Aizoaceae plants as potential antimicrobial agents

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Abstract

The aim of the present study was to screen and evaluate the antimicrobial potentials of three medicinally important plants of Aizoaceae family viz. Gisekia pharmacooides Linn., Mollugo nudicaulis Lam. and Trianthema decandra Linn. to find new effective antimicrobial agent(s). All the tested species were appreciably effective against the tested microorganisms but ethyl acetate extract of T. decandra showed promising activity (25.00 ± 0.00) against B. subtilis.

Keywords: Arid zone plants, agar well diffusion method

Abbreviations: MIC- Minimum Inhibitory Concentration

Introduction

The Family Aizoaceae contains 135 genera and about 1900 species. They are commonly known as “stone plants”, “carpet weeds” or “ice plant”. Carpobrotus edulis, C. acinaciformis, C. mellei and Sesuvium portulacastrum are some of the examples of this family that demonstrated appreciable antimicrobial activity against various microorganisms [1-4]. In the present study, three selected plants namely Gisekia pharmacooides Linn., Mollugo nudicaulis Lam. and Trianthema decandra Linn., belonging to Aizoaceae were screened for their potential antimicrobial activity.

G. pharmacooides is aperient, anthelmintic, aromatic in nature and used in female diseases, defective semen, destroyed fat, malfunctioning of sex organs and for killing of roundworm [5]. Tannin-like principles α- and β- gisekia; compounds such as triacontane, myristone, tetracosanol, dotriacontane; alkaloids, resins and cardiac glycosides have been isolated from this plant [6-8].

M. nudicaulis is used in whooping cough and in suppression of boil [9]. Various compounds viz. mollugoflavonolosides, saponins and cyanogenic glycosides have been reported [10, 11].

T. decandra is used in hepatitis, asthma, suppression of menses and inflammation of testicles; roots ground up with milk and given internally to cure orchitis while juice of leaves is dropped into nostrils to relieve one-sided headache [12]. Earlier antioxidant activity of roots of T. decandra has been documented [13].

In the present study various successive extracts of these plants were tested against selected bacteria (Bacillus subtilis, Enterobacter aerogenes Escherichia coli, Pseudomonas aeruginosa, Raouliella planticola and Staphylococcus aureus) and fungi (Aspergillus flavus, A. niger, Candida albicans, Penicillium crysogenum and Trichophyton rubrum).
Material and methods

Plant material
Whole plants of the selected species were collected from the fields of University during October 2009 – January 2010. The botanical identity was confirmed by Herbarium, Department of Botany, University of Rajasthan, Jaipur and their voucher specimens (G. pharnaceoides 20144, M. nudicaulis 20246 and T. decandra 20810) have been deposited at the Herbarium in the Department and laboratory for further reference.

Extract preparation
Whole plants (100 g) of each of the selected plant species were air-dried, powdered and Soxhlet extracted with pet. ether, dichloromethane, ethyl acetate, methanol and water successively. The resultant extracts were filtered, concentrated, dried in vacuo and refrigerated at 4°C, until used. All chemical used in the experiment were of analytical grade (Merck, Germany).

Test microorganisms and antimicrobial assay
Pure cultures of Gram +ve bacteria (B. subtilis, MTCC 441; S. aureus, MTCC 740) and Gram -ve bacteria (E. coli, MTCC 443; P. aeruginosa, MTCC 741; E. aerogenes, MTCC 111 and R. planticola, MTCC 530) were obtained from IMTECH, Chandigarh, India. These cultures were grown and maintained on Nutrient Broth (NB) at 27°C for 48 h. Similarly, test fungi C. albicans (ATCC 4718), A. niger (ATCC 322), A. flavus (ATCC 16870), T. rubrum (ATCC 2327) and P. crysogenum (ATCC 5476) obtained from IARI, New Delhi, were cultured on Sabouraud Dextrose Agar (SDA) medium at 37°C for 48 h.

