacterial species used in the present study in a range of 1.06 to 10.0 mg/ml. Water extract of *S. xanthocarpum* showed antifungal activity at a concentration of 1.2 to 2.25 mg/ml. Hexane extract of *S. xanthocarpum* showed antifungal activity at a concentration of 20.0 mg/ml. *Solanum*. This *in vitro* study corroborated the antimicrobial activity of *S. xanthocarpum* and *S. trilobatum*. Both plants can be used for further studies to develop protection against bacteria and fungi in some cases. Therefore, evaluation of plants described in Ayurveda may be potential sources of antimicrobial metabolites and beneficial from medicinal and economic standpoints.

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