Antimicrobial assay was performed by agar well diffusion method [14] using Müller-Hinton medium for antibacterial and SDA medium for antifungal activity of which 4 mg/well concentration was used and the density of microorganism was adjusted as per McFarland 0.5 standard. The culture plates were incubated at 37°C for bacteria and 25°C in case of fungi for 24 hr. The diameter of the inhibition zone (IZ in mm) around each hole was measured (in triplicate) by inhibition zone recorder (HiMedia), activity index (AI) calculated and statistically analyzed. A parallel control, gentamycin (10 mcg/ml) in case of bacteria and ketoconazole (100 units/ml) in case of fungi were used.

Minimum inhibitory concentration (MIC) was determined by agar well diffusion method. Serial dilutions of all the extracts were prepared ranging from 2000 µg to 20 µg and used further.

Results and discussions

The data of antimicrobial activity and MIC of the test extracts against the selected microorganisms is summarized in Table 1. Ethyl acetate extract of T. decandra showed very potent activity against the test bacteria and fungi. Most appreciable activity (IZ in mm) was against B. subtilis (IZ 25.00 ± 0.00), E. aerogenes (IZ 15.66 ± 0.66), P. aeruginosa (12.00 ± 0.00), R. planticola (IZ 10.33 ± 0.37), P. crysogenum (IZ 11.33 ± 2.02) and T. rubrum (IZ 10.33 ± 1.61) with MIC 125 µg/ml in all cases. Dichloromethane extract of T. decandra was also very potent against B. subtilis (14.00 ± 0.00), E. coli (15.66 ± 0.66) S. aureus (IZ 11.00 ± 0.81), A. flavus (IZ 14.66 ± 0.88) with MIC 125 µg/ml in all cases (Fig. 1, 2).

Pet. ether extract of M. nudicaulis showed moderate inhibition zone (in mm) against R. planticola (IZ 13.66 ± 0.32), T. rubrum (IZ 10.33 ± 1.61) with MIC 125 µg/ml and S. aureus (IZ 10.00 ± 0.00), C. albicans (IZ 13.00 ± 0.00) with MIC of 62.5 µg/ml. Pet. ether extract of G. pharnaceoides exhibited potential activity against B. subtilis (IZ 16.66 ± 3.18) and E. aerogenes (IZ 15.66 ± 0.66) with MIC of 330 and 500 µg/ml respectively.
Although the activities varied significantly against the test microorganisms of all the three plants species but most of the extracts showed appreciable antimicrobial activity against \textit{B. subtilis}. From these results, it is evident that the selected plants demonstrated potential antimicrobial activity but \textit{T. decandra} and \textit{M. nudicaulis} were found to be more active against most of the microbes.

The present study revealed that ethyl acetate and pet. ether extracts were more effective as compared to other extracts. These observations further indicated that triterpenes and flavonoids-rich fractions contain more antimicrobial rich substances and thus, appreciable activity of these plants can be attributed to these compounds. This view is supported from the results as exhibited by \textit{T. portulacastrum} which contained trianthenol and ecdyonsterone, the biologically active molecules [15]. Similarly, various triterpenes viz. mollugogenol A and B having antifungal have been reported from several \textit{Mollugo} species such as \textit{M. pentaphylla}, \textit{M. hirta}, \textit{G. lotoides} and \textit{M. oppoastifolius} [16, 17, 18, 20].

Table 1. Antimicrobial activity and MIC of selected medicinal plants of Aizoaceae family

<table>
<thead>
<tr>
<th>Solvent-solubles</th>
<th>B. subtilis</th>
<th>E. aerogenes</th>
<th>E. coli</th>
<th>P. aeruginosa</th>
<th>R. planticola</th>
<th>S. aureus</th>
<th>A. flavus</th>
<th>A. niger</th>
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</table>

Mean ± S.E. (Standard error),
Standard: Streptomycin (10 mcg/ml) for bacteria, Ketomoxazole, (10 mcg/disc) for fungi,
IZ = Inhibition zone (in mm) including the diameter of well (6 mm),
MIC = Minimum inhibitory concentration in µg/ml,
*NT = Not tested due to poor yield.
Conclusions

Plants demonstrated broad-spectrum antibacterial and antioxidant efficacies. These plants used for many years as decoction or infusions prepared in water to treat various ailments. Thus, these results provide a scientific basis for the use of plant extracts in home-made remedies and their possible application against microorganisms that cause infections. Further studies may lead to their use as safe alternatives to synthetic antimicrobial drugs.

Acknowledgements

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References